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# Sociology of Natural Resources

## In Pakistan and Adjoining Countries

Edited by


**Dr. Michael R. Dove**
Research Associate,
East-West Center's Environment and Policy Institute,
Honolulu, Hawaii, U.S.A.

&

**Dr. Carol Carpenter**
Associate Professor,
Department of Anthropology,
Syracuse University, U.S.A.



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## Jacket Photographs

Top: Village in Nagar Valley, Gilgit, Northern Areas, Pakistan.

Middle: Terraced slopes in Upper Kaghan Valley, NWFP Province, Pakistan.

Bottom: Irrigated state forest in Thatta Subdistrict, Sindh Province, Pakistan.

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# FOREWORD

It is difficult to say whether the actions of the poor lead to environmental degradation and resource depletion, or whether it is the degradation of the environment that leads to poverty. In any case, it is obvious that indiscriminate use of natural resources leads to increasing difficulty in maintaining these resources and sustaining an adequate standard of living.

The degradation of Pakistan's resource base is especially serious because the nation's population has increased from 32.5 million at the time of partition in 1947, to 108 million by the end of 1988, thus registering a three-fold increase in the last forty years. The land resources of Pakistan have not increased however, and indeed they have registered declines in fertility and productivity due to the twin menace of water-logging and salinization, in addition to the usual problems of recurrent drought, intermittent flooding, constant over-grazing, and excessive use of forests and rangelands.

Policy makers and planners have come to the realization, if somewhat tardily, that in order for Pakistan to meet its future needs for timber, fuelwood, fodder, and other natural resources, without causing irreversible damage to the environment, farmers and farmlands will have to play a more central role in all resource development programs. This necessitates vastly expanded social forestry programs and socially-oriented programs in the other resource sectors as well. But the problem is that very little is known about the art of these social development programs. The Foresters and other natural resource officers in Pakistan are still like small children playing with pebbles on the shore of the ocean of knowledge.

In this regard, the Forestry Planning and Development Project has made a beginning. The publication of this book, edited by Michael R. Dove and Carol Carpenter, with contributions of papers by renowned scholars and experts in natural resource management, is a blessing and a God-given opportunity that is welcomed by one and all.

If this book succeeds in creating a realization among its readers that there is no conflict between environmental and developmental goals, that the two sets of goals complement each other and contribute to the overall objective of improving the quality of life, then the efforts of the editors, and those of my own in writing this foreword, will be fully rewarded.

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| Islamabad, | Abeedullah Jan |
| July 1989. | Inspector General of Forests |

# EDITORS' PREFACE

Although the environment and natural resources of Pakistan have been overused by man for millennia, the pressure to which they are being subjected today is truly unprecedented. Throughout the country, the environment is being increasingly degraded, and supplies of natural resources are falling increasingly short of needs. The primary causes of this situation — increasing population, a developing economy, and changing patterns of resource use — are not physical, but social. The primary causes, that is, lie within the nature of Pakistani society. Accordingly, any attempt to understand the state of natural resources in Pakistan today must also begin with its society. Of most importance, any such attempt must include detailed analyses of how the peoples of Pakistan perceive and utilize their natural resources. Unfortunately, this is as yet an area in which little research and even less writing has been done in Pakistan. The literature on the sociology of natural resources in Pakistan is, for all practical purposes, non-existent.

In this combination of a need for and lack of such a literature lay the stimulus for producing this collection of readings. The collection consists of eighteen papers on different aspects of society's use of natural resources in Pakistan and surrounding countries. A major theoretical premise behind the collection is that resource use is at least partially determined by the nature of the society involved, and hence it will vary from one society to the next. Since this collection is intended primarily for a Pakistani audience, it was desirable to limit the readings to those pertaining to Pakistan and its neighboring countries. A second major theoretical premise behind the collection is that the best way to study and teach about society's use of natural resources is through case studies, as opposed to general and non-site-specific reviews of the topic. Accordingly, every reading in the collection presents data on a particular place and system of resource use, and bases its conclusions and recommendations on these data. The readings in this collection are all avowedly scientific or empirical, therefore, as opposed to normative. Instead of merely saying what should be, they first say what is, and then argue from there. Most of the papers have been previously published, but in all of these cases the place of publication was outside of Pakistan, rendering access to these publications difficult for Pakistani readers.

It is our hope that this collection will be of value to government officials, scientists, professors, and students, who are concerned with the fields of forestry, agriculture, soil conservation, irrigation, watershed management, energy, or environmental protection and conservation.

Hunolulu,
January 1991.

Michael R. Dove & Carol Carpenter

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# INTRODUCTION: THE SOCIOLOGY OF NATURAL RESOURCES IN PAKISTAN


## Michael R. Dove and Carol Carpenter


Our concern in this collection is the sociology of natural resources in Pakistan. Since this concern encompasses people as well as resources, we have restricted the readings to those pertaining to the resources upon which the livelihood to rural people immediately depends, namely soil and water, plants and trees, rangelands and forests. Resources that are of less immediate interest to rural people, such as mineral and petroleum deposits, are not discussed here. Given this concern with rural livelihood, the readings necessarily include topics in agriculture, forestry, animal husbandry, and energy use. Since some natural resources are consumed within the rural household, while others are collected for sale to urban households, the readings cover both subsistence and commercial economics, and rural and urban consumption patterns.

By the 'sociology' of natural resources, we refer to the analysis of resource perception, use, and management by human societies. Such analysis is by no means restricted to the discipline of sociology per se. The readings in this collection include analyses by anthropologists, geographers, ecologists, economists, and agricultural economists, in addition to rural sociologists.

We have elected to organize these diverse readings under five, analytical and cross-cutting headings: environmental perception, common resource management, energy flows, gender issues, and environmental conservation. We shall now briefly discuss the specific readings under each heading, in turn.

## TRADITIONAL PERCEPTIONS OF THE ENVIRONMENT

The readings in this first section of the volume are concerned with how rural peoples traditionally perceive — in a broad sense of this term — the natural environment. This includes not just how they 'see' the environment, but more particularly how they understand it, what they know about the environment and how to exploit it, and how accurate this knowledge is. In addition, in most of the readings an attempt is made to compare these traditional perceptions with the perceptions of development officials and scientists.

The first reading in this section is Richard Kurin's analysis of 'Indigenous Agronomics and Agricultural Development in the Indus Basin'. It is based on field research carried out in Sahiwal, in the Punjab, Pakistan, in which Kurin attempted to find out how farmers make agricultural decisions, especially as regards the acceptance, modification, or rejection of 'Green Revolution' technical inputs. Kurin rejects the view widespread among agricultural scientists that the rejection of such inputs by farmers is 'irrational' and is due to ignorance or the force of custom or tradition. Rather, based on the findings of his research, he maintains that this rejection is rational and explicable within the terms of the indigenous system of 'humoral' agronomy. This system, derived from classical Sanskrit and Greek sources, classifies crops, soils, fertilizers, and even water according to the humoral concepts of hot versus cold and dry versus wet. Kurin argues that this humoral system of agronomy (like the humoral system of medicine prevalent in Pakistan) is coherent, systematic, and empirically based.

Kurin also convincingly argues that this is a *shared* system of knowledge. Too often in Pakistan, development officials or scientists dismiss farmers' knowledge by saying that although one farmer may say that, every other farmer will say something else. This is not the case with the humoral system of agronomy: Kurin demonstrates that different farmers agree on the humoral characteristics of the various agricultural inputs, just as fully as agronomists agree amongst themselves on the biochemical properties of these inputs. So Kurin is describing the shared belief system of the farmers of Pakistan.

The basic principle of this humoral system is to moderate and hence preserve the agricultural environment, by balancing inputs with different humoral qualities. For example, this would involve prescribing 'hotter' fertilizers (viz., chemical fertilizers) for lighter and 'cooler' soils and prescribing cooler fertilizers (viz., manure) for heavier and 'hotter' soils. Within the terms of these principles, farmers see the traditional system of agriculture as generally more balanced, producing slower growing crops and lower yields but preserving long-term soil fertility, whereas they see the Green Revolution system of agriculture as less balanced, producing faster growing and higher yielding crops, but at the cost of long-term soil depletion. This insight into farmer views yields a number of concrete recommendations for modifying Green Revolution inputs to increase farmer acceptance of them, for example by: selecting 'cooler and wetter' crop varieties, chemicals, and water; and by having extension workers use terms from humoral theory when talking with farmers, instead of terms from western biochemistry.

The second reading in this section is by L.P. Bharara, on 'Notes on the Experience of Drought Perception, Recollection and Prediction'. Based on field research in West Rajasthan, India, it describes the way drought is perceived by common farmers. The presence or absence of drought is the most important determinant of the quality of human life in this arid region. This importance is reflected in the otherwise amazing ability of the farmers interviewed by Bharara to accurately recollect the occurrence or non-occurrence of drought during each of the past eighty years. The cultural importance of drought in this region is also reflected in the considerable efforts that the farmers devote to predicting future occurrences, by observation of climate, flora, and fauna. The principles linking these observations to specific drought predictions are expressed in folk sayings or homilies, such as the following:

> 'When the sparrow bathes in the dust, the rain will come; when the sparrow bathes in the water, the rain will go'.

Bharara modestly claims only that these sayings have psychological value, by fulfilling the farmer's need for order. We suggest that they are part of a folk system of meteorology, and that their empirical value in helping to predict — and hence allow for adjustment to — crop-threatening droughts should be investigated.

The third reading in this section is by Bimal Kanti Paul, on 'Perception of and Agricultural Adjustment to Floods in Jamuna Floodplain, Bangladesh'. His interest in carrying out this analysis was to investigate the ways in which farmers assess and respond to environmental hazards such as floods. He notes, first, that farmers in this floodplain distinguish between two different types of floods, based on their height, timing, and duration. One, the normal *barsha* flood, is necessary to their system of agriculture; while the other, the abnormal *bonna* flood, is injurious to it. Accordingly, farmers expend considerable effort in attempting to predict whether the next flood will be normal or abnormal, through observation of the weather, cloud cover, rainfall, and the level and velocity of water in proximate rivers and streams. Based on these predictions, farmers attempt to adjust to the character of flooding beforehand by selecting flood-tolerant versus drought-tolerant species of rice, and by planting in lowlands versus highlands.

The fourth reading in this section is by Michael R. Dove, on 'Perceptions of Tree Shade Among Farmers in Pakistan'. Surveys have shown that one of the major constraints to the development of agro-forestry in Pakistan is the farmers' fear of the impact of trees on their land and crops — which most farmers articulate as the feared impact of tree 'shade'. The thesis of Dove's chapter is that what the farmers mean by tree shade is not what is usually meant by this term in western science, and further, that the farmers' conception of tree shade is rational, useful, and merits consideration by developmental officials and scientists.

Dove begins by demonstrating that Pakistani farmers perceive shade as having four dimensions — length, width, height, and duration — in addition to temperature and taste. He then shows that there is considerable variation from one species to the next in these several dimensions and characteristics and, of most importance to the farmer, there is corresponding variation in the impact that each species has on the farmer's land and crops. This impact further varies according to the type of land and the season of the year. Deleterious impacts are countered by the farmers in a variety of ways, including species selection, watering, and especially pruning.

Dove concludes by noting that these folk concepts of tree shade are based on classical humoral principles of hot versus cold and wet versus dry (more usually associated within Pakistan with the practice of humoral medicine than agro-forestry). These principles essentially constitute a system for managing the relations between trees and crops; that is, they constitute a traditional or folk system of agro-forestry. This system of agro-forestry is far older and thus more time-tested than anything the national government can soon develop. Therefore, the government would do well to study it and utilize its principles in the current nation-wide effort to promote on-farm tree cultivation.

Dove's case study illustrates, again, the complexity and sophistication of existing systems of farmer knowledge. It also illustrates the difficulties of facile translation between different languages and different systems of knowledge: the Urdu term saia (and its cognates in Punjabi, Pushto, etc.) is and always will be translated into English as 'shade'; but clearly, while there is some shared meaning between the two terms, there is much that is meant by saia that is not meant by 'shade'.

The fifth and final reading in this section is by John P. Thorp, on 'Culturally Relevant Socio-Economic Categories of Rural Landholders in Bangladesh'. Thorp's concern in this chapter is to investigate how government offices and development agencies categorize rural households, especially with respect to landholdings, compared with the way the rural people categorize themselves. He argues that rural people and development officials measure and categorize arable land differently, and that this has implications for development policy.

Thorp begins by looking at several censuses compiled by or for the national government and its aid agencies, which he shows basically divide rural society into large landholders and the landless. For example, one census categorized any farmer with less than 0.5 acre as 'landless'. Thorp argues that there are problems in categorizing as landless — and hence in treating as landless — someone who owns a small plot of land or even just a house plot. He notes that in rural Bangladesh society, anyone who owns and productively uses land — no matter how little — possesses the all-important status of *malik* 'master'. Thus, the owner of even a tiny plot is more apt to act — under development programs sponsored by the government — like a landholder, than like the landless with whom he has been lumped.

Accordingly, Thorp recommends that government and development agencies use a system of classification that more closely resembles the one used by the people themselves. This would include the categories of landless (without homestead), homestead owner, marginal cropland owner, small landholder, medium landholder, big landholder, and super landholder. Using this system of classification, Thorp notes, the percentage of landless found in government censuses is revised from 50 percent down to just 8 percent. This lower figure offers a more realistic basis for development planning, for example with respect to the land reform that the government and the aid agencies have been attempting to implement. The government censuses imply that one-half of the rural population — the half categorized as 'landless' — should support their land reform program. But Thorp shows that since even the homestead and marginal cropland owners view land reform from the respective of landowners, the actual level of support for it is probably closer to the 8 percent of truly landless.

This study demonstrates the common danger in government and aid agencies of interpreting rural society and its needs in such a way as to support programs that the government or agency itself favors. In addition, it demonstrates the need for great care in the use and definition of the terms 'big farmer' and 'small farmer', and even of 'farmer' versus 'non-farmer'. Many government officials in the rural parts of Pakistan are fond of saying that they 'know all of the farmers' in their district, by which they mean that they know the five or six farmers with the largest landholdings and most political influence. Under this usage, the other cultivators in the district, the smallholders and tenants, are not recognised as 'farmers' and thus are not included in the distribution of government agricultural assistance.

## COMMON MANAGEMENT OF NATURAL RESOURCES

The readings in this second section of the volume are concerned with how rural people manage commonly-owned natural resources. This category of resources is extremely important in Pakistan (and neighbouring countries), because of the enormous importance of irrigation water (Pakistan has the world's largest system of irrigation), rangeland (more than one-half of the country's land surface is covered by arid, communally-managed rangeland), and forest (Pakistan's rural communities traditionally hold shared rights to village and state forests). Among the issues examined in the readings that follow are two of the most important aspects of the contemporary management of common property resources, namely the extent to which such management is constructive versus destructive, and why; and the way that this management is changing under pressure from population growth and development.

The first reading in this section is Douglas Merrey's analysis of 'Irrigation and Honor: Cultural Impediments to the Improvement of Local Level Water Management in Punjab, Pakistan'. It is based on field research carried out on the Chaj *doab*, between the Jhelum and Chenab rivers in the Punjab, Pakistan. The topic of Merrey's research was the reason for the local-level mismanagement of irrigation, which has come to be recognized as the major cause of the problems of low productivity, water-logging, and salinity in the Indus plain.

Merrey argues that this management is fundamentally a problem of embedded lack of cooperation among the local population themselves, which he explains in terms of the concern in rural Punjabi society for *izzat* 'honor' or 'respect'. This concern is associated with a set of social values and mechanisms that encourage conflict between fellow-villagers and discourage long-term cooperation. The over-riding concern for *izzat* causes men to support or oppose rural development programs (such as those involving the maintenance and rehabilitation of the water courses with which Merrey is concerned) based on whether the program weakens or strengthens their competitors within the village, regardless of the program's impact on their own interests. In this behavioral context, it is very difficult for a community to cooperate for a common end, even when it is in everyone's mutual benefit.

Merrey discovered that while the system of *izzat* and consequent lack of community cooperation generally prevails all over the Punjab, it varies in severity according to type of village and also the type of individual farmer. For example, Merrey found that a village with two or more *biraderi* 'lineages' of approximately equal size is likely to have more trouble organizing itself cooperatively than one containing either one large *biraderi* or many small *biraderi*. Among farmers, he found that those with land at the tail of the watercourse (and hence those who stand to gain the most from improvement in irrigation efficiency) are more willing to cooperate in development programs with other farmers than those with land at the head. Further, and of great importance, Merrey found that farmers with large holdings are less likely than those with small holdings to cooperate with their fellow farmers (e.g., in maintaining watercourses), are more prone to factionalism, and more often violate regulations. This finding contradicts the view widespread among Pakistani government officers, that the farmers with the largest holdings are the most 'progressive'. Merrey's article is a pointed reminder that wealth does not always ensure progressiveness and may indeed even preclude it.

Based on this analysis of how preoccupation with *izzat* and proclivities for cooperation vary both inside and between villages, it is possible to predict, Merrey says, which villages and which farmers are most likely to cooperate successfully in a given development program. It then becomes possible to focus the program on those particular farmers and villages with whom the likelihood of successful implementation of the program is greatest. This ability to predict a population's response to particular development programs, and thereby to focus programs on the most receptive parts of that population, exemplifies that best that the social sciences have to offer rural development.

When the target population has been selected, Merrey has further recommendations for coping with the problems of *izzat*. In order to promote cooperation and minimize obstruction, the *izzat* of all farmers involved in a development project must be carefully safeguarded. This can only be done if consensus is promoted in public, and public disagreement is avoided. If disagreements are resolved by submission to a vote, for example, those who lose the vote will also lose *izzat*, forcing them into opposition to the project. Tactics for avoiding or minimizing such opposition represent a short-term adaptation to the culture of *izzat*. In the long term, Merrey argues, the solution is to change the basic structure of rural society in the Punjab, so that successful community organization is rewarded, and *izzat*-based obstruction is punished.

A final, important point of Merrey's study is that farmers are not alone in disrupting developing projects by their arrogant character: development officials as well are often to blame. Merrey says that the priority of most officials visiting the field is not understanding the farmers, but rather convincing them of their own superiority. Hence, visiting officials address farmers using familiar pronouns (*tum* instead of ap), an urban dialect rather than the farmers' own language, and an authoritative tone. Many visiting officials wear western rather than traditional dress, and even those who do not invariably omit wearing the local headgear. In short, visiting officials tend to do everything in their power to *distance* themselves from their farmer-clients, when what they should be doing is trying to bridge the differences. Development officials would do well to set an example for the farmers by suppressing their own pride, giving the farmers more respect and demanding less themselves.

The second reading in this section is N.S. Jodha's 'Population Growth and the Decline of Common Property Resources in Rajasthan, India'. It is based on field research carried out over a period of twenty years in six villages of Rajasthan. Jodha begins his paper with a description of the environment of Rajasthan, which is characterized by recurring but usually localized droughts. The local population have adapted to this environment, he suggests, by developing an economy based largely on livestock. The mobility of the livestock permits the herdsmen to walk away from localized droughts, temporarily moving to whatever part of Rajasthan has received the most rain in a given season. To facilitate this movement, the local population also developed a system of common property resources, permitting herdsmen access to food and water for their herds wherever they might take them. Jodha's concern in the remainder of his paper is to analyze what has happened to these common resources in recent years.

Jodha rejects outright the thesis of Garrett Hardin, that the decline of common property resources is a simple function of population growth. Jodha points out that the population of Rajasthan grew during feudal times as well, but because the feudal system made it uneconomical for tenants to cultivate the marginal commonly-owned lands, they did not do so. This economic barrier to intensified exploitation of common lands was removed not by demographic pressure, he argues, but by land reform and the social changes that accompanied it.

Land reform encouraged the privatization of common property resources for agricultural use, reduced the cost of cultivating them, and dismantled the traditional institutions that had formerly regulated their use. This use today falls under the jurisdiction of the local *Panchayat* committees, which are far less authoritarian than the feudal *Jagirdar* were in assessing costs for the use of common property resources, or in levying fines for their misuse. As a result, there is no longer any cost to the farmer for use of these resources, and in the absence of any cost, use leads to misuse. The impact of effective traditional authority versus ineffective modern authority on resources use can be seen in contemporary Pakistan as well. Along any part of the border between Pakistan's settled areas and tribal areas, a marked differences in forest cover is easily observed. The forest in the tribal area, whose use is enforced by harsh tribal law, is relatively intact; in contrast, the forest in the settled area, which is protected only by the lengthy and uncertain process of national law, is typically degraded.

Another, albeit secondary cause of the decline in common property resources in Rajasthan, Jodha says, is the increasing commercialization of these resources. Communities that were formerly isolated and had subsistence economies are now tied to external markets. One of the most important consequences of this commercialization is the introduction of the tractor. On land that was once cultivated only periodically, tractor use has reduced the length of both short and long fallows, thus reducing the length of time available for common-access grazing. On marginal land that was not cultivated formerly, tractor use has permitted cultivation, resulting in the complete conversion of common access rangeland to cropland.

Jodha maintains that the changes taking place in Rajasthan's common-property resources are of concern for several different reasons. The first and most obvious reason is that the privatization, distribution, and conversion to cropland of marginal lands is leading to their long-term degradation. Moreover the rural poor, for whom this distribution was ostensibly carried out, are not benefitting from it as much as wealthy landlords are. Finally, the decline in area of Rajasthan's common-property rangelands has resulted in a gradual but definite long-term reduction in average herd size, a shift in herd composition from cattle to sheep and buffalo, and a shift from free-grazing to stall-feeding. Each of these changes raises the cost of raising livestock, and reduces the comparative advantage that Rajasthan used to enjoy in this respect. The loss of this advantage may be expected to contribute to a long-term decline in the economic position of this province within India.

To forestall these undesirable consequences, Jodha recommends that any further privatization of Rajasthan's common property resources should be banned; that no one be permitted to use them without being assessed some minimal cost to prevent overuse; and that these and other fees go to local bodies as revenue, which would give them the incentive to conserve and manage them better. Jodha concludes by saying that since common-property resources sustain the rural poor and also ensure the use of arid lands according to their capability, there is a strong case for protecting and developing them, as a valuable rural institution.

The third reading in this section is Michael M. Cernea's 'The Privatization of the Commons: Land Tenure and Social Forestry Development in Azad Kashmir'.[1] The focus of his paper is how social organizations collectively adopt innovations, and in particular what organizations are most capable of adopting the innovation of social forestry. The data for his discussion come from an analysis he carried out in 1979-1980 of the forestry component of the World Bank's 'Hill Farming Technical Development Project' in Azad Kashmir. This component, intended to address the severe deforestation being experienced by Azad Kashmir, originally targeted *shamilat* land. The assumption in the project design was that this land belonged to the community, which would collectively participate in cultivating trees on it and share the benefits.

In fact, Cernea says, this assumption was flawed. While the targeted *shamilat* land indeed belonged to the community on a de jure basis, on a de facto basis much of it did not. Over time, this land had been subject to informal partitioning, progressive appropriation, and gradual privatization by large landowners. This was the land that was mostly offered for inclusion in the project, as opposed to true *shamilat* land that still belonged to the community. In addition to offering privatized *shamilat* land to the project, the large landowners were also more quick to offer their personal *malkiat* lands to the project than were the small owners. In contrast, the small farmers feared that if they gave up their land, the government would appropriate it and/or the trees to be planted on it. The big farmers also demanded the most services from the project, although they were least in need of them; and they were least willing to contribute any of their own resources in return (such as labor), although they were most capable of doing so.

This over-exploitation of government resources by big farmers plagues rural development projects throughout Pakistan. It is based on a cultural association of the right to government services with power and wealth rather than need. The big farmer, rather than feeling embarrassed at being offered government assistance that he does not need, feels slighted if it is not offered. Many government officers, to avoid inflicting such slights, focus their attention and resources on the wealthiest farmers in their jurisdictions. The singular problem in doing so is that this sharply reduces or even eliminates the net impact of development assistance. When the government subsidizes development activities by farmers who could carry out the activity on their own, the net impact of the government assistance is nil. A positive impact occurs only when assistance allows a farmer to do something that he could not otherwise have done.

As a result of his evaluation of the World Bank project, Cernea says, the project was re-oriented away from community land to government land or private land, and away from large farmers to small ones. The principal lesson of the project is that the most important sociological contribution to social forestry programs is the identification of the social unit that can carry out the program successfully. Selection of the community as the unit for social forestry programs has — as in the project described here — rarely been successful.[2] The reasons for this lack of success include (i) the fact that communities are never homogeneous in abilities or needs, (ii) it is difficult for them to act as a unit, (iii) tenure of community lands is uncertain, (iv) equitable distribution of benefits is difficult, and (v) communities have no tradition of collective organization and action for productive purposes. This last point is one often forgotten by social foresters and other development officials in Pakistan: if rural communities do not grow wheat or rice together, (e.g.), why should they be expected to grow trees together?

The growing awareness of the difficulty of community-centered approaches to social forestry, Cernea says, has led to the current emphasis on household- or farm-centered approaches. It is easier to motivate a farm family to plant trees on their bunds or along their hedgerows, than to persuade an entire community to plant trees on a plot of common land. When working with individual farmers as opposed to communities, however, the social forestry strategy must be modified accordingly, with more emphasis on integration into the overall farming system. Thus, while farmers can almost always set aside land for linear or scattered plantings of trees, they can rarely set aside enough land for block plantations. Similarly, whereas farmers can easily be interested in planting trees with multiple uses, it is much more difficult to interest them in planting trees that have only a single use.[3]

The fourth paper in this section is Nek M. Buzdar's 'The Role of Institutions in the Management of Commonly-Owned Rangelands in Baluchistan'. Buzdar's intent in this paper is to show that the government's tacit opposition to common property rangelands, expressed through its support of their privatization or incorporation into state lands, is misplaced. His thesis is that the traditional tribal management of Baluchistan rangelands as common property resources is the optimum way to utilize and conserve them.

Buzdar begins his analysis with a discussion of the traditional tribal institutions that play a role in the management of Baluchistan's rangelands. The most obvious of these institutions is the annual summer closure of tribal ranges for one to four months, and associated rotations of rangelands, all for the explicit reason of allowing the grasses to regenerate themselves. These closures and rotations, along with other regulations on the use of the rangelands, are enforced by the tribal chiefs, sub-chiefs, and elders. This political system, Buzdar maintains, is thus a second important management institution. A third management institution, which is also important from the standpoint of enforcement of regulations on rangeland use, is religion: the traditional tribal religion of Baluchistan categorizes certain parts of the range as off-limits, which helps to limit over-use of the range. In addition, religion mandates the sacrifice of livestock on numerous occasions, especially by wealthier men with large flocks. This limits the build-up of individual flocks, and thus also reduces pressure on the range. A fourth institution, the tribal economy, also mitigates against the build-up of flocks and concentration of wealth, and consequent over-use of the rangelands, through its subsistence orientation and egalitarian character. A fifth and final institution of relevance to rangeland management is the joint family system: since the joint family is not only the social unit but the economic and hence range-using unit as well, the number of people engaged in any given use of the range is relatively high (compared with a nuclear family system). As a result, individual families can reap the benefits of economics of scale in their rangeland use, and the overall system is more efficient.

Buzdar goes on to say that these traditional institutions, and the traditional system of rangeland management that they make possible, no longer prevail throughout Baluchistan. In what he calls the non-traditional areas of the province, the settled areas with more government control and more development, the institutions that he describes have weakened or disappeared entirely. In these non-traditional areas, tribal political authority has weakened, and individual tribesmen have responded by drastically shortening the annual closing periods and reducing rangeland rotations. In these same areas the orientation of the household economy has shifted from subsistence consumption to market sales, with a resultant shift in herd composition from mostly goats to mostly sheep.

Buzdar suggests that the productivity of the rangelands in these non-traditional areas should be compared with that of the rangelands in the traditional ones, in order to demonstrate what function these institutions play in rangeland management. Buzdar measures productivity in four ways: as birth and survival ratios of livestock, and as economic returns per animal and per rupee invested. All four measures, he finds, vary inversely with stocking rates (that is, the number of animals raised per unit of area of rangeland). He finds that stocking rates are significantly higher in the non-traditional areas that the traditional ones, and that they are associated with lower birth and survival ratios, and lower returns per rupee invested (and somewhat lower returns per animal). All of these measures suggest that the rangelands in the non-traditional areas are less productive — and hence more degraded — than those in the traditional areas. His unavoidable conclusion is that the tribal institutions in the traditional areas play a crucial role in maintaining rangeland integrity and productivity.

In light of this conclusion, the ongoing weakening of traditional tribal institutions in Baluchistan is cause for alarm. Buzdar correctly points out that the chief cause of this weakening is the incompatibility of these institutions with the institutions and attitudes of the state within which they exist — including the government's concern for the common man. The government believes that the common man is oppressed by tribalism and will therefore be better off if tribalism is eliminated. But no thought is being given to whether the common man benefits from the resource-regulating functions of tribalism, nor how he will fare when these are eliminated along with its political aspects. In addition to recommending various revenue and investment measures to encourage conservation and ease pressure on the rangelands, Buzdar suggests that the government establish cooperatives to take on the regulating functions of the disappearing tribal institutions. Since experience with cooperatives all over the world suggests that this will not be easy, and since it is usually easier to preserve what exists rather than create what does not, the government should also consider supporting and strengthening existing tribal institutions before they disappear entirely.

The fifth and final paper in this section of the reader is Dove and Rao's 'Common Resource Management in Pakistan: Garrett Hardin in the *Junglat*'. The intent of this paper is to analyze the applicability of Hardin's thesis to Pakistani society. Hardin's thesis is that the drive to maximize individual and short-term benefits from the use of common property resources subverts the sustained management of these resources for the common and long-term good. The paper draws on data from case studies by several different scholars on the management of common resources in both traditional and modernizing contexts in South Asia.

Looking first at traditional contexts, Dove and Rao discuss cases studies of tribal management of common resources from Baluchistan, Rajasthan, and Swat. In each case, they find that such management promotes balanced use of common natural resources, in direct contradiction to Hardin's thesis. The explanation for this contradiction involves the important role of sanctions in common property resource use. Sanctions are completely missing from Hardin's model, which assumes that individual use of resources is determined solely by the individual's assessment of his own best interests. In any traditional context, however, sanctions are likely to be present, mediating between individual self-interest and the self-interest of the group. These sanctions begin to disappear only as the traditional society is integrated into the modern nation-state. Before integration is complete and the nation-state has effectively imposed its own sanctions at the local level, a period often occurs during which no effective sanctions at all are present. When this occurs, common property resources are likely to be over-exploited for individual as opposed to group ends. This suggests that Hardin's thesis actually applies only to this particular modernizing or developing context, to disintegrating as opposed to integrated societies.

For a detailed example of what happens in this context, Dove and Rao draw on Cernea's case study from Azad Kashmir (cf. Chapter II.3 in this volume). As noted earlier in this Introduction, Cernea's study illustrates how difficult it is for developers to understand indigenous institutions (such as *shamilat* land), much less to improve upon them (or even just to avoid undermining them). In particular, it illustrates how difficult it is to retain traditional sanctions on the over-exploitation of common property resources in developing contexts. Development projects often unwittingly provide village elites an excuse to throw off these constraints.

This paper concludes that effective sanctions are crucial to the proper management of common property resources, and that the creation of a new and effective institution to apply such sanctions is less likely to succeed than use of an existing traditional institution. A major challenge to governments of developing nations, therefore, is to preserve or even augment the authority local institutions have over such resources, instead of undermining it. Religion is one institution — with a role in the use of common property resources — that is less easily undermined than many others. An important question for development, therefore, is whether religion can be invoked as a sanctioning authority for common resource management.

## ENERGY FLOWS

The readings in this third section of the volume are concerned with the flow of energy through the rural landscape. Their foremost concern is with the complex strategies that households pursue to draw sufficient energy from the biomass-poor rural environs of this part of the world to meet their needs for cooking, heating, and lighting. At a higher level of analysis, these papers are concerned with how energy flows from one part of the farm economy — such as food cropping — to another — cooking and heating. Similarly, the papers are concerned with how energy flows between different social classes in the countryside, and also how it flows between countryside and city. The aim in delineating the lines by which energy flows is to show the complexity of this field, and hence the necessary complexity of developing solutions to energy problems.

The first reading in this section is John Briscoe's analysis of 'Energy Use and Social Structure in a Bangladesh Village'. Briscoe begins his paper with a critique of traditional thinking in the energy development sector, which he says is concerned only with whether the total amount of energy available equals the total amount of energy needed — with no concern for how the available energy is distributed. The assumption, Briscoe says, is that energy is distributed and consumed strictly according to need. The corollary assumption is that rural society is homogeneous, harmonious, and cooperative — which we know is not the case. Given that rural society is heterogeneous, inharmonious and uncooperative, Briscoe says, how energy is distributed within the rural population is just as important to the overall social welfare as how much energy is available.

Maldistribution of energy resources has become more of a problem in recent years, according to Briscoe, because of changes in rural social structure. The traditional patron-client relationships, which formerly provided the poor with sources of energy, have weakened. Transactions in land, labor, and crop revenues are now concentrated not between classes, as was formerly the case, but within them. This has created class cleavages in the use of some important sources of energy. Whereas fuels that are abundant or difficult to protect are still used by all classes, fuels that are scarce or easy to protect are now used largely within the class that owns them. As a result, while the rural poor today consume fuel at approximately the same rate as the rural rich, they must expend significantly greater amounts of time or money to acquire it. This increasing pressure on fuel sources has indirect effects on the entire rural environment, beginning with decreases in the amounts of organic material returned to the soil, which causes both soil fertility and ultimately crop yields to decline.

As bad as the fuel situation is for the rural poor at present, Briscoe argues that proposed government development programs are likely to make it much worse. He specifically cites the Bangladesh government's announced intention to shift farmers from the use of traditional rice varieties to high-yielding varieties. The difference between the two in straw to grain ratios — 5:1 for the former and 1:1 for the latter — is normally cited as one of the advantages of the high-yielding varieties. Briscoe points out, however, that this shift of plant biomass from straw to grain has different implications for the laborer than for the landowner. Specifically, it will drastically reduce the fuel supplies of the rural poor, forcing them to divert some of their already limited disposable income away from food to fuel. This is a good example of the integration of the rural ecology and economy, and illustrates the sort of development disaster that has too often resulted from focussing on one narrow objective — in this case, a rice plant that produces more grain — at the expense of the whole society. It was this sort of problem that led to the development of 'farming systems analysis', which consciously strives to look at the interrelations between different groups, areas, and activities in the rural society.

Briscoe concludes his paper by acknowledging that it is necessary to modernize agriculture in Bangladesh, but adding that if this is done as currently planned, it will have a disastrous impact on the already minimal energy supplies of the poor majority. He believes that the only way to mitigate this disaster is to provide off-setting government assistance to the segments of the population affected. One solution he suggests is a government subsidy of the cost of energy, since it is mostly the poor who buy fuel (which is true in Pakistan as well). Another solution is an energy program targeting women agricultural laborers, since it is women who gather and use most fuel, and since it is the laboring class whose fuel position is least secure.

The second reading in this section is Lee Horne's 'The Demand for Fuel: Ecological Implications of Socio-Economic Change'. Her aim in this reading is to explain fluctuations in the intensity of exploitation of wood vegetation for fuel on the Tauran plain of Iran, and consequent fluctuations in the integrity of the vegetative cover. Her major thesis is that levels of exploitation and environmental impact are explained not just by the internal conditions of rural society, but also — and perhaps even more so — by events and conditions located outside rural society, in particular in urban society. She begins with a detailed ethnography of fuel use on the plain, followed by an analysis of the ecological impact of fuelwood extraction and historical variation in this rate.

This last section is the most important theoretically. Up until 1966, according to Horne, the tree cover of the Tauran Plain was heavily exploited for the making of charcoal. The charcoal was sold in the city of Sabzevar, four to five days away by camel, for both domestic and industrial use. (Note the impressively long 'reach' of urban demand into the rural areas.) This exploitation had a severe impact on the plant cover of the plain. Following the prohibition of charcoal-making by the central government in 1966, and the increasing use of electricity and fossil fuels in Sabzevar city, the plant cover made a dramatic comeback. This reading shows that the rural ecology is dependent not only on the actions and needs of the rural people, but also on the actions and needs of urban peoples, and on the government regulations that govern their fulfillment. In Pakistan as elsewhere in the developing world, this crucial linkage between the cities and the rural areas is too often forgotten. Degradation of the rural environment is too often attributed to over-exploitation of resources by the rural population, ignoring the fact that much of this exploitation serves the urban population.

In her conclusion, Horne notes that trade in domestic and industrial fuels has long linked rural and urban areas. In the past, urban areas depended on rural areas for fuel, and now rural areas are increasingly depending on urban areas for fossil fuels and associated technology. This new dependence on urban areas may have just as great an impact on the rural environment as did the earlier dependence on rural areas, although in this case the impact is likely to be benign. (Thus, Horne states that the average household on the Tauran plain is buying and burning 500 to 800 kilograms of paraffin per year, in the absence of which they would have to burn — and hence cut — 25 to 40 percent more wood.) Horne concludes by saying that in order to understand and combat deforestation and desertification, it is first necessary to understand the social and economic contexts of exploitation of rural resources.

The third and final reading in this section is Tim Campbell's 'Socio-Economic Aspects of Household Fuel Use in Pakistan'. The focus of this paper is the social, economic, and cultural aspects of introducing a new household cooking fuel in Pakistan, composed of densified or compacted agricultural residues. In the process of discussing this, Campbell provides a comprehensive overview of the household energy situation in Pakistan.

Campbell begins his analysis with a discussion of the demand for biomass fuels. He notes that the percentage of domestic demand met by biomass fuels has apparently increased in recent years, while the percentage met by non-biomass commercial fuels has declined dramatically. The biomass fuel that has largely been used to make up the difference, he maintains, is fuelwood. This suggests that the supply of fuelwood in Pakistan, far from being under the pressure that is popularly feared, has been able to expand considerably to meet increasing demand. This suggestion is supported by the fact that increases in the price of fuelwood over the past two decades have no more than kept pace with inflation. This finding is so counter-intuitive, however, that we are led to ask whether the supposed increases in the use of fuelwood is due rather to under-reporting of its use in earlier surveys. Whatever the answer to this particular point, one of the principal insights of this analysis, as Campbell himself says, is that the data on household energy use in Pakistan (as in other developing countries) are 'appallingly imprecise'. Given this imprecision, it is not possible to develop a national energy program that addresses real as opposed to merely perceived needs. The acquisition of a reliable data base, in particular on non-commercial household fuels, is therefore a matter of the greatest urgency.

After discussing the overall demand for biomass fuels, Campbell discusses each of the major fuels in detail, including dung, which he notes is the second most important biomass fuel after wood. The burning of dung is not confined to the lowest income groups, but persists even in cities and in high income groups, even rising as income rises — reflecting the fact that dung fuel is more desirable and more costly than many of the other non-wood fuels available. The demand for dung as a fuel is such, Campbell estimates, that 64 percent of it (on average) is used for fuel, and just 36 percent for fertilizer. This statistic is supported by a recent survey carried out by the Forestry Planning and Development Project, which yielded a figure of 60 percent of dung being used for fuel and 40 percent for fertilizer.[4] The use of dung (and to a lesser extent agricultural wastes) for fuel instead of fertilizer is probably contributing to a long-term decline in the fertility of Pakistan's farmlands. Campbell properly points out that this may surpass deforestation as Pakistan's most serious environmental problem. It receives less attention than deforestation because it is less visible and its effects are less immediate

For a nation like Pakistan whose economic base is still largely agricultural, this problem should not be ignored.

In Campbell's discussion of the demand for and use of biomass fuels, he is careful to note that consumers of these fuels are found in urban as well as rural areas. He finds that while biomass fuels are not used as extensively in urban areas as in the rural ones, they still comprise over 50 percent of the total fuel used. The biomass fuels used in urban areas originate largely in rural ones. The higher incomes, higher prices, and more concentrated demand of the urban areas draw a large fraction of fuel resources from the rural to the urban areas. This increases fuel prices in rural areas, obliging the rural population to devote a greater percentage of their income to fuel. It also places greater overall pressure on rural biomass resources, contributing to depletion of standing stock and degradation of the environment. Like Horne, Campbell draws attention to the fact that the urban population is also responsible for pressure on rural resources. The implication of this is that rural problems cannot be resolved solely through extension and education efforts directed at the rural population. Efforts must also be directed at the urban consumers of rural resources, and at the urban entrepreneurs who bring these resources into the urban areas (see Dove 1989).

Following his discussion of the supply of and demand for biomass fuels, Campbell discusses the use of fuel within the household. Campbell takes pains to demonstrate that fuel use is not a simple matter, but is part of a complex and multi-purpose household strategy. He says that the major fuels of firewood, dung, and crop residue have been fine-tuned over many generations of use to meet multiple objectives, including long-term survival, short-term gains, and freedom from uncertainty and risk. As a result, the average household fuel-use strategy is based not on use of a single fuel, but rather on a mixture of fuels — which it variously draws upon depending upon the type of cooking apparatus in use, the type of cooking to be done, and the state of the fire. This fuel mixture further varies according to the season of the year, market conditions, and the size, location, and economic fortunes of the household.

The complexity of these fuel strategies merits attention, Campbell says, because — to return to the original objective of his analysis — it shows that the introduction of any new fuel is an equally complex matter. The introduction of a fuel such as densified agricultural waste would necessitate a complicated series of adjustments not only in price and fuel selection, but also in cooking, organization of household activities, and even in the balance of power among classes and genders. Some of these adjustments would be beneficial to the household, and some would not:

Campbell predicts that this new fuel would assist households through lower costs, but that it would reduce the flexibility of the household fuel strategy and potentially disrupt established patterns of fuel making, fuel purchasing, and ancillary social relationships. Campbell says that the *greatest uncertainties surrounding* acceptance of densified fuels involve the norms governing substitution of one fuel for another (about which we know next-to-nothing), the role of women in the fuel sector, and the use of individual time within the household.

In the absence of reliable data on these and related topics, Campbell implies, it is difficult to predict whether densified fuels will be accepted by the public or not. It is difficult to predict, that is, because we do not yet know ourselves whether adoption of the new fuel is, in the end, in the best interest of the public or not. Campbell reminds us that new fuels (and also new cooking technologies such as fuel efficient stoves) are accepted or rejected by target populations in the developing world because they either promote or threaten the long-term self-interests of the population. They are not accepted or rejected because the populations involved are 'enlightened' or 'backwards'. When a government agency believes that a new technology is in the best interests of a population, but the population rejects it, in the vast majority of cases it is the agency that has made a mistake and not the population.

## WOMEN AND NATURAL RESOURCES

The readings in the fourth section of this volume, on 'Women and Natural Resources', describe women's economic roles in rural Pakistan (Carpenter), Bangladesh (Feldman et al.), and India (Stanbury). The main theme reiterated by these three readings is that rural women in South Asia are heavily engaged in livestock production. In the division of labor in South Asia, in other words, agricultural production is men's work and livestock production is women's work. It is thus primarily through livestock production that South Asian women interact with natural resources, a fact with important implications for development and conservation. Fodder — especially leaves and grasses collected or grazed from uncultivated grasslands and forests — is the natural resource on which women's main economic role in rural South Asia depends. This means that the development or conservation of fodder-producing lands in South Asia depends primarily on women. The most important implication of the readings in this section is that plans for such development or conservation must carefully consider women's economic interests in fodder, so that both women and natural resources benefit.

This point is most clearly made in the first reading, Carol Carpenter's 'The Impact of Afforestation on Women: The Development of Marginal Lands and Female Fodder Collectors in Pakistan'. In this reading Carpenter argues that development projects that aim to transform grasslands into forest could inadvertently undermine the economic position of women in rural Pakistan. She describes the importance of grasslands to women's livestock-producing activities in four provinces of Pakistan, concluding that forestry projects can benefit women and increase their own success by including fodder-producing components.

Carpenter begins by establishing the link between rural women and livestock production. She demonstrates that women in rural Pakistan spend an average of 40 percent of each workday on livestock-related activities, with 17 percent of their time being spent just cutting, collecting, and preparing fodder, or grazing animals. Carpenter also demonstrates the importance of livestock production to the rural economy of Pakistan. In some areas of Pakistan, like the unirrigated sections of Baluchistan and Sind, the economy is based on livestock production. But even in areas where the economy is apparently based on agriculture, livestock raising is essential. In rainfed areas of the Punjab and NWFP, for example, livestock production is culturally secondary but economically more important than agriculture. Finally, Carpenter demonstrates that livestock production is one of the few areas of the rural economy where all in-puts and out-puts traditionally flow through women's hands.

Carpenter describes two different patterns of livestock production that occur in Pakistan. In the first, which occurs in Baluchistan and the irrigated parts of the Sind and is particularly associated with nomads, the rural economy is based on livestock production. In this pattern, men and women divide the labor of raising livestock between them. In the second, which occurs in the rainfed areas of the Punjab and Northwest Frontier Province, agriculture has superceded livestock production. In this pattern, men are associated with agriculture and women with livestock raising. But in this second pattern, Carpenter argues, agricultural and livestock production — men's work and women's — are interdependent: agricultural production benefits from manure, and milk production depends on fodder crops, weedings, or crop residues.

These two patterns are found side-by-side in the irrigated portions of the Punjab and Sind, where the subsistence of marginal farmers and the landless depends on livestock production, and the subsistence of farmers with sufficient land depends on intensive agriculture. Carpenter notes that irrigation allows those with sufficient land to intensify livestock production as well as agriculture. On the other hand, irrigation makes livestock raising problematic for those without sufficient land, because it reduces the amount of uncultivated land available for grazing, leading to over-grazing on what is left.

The second reading, Pamela Stanbury's 'Women and Water: Effects of Irrigation Development in a North Indian Village', echoes Carpenter's description of irrigated Pakistan. Stanbury describes the different effects of irrigation in India on women of different castes. She demonstrates that, in a village located on the Northern edge of the Thar desert, land-holding upper-caste Jat and Siami women receive the majority of the benefits from irrigation, while landless lower-class Harijan women receive few benefits. According to Stanbury, the introduction of irrigation removes Jat and Siami women from paid agricultural work, but significantly increases their income from livestock production: conversely, it provides additional paid agricultural work for Harijan women, but dramatically decreases the viability of their livestock production. The result is two entirely different systems of livestock production: one in harmony with agriculture and with the land, and the other disconnected from agriculture and degrading the land.

Jat and Siami women are responsible for gathering weed fodder from their fields, harvesting fodder crops, stall feeding the family's cows and buffaloes, milking them, processing the milk into ghee, selling ghee within the village, and making and drying dung cakes. They also participate in cotton harvesting, and gather crop residue from their fields to be used as fuel.

Harijan women, on the other hand, gather fodder for the family's few dairy animals along the roads, while their sheep and goats graze in vacant lands near the village. Stanbury notes that goats fill the same function for the Harijans as cows do for the Jats and Siamis, that of a back-up for the primary milk producer. Fewer dairy animals and limited fodder supplies means Harijan women often have no milk surplus to process into ghee; Stanbury notes that the primary milk producer for the Harijans is the cow, while irrigation has allowed water buffaloes to become the milk animal of the Jats and Siamis. Similarly, Harijan families rarely eat milk products. With little or no dung to collect, fuel shortage accompanies fodder shortage. The main benefits of irrigation for these women are new opportunities to do agricultural work for wages. This benefits is precarious: Stanbury notes that it is probably due to the relatively unmechanized character of the village, and will diminish as mechanization develops.

The causal factors behind the differences between the Jat/Siami and the Harijan systems of livestock production are that irrigation increases the amount and productivity of agricultural land while decreasing the availability of non-agricultural — fodder-producing — land. Landholders like the Jat and Siami are able to intensify both agriculture and livestock raising by stall feeding livestock with fodder crops, while landless laborers are left to depend on shrinking and increasingly degraded grazing lands.

This shift represents one aspect of a change from a subsistence pattern based on livestock production that is supplemented by some agriculture, to an agriculture-based economy supplemented by livestock raising. For women of land-owning castes, this change intensifies their responsibility for livestock production. As livestock production becomes secondary, in other words, it also becomes more exclusively women's work.

In the third reading, 'The Role of Rural Bangladeshi Women in Livestock Production', Shelley Feldman, Fazila Banu, and Florence E. McCarthy describe women's adaptations to a rural economy in which both agriculture and livestock production are under pressure. They begin by demonstrating that women in rural Bangladesh play a significant role in the important economic activity of livestock production. Livestock production, they argue, is the most important opportunity women have to initiate and control an economic activity: 30 percent of the animals owned by households in their 1983 study were completely controlled by women, and another 62 percent were shared with their families.

According to Feldman et al., livestock production is more important to the economy of rural Bangladesh than usually recognized: they report that 94 percent of the households in their study raise some livestock (including poultry). But while livestock production is important, it faces serious constraints in Bangladesh, including limited access to extension services and thus to the knowledge to combat disease and improve stock. Feldman et al. do not note it, but this constraint is more serious for women than for men: purdah, as observed in the study villages, completely cuts women off from extension services.

The primary constraint on livestock production, however, is a severe fodder shortage. Feldman et al. suggest that land pressure in Bangladesh has resulted in a decrease in the cultivation of fodder crops. This article can be read as a case study of women's strategies in response to a severe fodder shortage. According to Feldman et al., the strategy women in Bangladesh have developed to cope with this fodder shortage is two-pronged.

First, women in Bangladesh typically minimize the risk of engaging in livestock production through share arrangements contracted with relatives or neighbours. Of the women with livestock in the search sample, 67 percent had goats and 44 percent had poultry through a share arrangement. In rural Bangladesh, goats and poultry are reared to produce offspring for sale, not products like milk or eggs, and this pattern is reflected in share arrangements. In a typical share arrangement, one woman gives another an animal, thus providing the initial investment; the second woman bears the expenses of raising the animal. The women share the offspring, with all female animals going to the original owner. Most share arrangements are made by women independently of their husbands, and the income they earn is their own.

The second strategy women in Bangladesh have developed to cope with fodder shortages is a concentration on small livestock (especially goats and poultry) that can scavenge their own food, especially on commonly-owned grazing lands. They note that growth in the livestock sector has been remarkably small in Bangladesh — with the exception of these two scavengers. Livestock production (and indeed agriculture) in Bangladesh is clearly under extreme pressure, and there are indications that this pressure is putting pressure in turn on commonly-owned grazing lands.

# DEVELOPMENT AND CONSERVATION

The focus of the readings in the fifth and final section of the volume is on the implications of traditional systems of resource use for rural development and environmental conservation. These readings challenge the popular view that peasants over-exploit resources, by demonstrating that most peasant systems of resource use (including common resource use) are rational and oriented towards sustained long-term use as permitted by local conditions. These readings also make the more basic point that any evaluation of resource use, whether from the perspective of the government agency and western scientists, or from that of the local peasant, is necessarily subjective.

The first reading is Mary A. Martin's 'Conservation at the Local Level: Individual Perceptions and Group Mechanisms'. Like the reading by Lee Horne in Section III, this draws on data from the Tauran plain in Iran. Martin takes as her starting point the widely-accepted proposition that environmental degradation in this part of the world is due to the profligate use of natural resources by the rural populations, who are either unaware of the ill-consequences of their actions or uncaring. Martin disputes this proposition, primarily because it assumes that all rural peoples are alike in their patterns of resource use. She properly notes that rural people vary widely in their knowledge of the environment and the way they adapt to it, as well as in the impact they have on it. She then analyzes the environmental knowledge, adaptation, and impact of one exemplary rural population, the farmers and herders on the Tauran plain.

Martin begins by discussing the system of dry agriculture on the plain. Although this system would appear to place great stress on the environment, it encompasses a number of conservationist techniques that mitigate this stress. These include ploughing fallowed fields to maintain high moisture and nitrogen content, and constructing bunds and leaving post-harvest stubble and weeds in the field to control erosion. In addition, the spatial expansion of dry farming is limited by (in addition to a 1966 government ban) the scarcity of both rainfall and labor. The threat that dry farming poses to the environment stems largely from recent innovations, including the increased demand for grain as supplemental animal feed to compensate for the deterioration of the range, and the replacement of the scratch plough by the tractor, which disrupts soil-stabilizing root systems. This last point is of particular importance: while the tractor symbolizes modernization, it does not necessarily — as this example shows — represent more rational or agronomically-sound farming.

Aside from dry agriculture, the two other major economic activities on the Tauran plain are fuel collection and grazing. Regarding the latter, Martin notes that the situation in the Tauran plain fulfills most of the conditions for Hardin's 'tragedy of the commons', but — although the resources on the plain are under pressure — no tragedy is taking place. Martin attributes this to the presence of a variety of traditional mechanisms that limit overgrazing. These include restriction of access to pasture by outsiders, alternating grazing areas on an annual or semi-annual basis, increasing competition from agricultural activities for labor as herd size increases, and the simple recognition of the poor state of the range on the plain and the consequent desire to graze better areas off the plain whenever possible. As noted earlier in the discussion of the Section II readings, therefore, most instances of common resource management are not associated with over-exploitation and degradation.

While Martin is able to identify a number of mechanisms that incidentally minimize over-exploitation of the Tauran plain, she does not find any formal control mechanisms. Assuming that the villagers recognize the negative impacts of their exploitation of the natural resources on the plain, why, Martin asks, do they not organize to better protect and manage them? Certainly examples of such organization have been found in many other societies. From an area adjoining the Tauran plain, Martin can cite the case of Asbkeshan, a village that on its own successfully imposed a ban on charcoal production in its territory ten years before the government ban. Martin attributes this success to the fact that the village was small, closely knit, and of tribal origin (and not itself in need of supplemental income from charcoal). These characteristics prevailed on the Tauran plain in pre-modern times, but not today. Collective action to conserve natural resources is nowadays frustrated by too much variation among households in the possible benefits to be derived from this action, and in the possible costs of not taking it. Another frustrating factor is the vitiation of tribal authority that has accompanied the extension of the central government's control to the Tauran plain. This control has included some restrictions on the use of natural resources, but they do not appear to be as effective as those that were formerly imposed by local tribal institutions. Martin concludes — as we did in our discussion of the papers in Section II — by suggesting that problems controlling the use of natural resources, and possible solutions offered by traditional tribal institutions, merit reevaluation.

The other reading in this section is Brian Spooner's 'Insiders and Outsiders in Baluchistan: Western and Indigenous Perspectives on Ecology and Development'. The thesis of this paper is that development planning has suffered as a result of placing too much emphasis on the objectivity of ecological science, and too little emphasis on the subjective moral and political aspects of ecological analysis. Spooner maintains that the validity of any given ecological analysis is in fact relative, varying according to whether one is a member of the ecological community in question or an outsider. Spooner develops this thesis drawing on data on the Baluch nomads of the Makran division in Pakistan's Baluchistan province. These nomads have recently drawn a great deal of attention from development officials and scientists, in part because of their purported over-use of the Makran range.

Spooner begins by noting that the Baluch nomads contribute seasonal labor as well as agricultural and pastoral produce to the local economy. But he goes on to say that their true importance to the economy and development of the Makran is far greater than these contributions suggest. The nomads are the only people using the least arable 90% of the Makran territory. By this use, and by their constant movement, they constitute a communications and resource-utilization network linking the scattered, settled communities of the Makran. Without these linkages, the sedentary majority of Makran's population would be marooned in isolated and thus untenable oases. With the linkages afforded by the nomads, the Baluch form an interdependent social, cultural, economic, and political unit covering the entire division.

In light of this role played by the Baluch nomads in the regional economy of the Makran, Spooner evaluates the types of development programs that are currently targeting them. These programs largely consist of the enforced application of western range-management principles to the nomads' territory. Whereas western range science focuses on the range, however, the Baluch themselves focus on the interaction between the range, the animals, and the people. Whereas the first priority of western range science is primary production, the first priority of the Baluch is to avoid any disruption of social relations, which are their primary form of economic insurance in times of need. What the Baluch need most from development programs, therefore, is some defense against the intrusive aspects of the national economy that threaten these social relations. Spooner suggests that this could consist of governmental manipulation of prices in such a way as to reinforce local Baluch social relations and social values, instead of subverting them.

This analysis is notable for drawing attention to two of the most serious weaknesses of western-inspired development. First, the biological scientists whose work directs most of this development regard (and present) their analyses as objective. But they are not: they reflect the particular values and world view of the practitioners just as much as a Baluch nomad's use of the range reflects his values and world view. Secondly, the development these same biological scientists are mostly concerned with is the development of plants or animals, which is not necessarily the same thing as the development of the people who use these plants and animals. One of the major lessons of post-war rural development is that improvement in rural social welfare does not automatically follow from the narrowly-focussed improvement of plants and animals, and indeed the reverse is often true.

In his conclusion, Spooner reaffirms the importance of ecological analysis in development, so long as it is remembered that any ecological question that involves human activity, as it does in the Makran, is not just an ecological question, but also a moral and political one. Development studies and projects have tended to ignore these moral and political dimensions of ecological problems, concentrating instead on their scientific and technological dimensions. In the long run, Spooner avers, this must change if development is to succeed.

# CONCLUSION

This review of the papers in this reader shows that they all, in one way or another, draw the same lessons regarding the use of natural resources by rural populations.

First, rural people perceive and utilize natural resources in rational and valid ways, even though these are often not the same ways that government officials and scientists perceive them and would like to see them utilized. This means that while rural people have much to learn from development scientists, they also have much to teach them.

Second, rural people are no more predisposed to cooperation with each other than the rest of us, but occasionally they do cooperate in the management of critically important resources. The imposition of sanctions by the community against non-cooperation is always vital to such cooperation.

Third, traditional tribal institutions are often effective in ensuring sustained, long-term management of natural resources. Attempts to replace these with the institutions of a modern nation state are rarely successful, at least initially. Governments should be careful, therefore, not to undermine existing tribal or other traditional institutions for managing natural resources.

Fourth, development affects men and women differently, because of the customary division of labor between the two. Since women are primarily responsible for animal husbandry, any development program involving livestock or affecting fodder supplies will have a greater impact, whether for good or ill, on women's welfare.

Fifth, rural peoples traditionally practice many techniques that, directly or indirectly, have a resource-conserving not resource-degrading impact. In many cases of resource degradation, the ultimate cause is not local use for local needs but rather extraction for the urban markets. In other cases, it is not traditional technology that is harming the environment, but rather modern technology that is being promoted by government — especially the tractor.

Sixth and finally, development officials and scientists have their own biases and can be as subjective as the rural people with whom they work. One of their most tenacious biases is focussing too narrowly on the biology of plants and animals, as opposed to the economy and sociology of the people to whom they belong. Rural economies and ecologies are so finely integrated that it is dangerous to intervene in one part, without considering the possible, attendant changes in the other parts. When rural people reject an innovation, it is usually because they perceive some side-effect of the innovation that the developers have overlooked.

# NOTES

1. A revised and expanded version of this paper is forthcoming in the second edition of 'Putting People First', to be published by Oxford University Press in 1990.

2. An ongoing project in Malakand agency is employing the community as the unit for implementing a social forestry project on *shamilat* lands, and so far it appears to be enjoying some success.

3. Michael R. Dove, *Prospects for Wood-Dung Fuel Replacement Through Farm Forestry Development* (Forestry Planning & Development Project Report #6, 1987).

# I. TRADITIONAL PERCEPTIONS OF THE ENVIRONMENT

30a

# I.1

# INDIGENOUS AGRONOMICS AND AGRICULTURAL DEVELOPMENT IN THE INDUS BASIN

**Richard Kurin**

The increasing involvement of anthropologists in development issues has intensified debate concerning the substantive contributions to be made by the discipline (e.g., Foster 1969; Arensberg and Neihoff 1970; Sanday 1976; Thompson 1976; Cochrane 1979; Vivelo 1980) and the types of strategies to be encouraged by its professionals (e.g., Brokensha and Hodge 1969; Cochrane 1971; Pitt 1976; van Willigen 1979; Shimkin and Tax 1979; Schwartz 1981). Here it is argued that symbolic anthropology, directed toward the analysis of cultural systems, offers a contribution that is distinctly anthropological and at the same time well-suited to those development programs and projects that seek to incorporate appropriate or participatory strategies in their design and implementation. In this case, the cultural analysis of the system of agronomical knowledge used by Pakistani peasant farmers reveals the rationale for agricultural practice and for the ways in which inputs of the green revolution have been accepted, modified, or rejected. Based on field research in Chakpur, a Punjabi village, and performed under the auspices of the UNDP and the Government of Pakistan Indus Basin Master Planning Project, the paper explicates the indigenous conceptual scheme for agronomical decision making and discusses its issues in allowing for the cognitive participation of those "being developed" in the agricultural development planning process.

## THE PROBLEM IN CONTEXT

Both Pakistan and India are heavily dependent on Indus Basin agriculture for internally consumed foodstuffs and exportable produce. Basin agriculture is supported by the Indus and the five major rivers of the Punjab, all of which begin in India and flow through Pakistan on their course to the Arabian Sea. In 1980, after years of negotiation, the two countries signed the Indus Basin Waters Treaty. This treaty, presently in its final stages of implementation, calls for the cooperative division of Basin water sources, with Pakistan obtaining the water of the three western rivers and India retaining use of the eastern ones (cf. Michel 1967). For Pakistan, a country receiving scanty rainfall, losing farm acreage to salinity and water logging, and experiencing rapid population growth, the reduced supply of surface water necessitated some means of enhancing agricultural production.[1]

The Indus Basin Master Planning Project was organized and funded as an organizational mechanism to meet this goal. In order to increase productivity, its planners, drawn from the government of Pakistan (WAPDA, Ministry of Agriculture), the United Nations (UNDP, IBRD), the United States (AID), and private companies, foundations and universities, emphasized infrastructural investment and the utilization of the inputs and technology of the "green revolution".[2] The success of the latter has depended on Pakistan's farmers to effectively use high yielding variety (HYV) seeds, chemical fertilizers, and new production techniques, to invest in such items as tube-wells, and to be responsive to market constraints and incentives (Papenek 1967).[3]

While the response to the new agriculture was encouraging to development planners during the late 1960s and early 1970s (cf. Johnson 1979), recent government data (Government of Pakistan 1978) and agricultural economics surveys (e.g., the WAPDA 1977 Agricultural Economics Survey of the Indus Basin) indicated that the use of innovative inputs was leveling off (HYV wheat at 70% of potential, HYV rice at 50% of potential), and in some cases not making much of an impact at all (e.g., chemical fertilizer use among small peasant farmers). To advocates of innovation, Pakistani farmers were not behaving as could be expected, given the high benefit-to-cost ratio of the new agriculture. For Indus Basin planners responsible for formulating accurate projection and viable long-term development strategies, the reasons for this had to be ascertained.

## THEORETICAL ORIENTATION

Throughout the Third World the tendency has been to deem as "irrational" those peasant farmers who have failed to respond adequately to the new agriculture. The source of this "irrationality" is often taken to be "culture", "local beliefs", "traditional practices", "superstitions", or "general ignorance", all of which, according to modernization theorists, have to be overcome if development is to occur (cf. Rostow 1960; Schultz 1964; Myrdal 1972). A problem with such a view is that farmer "irrationality" becomes a gloss for a wide variety of behaviors and beliefs that are, in the particular terms of the analyst, not explicable in terms of economic maximization. The result is that "culture", "beliefs", "traditions", etc. become residual categories with no positive or systemic significance for model building.

Assessment of the impacts and effects of the green revolution have challenged the notion of peasant "irrationality" (e.g., Moerman 1968; Popkin 1979; Nair 1979). A most useful position, illustrated by Brokensha et al. (1980) and Hill (1970), suggests that modern agricultural practices based on Western systems of knowledge constitute an alternative to practices based on indigenous systems. Indigenous systems of knowledge, though different in content from Western ones, may be quite systematic, coherent, and rational, and are likely to define particular types of skills and abilities as well suited to their application.

Analyses of innovation and social change based on the premise that rational knowledge replaces rational knowledge, not ignorance, have yielded impressive results (cf. Kuhn 1962; Wallace 1978). Singer's (1972) exploration of modern industrial and traditional Brahminic systems of knowledge in south India and Leslie's (1976) survey of Asian medical systems point to the existential integrity of such knowledge systems as well as the ways they may be synthesized with, compartmentalized from, or de-legitimated by exogenous systems.

The use of a knowledge systems approach in social planing, based on the promise that definition of the situation and information used by participants are relevant for understanding project outcome, is a relatively recent development in the United States (cf. Forester 1980; Bolan 1980), although it has deep roots in the work of Weberian sociologists, psychologistic economists, and cognitive anthropologists. Internationally, concerns for cognitive participation (cf. Berger 1976) or "appropriate" strategies have been posed as correctives to the impositional qualities of ethnocentric schema that have either ignored or denigrated indigenous resources, specialists, institutions, and knowledge systems. Freire (1970) conducting literacy training in Brazil, Fathy (1972) designing housing in Egypt, and Schumacher (1973) planning village technology in India have all viewed indigenous systems of knowledge as an appropriate resource that can be applied to practical problem solving.

Planners knew very little about the indigenous agronomical system of Punjabi farmers and how it was related to innovation in the Indus Basin. The study reported on here sought to discover how agricultural production is conceptually organized and how this organization provides a framework within which peasant farmers form purposes, feel motivations, pursue intentions, and posit explanations for what they do. Assuming that social action is meaningful and voluntaristic (i.e., negotiated, decisioned) and not merely mechanical, the indigenous agronomy of Pakistani farmers is investigated as a cultural system — a system of symbols and meanings (cf. Schneider 1975). The study does not attempt to either validate or invalidate Punjabi agronomical assumptions and principles, but rather, following the ethnographic applications of cultural analysis (cf. Schneider 1968; Geertz 1973; Marriott and Inden 1977; Silverman 1971; Inden and Nicholas 1977; Varenne 1978), seeks that shared transmitted system of knowledge taken by farmers to represent the "natural" conditions of their lived-in reality. Viewing agronomical knowledge as a system of symbols does not suggest that Punjabi farmers, or any other farmers, are more motivated by the symbolic than the practical. What is suggested is that the farmers' practicality, the hard facts of life, and the business of producing food are, from the analyst's (but not the actor's) point of view, symbolically constituted (cf. Sahlins 1976).

## THE SETTING: CHAKPUR

Chakpur, a village of 1,200 people, is located in Sahiwal District, Punjab. It is one of scores of villages established in the 1930s by British authorities as part of the Sutlej Valley Canal Colony. While the main canal is miles from Chakpur, one of its distribution channels terminates on the village border and presently offers seasonal irrigation to about 300 of the village's 2,600 hectares. Most village land is watered by some two dozen electric- and diesel-powered tubewells installed in the late 1960s. Additional irrigation is offered by animal-powered shallow Persian wells.

The main staples in Chakpur are wheat and rice, and the main cash crops cotton and sugarcane. Surplus grains and cash crops are marketed in nearby mills and processing centers for regional distribution and consumption. One farmer, an absentee landlord owning 120 hactares, markets vegetables for export to the Middle East.

The largest group in Chakpur is the Nunari, with 104 households. The Nunari obtained their land in the original settlement, and while they claim to be descendants of a Rajput chief who converted to Islam some six centuries ago, the Nunari have been farming in the district for at last 100 years (cf. Ibbetson 1974 [1883]:235). More than 60% of the Nunari households own land, with the average holding being 13 hectares and the largest non-joint holding being 77 hectares. With one or two exceptions, the remainder of the Nunari households are dependent on sharecropping and agricultural labor for their livelihood.

Chakpur's second largest group is the Bhatti, with 17 households. Though also claiming to be converted Rajputs, Bhattis include a variety of service groups. Nunari landowners engage other Nunari and Bhatti households in a system of barter called *seipi* in which services provided by contracted share-croppers, carpenters, smiths, porters, barbers, cobblers, etc. are exchanged for traditionally stipulated amounts of harvested produce.

Chakpur is within a short walking distance of a metalled road on which crops are transported to market. Electricity lines from tubewells power a cotton gin, the village mosque loudspeaker, and its one light bulb. In addition, the village supports an elementary school and is served by *hakims* (indigenous physicians) of various levels of training. Most village homes are made of dried mud, but some are of baked brick. No home has either indoor plumbing or a latrine. Several villagers have portable radios, a handful have bicycles, and one has a tractor.

## THE CHAKPURI CONSTRUCTION OF AGRONOMICAL KNOWLEDGE

Chakpuris have very clear ideas about how crops grow and how various inputs and operations are related to that growth. Such ideas were elicited from discussions with many Chakpuris and through formal intensive interviews with the observation of 15 Nunari farmers over a nine-month period. In seeking indigenous agronomical variables, relationships, and principles, Chakpuris were first treated as informants and later as respondents. Farmers were basically asked why they did the particular things they did and what they thought they were doing. Only after a framework for decision making was revealed were farmers subjected to more rigorous and formalized data collection instruments. This is not a method often used by macro-sociologists and economists who rely on survey techniques that a priori formulate specific variables and relationships and then attempt to reconstitute, as it were, the decision making, through the analysis of statistical correlations of the farmers' responses to questions that may or may not have been relevant to the framework used by the farmer in arriving at his decisions.

## *The Agronomical Domain*

In indigenous terms, the process of crop production is a model of and for other naturalistic processes, most popularly that of the human life cycle. The agricultural operations of (1) readying the seed and soil, (2) planting the seed, (3) raising and tending the crop, and (4) harvesting the produce are spoken of as analogs of stages of human life, that is, (1) conception, (2) birth, (3) nurturance and maturation, and (4) death. Similarly, units within both the agricultural and human domains are metaphorically related. Equations are made between seed and sperm, soil and womb *(e.g., bii-zamiin)*, irrigation water and mother's milk, and fertilizer and food. This is carried into the realm of actions, so that anthropomorphized crops and soils may "eat" fertilizer, "drink" water, "struggle", "feel discomfort", and even become "intoxicated".

As with descent in the human domain, species *(nasl)* continuity is "partrilineal" and provided through the seed. While the seeds of a species all strive toward the same nature, individual variation is thought to occur as a direct result of the effects exerted by contact objects (e.g., soil, water, fertilizer) on a particular crop. As human persons are said to develop specific characteristics through the manipulation of diet, residence, and regimen, so too are crops thought to be subject to purposive and directed manipulation. In Chakpur, the characteristics of crops and the dynamics of such manipulation are conceived of in terms drawn from classical and folk humoral theory.

## *Humoral Agronomy*

The humoral system used by Chakpuri farmers derives from Greco-Arabic sources with Persian and Indian influences. In this system, all material objects are composed of varying quantities of earth, air, fire, and water. Associated with these basic elements are qualities or dispositions *(mazaaj)* described in terms of hot *(garm, taa)*, cold *(thand, sard)*, dry *(xushk)*, wet *(tar, gillii)*, and moderate *(mot adil)*. For Chakpuris these categories refer neither to temperature nor to moisture levels. Rather, as articulated by Shah (1966), an allopathic physician trained in indigenous medical traditions, hot and cold respectively refer to the expenditure and conservation of energy and wet and dry to the receptivity and resistance of matter.

In all animate forms, energy and matter are related through the life process. Initially, life (*jaan*) in plants, animals, and humans can only exist if sufficient levels of innate heat and wetness occur. As heat is expended, growth and development occur — matter is transformed from more amorphous and malleable wetter forms to more rigid drier forms. As heat expenditure continues, matter eventually dries, becoming less receptive to further development. Life continues until the store of innate energy is completely expended and matter is no longer animated. Hence, say villagers, though some wetness is necessary if heat is to be expended, wetness generally slows heat expenditure, and if it is in excess may "dampen" it completely. Similarly, dryness may accelerate heat expenditure, and if in excess, may cause "burn out", making further development impossible.

All life forms share the same general process although the time it takes for different species *(nasl)* to complete this process varies (see Figure 1).

Species also vary as to their quantities of innate heat and wetness, as well as with regard to how rapidly heat is deployed and how resistant matter becomes. Those species or "breeds" having relatively great stores of innate heat, or deploying their heat rapidly, are said to be of a hot disposition. Those having relatively limited sources of innate heat, or conserving its deployment, are said to be of a cold disposition. Species exhibiting neither characteristic in the extreme may be said to be relatively moderate. Parallel criteria are said to underlie judgements concerning the relative dryness, wetness, or moderateness of different species with regard to the resistance and receptivity of matter.

The natural disposition and process of development of any living thing can be altered by the heating, cooling, drying, wetting, and moderating effects (*tasiir*) of contact objects, or in the case of crops, agricultural inputs. The proper realization of the species nature of a crop would require such effects to reinforce the disposition of that crop at the appropriate stages of the life processes. Inconsistencies — excessive heating or extreme cooling, for example — may either accelerate or check the progress of a crop's development. Such effects on plant life may be consciously manipulated by human beings to achieve certain desired re sults. For the Chakpuri farmer this is what agronomy is all about. Given a particular crop, Chakpuris choose their inputs in such a way as to accord with its disposition or to deviate from it in diverse goal-directed ways. They also consider the effects of such inputs, and of the crop

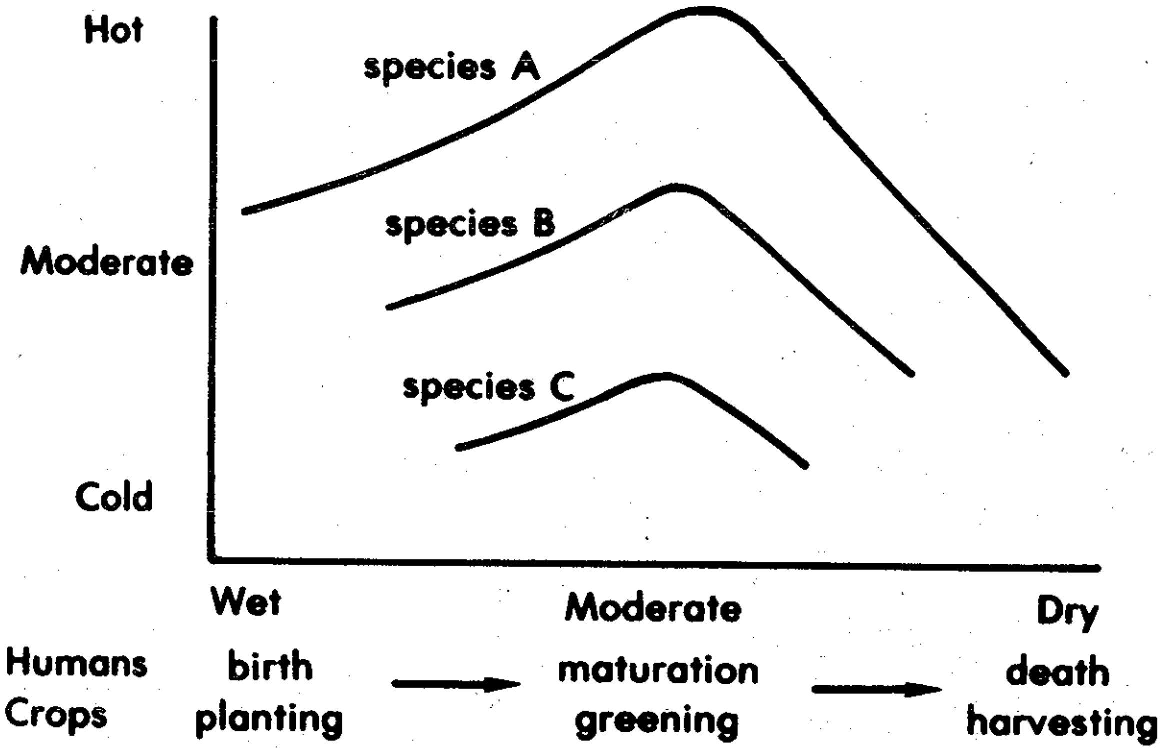


Figure 1. The Life Process in the Humoral System

itself, on the soil. In their considerations, farmers attempt to accurately assess the species nature of the chosen crop seed in order to predict its normal growth, and then undertake those actions which will allow both the crop and the land to attain desired humoral states.

## *Disposition of Crops*

In human beings blood is seen as the primary bodily constituent and its disposition used as an indicator for that of the body. For plants, Chakpuri farmers generally use the exploitable (i.e. edible) portion of a crop as an indicator of its disposition.

The normal dispositions or humoral characteristics of crop species familiar to Chakpuris are given in Table 1. Farmers were asked to judge each crop in terms of both hot-cold and dry-wet properties. Response choices allowed for judgements covering the degree to which a property was thought to be present. Response choices for both scales were scored for each farmer, summed, and then averaged to arrive at a group judgment. These scores were then converted back into ordinal categories consistent with the terminology and procedures of indigenous physicians and pharmacologists. Hence, the disposition of crops are given in terms of grade distinctions for hot-cold and dry-wet properties: the higher the grade the more extreme the characteristic.

Farmers had little difficulty in making judgments about the humoral properties of the 45 crops listed in Table 1. Only less than 5 percent of the time did farmers find themselves unable to make a judgment concerning the hot-cold characteristics of a crop. Inability to judge the dry-wet characteristics was more common, but still well below 10 percent. These findings indicate that the terms of reference — judgment of crops in terms of humoral properties — are indeed meaningful to Chakpuri farmers.

Variation in the judgments of farmers was computed on the basis of scored responses. For 80 percent of the crops the standard deviation indicated a variation in hot-cold and dry-wet attributions of less than one response choice rank. That variation in judging the disposition of crops is quite small indicates that the humoral system is commonly shared among those interviewed and that they may be using the same criteria for assessing the disposition.

**Table 1. Disposition of Crops in Chakpur[a]**

| | | | | | |
|---|---|---|---|---|---|
| *Small grains* | | | Vegetables (cont) | | |
| wheat (HYV) | H2 | D2 | squash | C2 | W2 |
| barley | M | D2 | carrot | C2 | W2 |
| rice (HYV) | M | D1 | turnip | C2 | W2 |
| wheat (traditional) | C2 | W1 | | | |
| rice (traditional) | C2 | W2 | *Feed grains* | | |
| | | | millet | H2 | D3 |
| *Pulses and legumes* | | | corn | H1 | M |
| gram | H2 | D3 | sorghum | M | W3 |
| chana dal | H1 | D3 | | | |
| mang dal | M | D3 | *Grasses* | | |
| | | | fodder(lucern) | H1 | D1 |
| *Fruits* | | | clover | M | M |
| date | H2 | D3 | | | |
| mango | H3 | D2 | *Spices* | | |
| banana | M | W2 | black pepper | H2 | D4 |
| apple | M | W3 | red pepper | H2 | D3 |
| plum | C2 | W1 | turmeric | H1 | D3 |
| orange | C3 | W2 | ginger | H1 | D1 |
| | | | garlic | H1 | D2 |
| *Vegetables* | | | green pepper | M | D2 |
| eggplant | H3 | D3 | mustard | M | M |
| onion | H1 | D1 | coriander | C2 | M |
| spinach | H1 | M | | | |
| potato | H1 | M | *Other* | | |
| tomato | H1 | W1 | tobacco | H2 | D3 |
| peas | M | M | cotton (traditional) | M | D2 |
| okra | M | W1 | cotton (HYV) | M | D2 |
| cauliflower | C1 | W1 | sugar cane (traditional) | M | W1 |
| cabbage | C1 | W1 | henna | C3 | D1 |

[a] Dispositional attributions are based on responses by 15 Chakpuri farmers. Responses were scored on hot-cold (very hot = 5, hot = 4, moderate = 3, cold = 2, very cold = 1) and dry-wet (very dry = 5, dry = 4, moderate = 3, wet = 2, very wet = 1) scales. Nine grade distinctions (following indigenous pharmacological practice) for each scale were made at .44 intervals to re-convert average assessments to dispositions given in the table. H4 is the hottest disposition assigned, followed by H3, H2, H1, M (moderate), C1, C2, C3, and the coldest C4. Similarly, for the dry-wet scale, D4 is the driest disposition and W4 the wetest.

The basis for judgments of crop disposition rests on subjective and objective types of observations. Subjective observations include the way the crop, as a food, affects farmers who eat it. Crops are commonly judged in terms of their effect on bodily humors and attendant human processes of digestion, perspiration, metabolism, and sexuality. In a sense, the farmer's body, and perhaps those of his family, are used as the measuring devices for arriving at attributions of the humoral qualities of the crop.

Chakpuris note that such attributions may be faulty. First, the disposition of a food derived from a crop may be different than that of the harvested produce. Refining, grinding, milling, and cooking operations may all affect the disposition of the crop. Second, human humoral configurations are themselves varied. A food perceived as "cold" by a teenager (who is relatively "hot") may be perceived as "hot" by a septuagenarian (who is relatively "cold"). Although Chakpuri physicians *(hakim)* conventionally grade objects relative to a youthful disposition, farmers note that differences in the human body limit the reliability of its use as a measure of crop disposition.

Farmers tend to put greater stock in the growth pattern of the crop itself as the basis for making humoral attributions. To Chakpuris, a good farmer is one who carefully observes how a crop affects and is affected by its immediate environment. Farmers observe how crops are either adversely or beneficially affected by hot and cold weather, dry spells, rain, and different types of soils and fertilizers. Farmers may note the condition of trees and brush that surround a field and ascertain the types of weeds that may sprout within a cropped plot of land. Chakpuri farmers do not formally record or quantify these objective observations any more than they do their subjective ones. They do, however, specify relevant criteria and formulate generalizations that allow for the interpretation of those observations.

As with subjective assessments, farmers recognize problems in attributions of crop dispositions. The same crop may be differentially judged because its interaction with the environment is perceived at two or more different points along its lifetime. The disposition of a crop as a seedling is different than that when ready for harvest. Second, assessments of a species may not involve comparable units. Subspecies and breeds may vary considerably in their dispositions — as for example HYV and traditional varieties of wheat and rice.

Despite multiple factors that may lead to differential assessment, Chakpuri farmers exhibit general agreement as to the dispositions of various crops. Furthermore, these attributions seem to be relatively consistent with those made for crop foods by Shah (1966) and Awan (1973), authorities on indigenous medicine and pharmacology in Pakistan. The similarities between village attributions and those made by independent professional sources indicate not only the likely systematicity of the humoral framework but also its relatively wide geographic and societal distribution.

## *Disposition of other Inputs*

As with crops, farmers in Chakpur have notions about the hot-cold and dry-wet properties of other inputs. Assessments of the characteristics of those inputs that affect crop growth are commonly made and generally reveal high levels of agreement.

***Soil*** Chakpuris classify soil texture *(zamin)* on the basis of clay-sand content and divide soils into those of clay *(mehraa)*, mixed *(ghusaa)*, and sandy *(retalii)* categories. Numerous distinctions are made by farmers to further specify soil texture. Frequent adjectives prefixed to these category labels include "good" *(changii)*, "weak" *(kamzoor)*, and "powerful" *(taqtii)*. An alternative taxonomy classifies soil texture as either heavy *(bharii)*, medium *(darmiyanii)*, or light *(halkii)*.

The humoral properties of soil are primarily dependent on texture, secondarily dependent on seasonal conditions, and also influenced by contact with crops, irrigation water, and fertilizer. Lighter soils are generally thought to be drier than heavier soils. They are more seasonally variable, so that while the heaviest of soils might stay fairly close to moderate through the year, lighter soils will exhibit extreme variation — becoming cooler in the winter *(haarii)* and hotter in the summer *(saunii)*. The humoral properties as determined by farmer responses (following the procedure described for crops) for the cold season (September to February) are heavy soil, C1D1; medium soil, C3D3; and light soil, C4D4. In the hot season (March to August) the disposition of heavy soil is H1D1, of medium soil, H3D3, and for light soil, H4D4.

Heavier soils are said to be more fertile and possess more "power" — often attributed to moderate wetness. In this view, the land is powerful when it has a great deal of potential energy, but expends that energy in a slow or dampened manner.

***Water*** For Chakpuris, canals, tubewells, shallow wells, and rain provide water for irrigation. Coolness and wetness seem to be equated with heaviness, heat and dryness with the lightness. For Chakpuri farmers, canal and shallow well water tend to be judged as heavier than tubewell and rain water.

As with soils, heaviness is said to be indicative of power and fertility. Farmers explain that canal and shallow well water have a high content of soil, manure, minerals, and organic matter, while rain and tubewell water are light, purer, and cleaner.

Water from various sources is subject to seasonal changes that alter its humoral properties. According to farmers, canal water is MW2 during the summer and C2W3 during the winter. Tubewell water is thought to be relatively cooler (H1D1) during the summer than during the winter (H2D1) because the lower levels of the land are thought to retain the winter's cold. Rainwater is judged to be H1W2 during the hot season and C1D1 during the cold season. The water from shallow wells is accorded the humoral properties MW2 during the summer and C2W3 in the winter.

***Fertilizer*** Bovine manure, a traditional fertilizer, is relatively cool and wet (C1M). Although Chakpuris were not asked about other types of organic fertilizers, there is evidence that other organic fertilizers are also accorded humoral dispositions (cf. Government of India 1904:89).

Chakpuri farmers also use chemical fertilizers and have little trouble in discerning their properties with high levels of agreement. All chemical fertilizers used in Chakpur are thought to be hot and dry. To allow for the verbal judgments of farmers (e.g., "very very hot") and so as to adequately represent the significant differences in the heat and dryness levels for fertilizers apparent to Chakpuris, the hot-cold and dry-wet scales were expanded to include the scoring of responses indicating extreme attributions. Urea, the hottest and driest fertilizer, is judged to be H6D6, ammonium sulphate and super-phosphate, H4D4, nitro-phosphate, H3D4 and DAP H2D2.

## Agronomic Production Concepts

From the indigenous agronomical perspective, sound farming entails choosing inputs that will not create adverse conditions of heat, cold, dryness, or wetness for a given crop. Similarly, such inputs, including cropseed, may be chosen so as not to adversely affect the land on which Nunaris continually depend for their livelihood.

Crops generally require inputs that do not, as farmers say, "fight", "war", or "struggle" *(laRaaii)* with their species nature. Moderately cool crops, for example, should not be exposed to very hot inputs or to extremely cool ones. Rather, say Chakpuris, inputs should either conform to the species nature or deviate from it in relatively moderate ways.

This notion of inconsistency is expressed in anthropomorphic terms by Nunari farmers. Crops and soil may "eat fertilizer" and "drink water", but sometimes they may "not get enough". The fertilizer and water they do receive may cause problems with "digestion" and may still leave the soil and crop "hungry" or "thirsty". A crop may become "intoxicated" *(nashaa)* by a fertilizer, as in the case of being exposed to overly hot chemicals. Crops whose "thirst" is not quenched may remain dry and "unhappy", or may "burn up". Inputs that do not "satisfy" the crop may "confuse" it by creating situations it is "not used to".

Farmers distinguish several types of crop growth situations. "Correct", "balanced", or "moderate" growth is achieved when a crop is exposed to inputs that accord with its species nature. When inputs are much hotter than normal, they spur energy expenditure, creating a situation of "rapid" or "expansive" *hyperactive* growth. When inputs are abnormally cool, limited or *hypoactive* growth results. Chakpuris note that dry inputs tend to accelerate the effects of hot inputs, that is, hyperactivity, while wetter inputs tend to retard their effect.

The pursuit of various types of growth strategies bears on soil fertility. As soil fertility is associated with wetness and coolness, Chakpuri farmers note the importance of choosing inputs that do not excessively dry the land. Soil "tiredness", "weakness", or depletion occurs when inputs excessively dry the soil. Conversely, soil fertility is "strengthened", or enhanced, when inputs increase the wetness of land (but not to such an extreme as to result in waterlogging). Soil fertility is maintained when neither excessive conditions of wetness nor dryness occur. Consistent with the often cited phrase, "whatever is hot will dry out, whatever is cool will stay wet", heat tends to promote soil depletion and coolness tends to retard it.

Concerns for crop output and soil fertility may often be at odds. Crop hyperactivity, if not extreme, may mean both higher yields and soil depletion; crop hypoactivity, smaller yields and soil enhancement. Crucial for Chakpuri farmers is the ability to recognize production interactions of inputs, to choose inputs that accord with goals, and to avoid pathological humoral states that can be harmful to either or both crop and soil.

## *Input Production Relations*

When asked to specify how they produce various crops (i.e., wheat, rice, cotton, sugarcane), Chakpuris include what they take to be relevant inputs and appropriate measures. Planting is described on the basis of area — a *kilaa* (1 acre) or *do kanala* (a 40-yard-square plot). Irrigation water is quantified on the basis of the number of floodings or inundations of a plot of land. Chemical fertilizer usage is described in bags (100 kg) or half-bags, and manure usage in terms of *tralliis* or cart loads (approx 1,400 kg). The amount of time from sowing to harvest is described in months, and yields in *maunds* (37.3 kg).

The disposition of the crop output is taken to be a function of the humoral properties of the different quantities of the various inputs. Crop yield, described in quantitative terms, is said to be a function of this disposition. According to Chakpuris, the disposition of a crop output may be reached in a variety of ways. The way in which the final dispositional state is reached, as well as the state itself, gives an indication of the yield. For example, a humoral state may be achieved by inputs all consistent with the species nature of the crop, or it may be reached through a mix of very extreme inputs that offset or balance each other. Farmers find that certain crops (e.g., wheat) "enjoy" and "prosper" in situations of "comfort" or limited humoral dynamism, while other crops (e.g., tobacco) are better suited to intensive struggle. Hence, yields are thought to vary among particular crop outputs even though they may have the same final or resultant dispositional states.

Soil output, also a function of the production mix, is often described in humoral anthropomorphic terms. Chakpuri farmers do not quantify soil output in any way that would be analogous to crop yield, although soils too are said to experience various types of "struggle".

The interrelationships between inputs and output situations with regard to crop growth and soil fertility are expressed through various "rules of thumb" applied by Chakpuri farmers. In cold season production, Chakpuri farmers note several principles for combining inputs if balanced crop growth and soil fertility are to be preserved:

1. As soil texture becomes lighter, and therefore cooler, a hotter fertilizer input is called for.

2. As soil texture becomes lighter it also becomes drier. Hence an increased (wetter) water input is required.

3. As the fertilizer input becomes hotter and drier, additional increases in water input (cooler and wetter) are needed.

4. More tubewell water than canal or shallow well water is needed if the soil and crop are to be cooled and wetted adequately.

The relationship between variation in the humoral dispositions of inputs and perceived crop and soil output states is illustrated in Figure 2 for the production of winter wheat. Traditional wheat may be optimally produced, according to Nunaris, by sowing it in heavy soil, using manure and canal water. Such is said to assure balanced growth and soil fertility maintenance. Because of a variety of situational factors, Chakpuris sometimes plant in lighter soils. They note that lighter soils will exert cooler and drier effects on the crop than usually preferred. To overcome the effect of the added coolness, farmers indicate the need for relatively hotter fertilizer inputs, that is, to use chemical fertilizers instead of manure. To overcome the effect of the accentuated dryness of both the soil and chemical fertilizer, additional cooler and wetter water is called. Since tubewell water is not as effective a cooling and wetting agent as canal and shallow well water, relatively more floodings are needed if it is to perform its function.

The relationships depicted in Figure 2 have, according to Nunaris, direct bearing on crop and soil outputs. Farmers may choose or be forced into situations of not achieving balanced growth. For example, traditional wheat may be grown in heavy soil with the use of urea. To farmers, it takes only two or three bags of urea (when not offset by an increased water input) to create a situation for hyperactive crop growth. In such a situation, farmers suggested that yield would be quite abundant — greater than in a "balanced" growth situation — but the soil would be depleted of its fertility due to the adverse heat and dryness generated by the chemical fertilizer.

Inversely, lacking chemical fertilizer, a farmer might have to use manure to fertilize his wheat crop in light soil. In such situations, say Chakpuris, the manure will not provide the amount of heat necessary to spur crop growth. Or as several farmers put it, "the sand will completely eat the manure and still be hungry". Hypoactivity is thus expected — yield will be low, but the soil will be enhanced by the effect of the wet manure.

The systematicity of these principles was tested by eliciting the responses of 15 farmers to specific production situations. Farmers were asked to decide what quantities of three types of fertilizer — manure, DAP, and urea — would be appropriate to produce a balanced crop of wheat and maintain soil fertility in heavy, medium, and light soils. Farmers were then asked to judge how many floodings of canal water and tubewell water would be needed for each specified situation. The results, given in Table 2, indicate the means for the various responses.

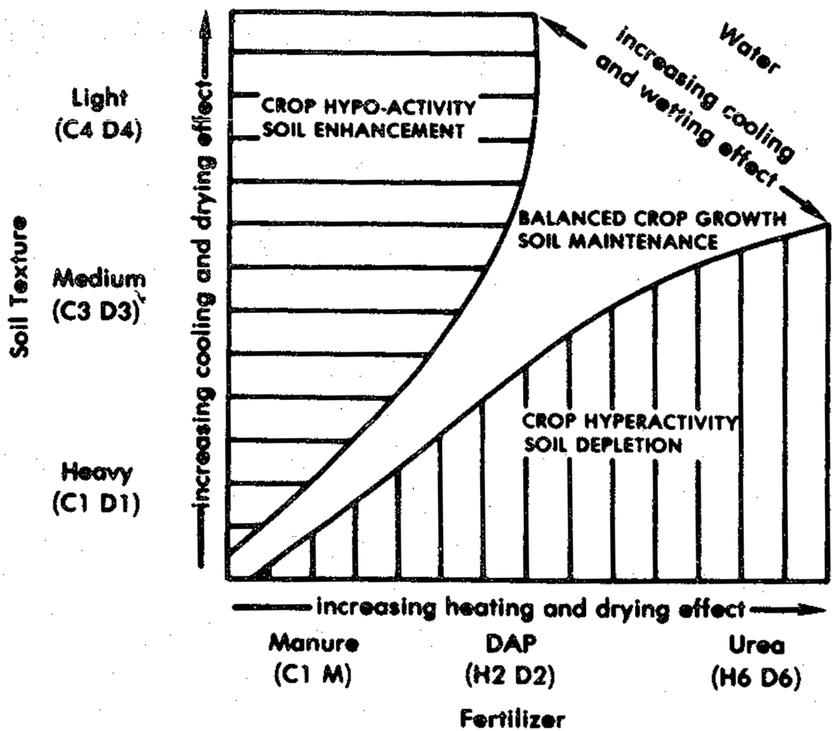


**Figure 2. Winter Wheat Production Based on Chakpuri Heuristics**

**Table 2. Attributed Variation of Inputs for Optimal[a] Production of Traditional Wheat**

| Soil texture | Fertilizer: Type | Fertilizer: Quantity[b] | Floodings by water source: Canal | Floodings by water source: Tubewells |
|---|---|---|---|---|
| | Manure | 7.1 | 3.1 | 4.2 |
| Heavy | DAP | 1.6 | 3.7 | 4.7 |
| | Urea | 1.1 | 4.4 | 5.5 |
| | Manure | 9.3 | 4.9 | 7.9 |
| Medium | DAP | 2.4 | 5.6 | 6.7 |
| | Urea | 1.8 | 6.3 | 7.5 |
| | Manure | 10.1 | 6.8 | 7.9 |
| Light | DAP | 2.9 | 7.5 | 8.5 |
| | Urea | 2.3 | 8.1 | 9.1 |

[a] Optimal is defined in terms of balanced growth and preservation of soil fertility.
[b] Quantities refer to bags of chemical fertilizer or cartloads of manure per acre.

Individual and group attributions concerning production situations accord consistently with explicitly stated principles of humoral agronomic relationships. Since urea is a hotter and drier fertilizer than DAP, somewhat lesser amounts are needed to cause the same humoral effect. Greater amounts of water are seen to be necessary to offset the increasing dryness of soil as it becomes lighter in texture, and the increasing dryness (and heat) of the chemical fertilizer. More tubewell water than canal water is consistently deemed necessary to do this.

The application of these principles is evidenced in actual production situations — that of HYV wheat, for example, which is grown in a wide enough variety of soil textures to allow for comparative analysis. Fifteen plots of land on which HYV wheat was about to be harvested were considered. Details of the production situation were elicited from the farmers of those plots of land, and are indicated in Table 3.

Patterns of humoral relationships seem to hold for actual production situations involving HYV wheat. As soil texture lightens, greater quantities of hotter and drier fertilizers are used. Concomitant with this, water inputs are increased. Although Nunari farm production may tend toward situations of balanced growth and soil fertility maintenance, yield estimates for the different production mixes indicate that for farm ers "too much struggle" is not good for wheat, reducing the quantity of crop output. That is, growing the moderately hot and dry HYV wheat in a

**Table 3. Chakpuri Production Patterns for HYV Wheat**

| Type of soil texture | Number of plots | Number of tubewell floodings | Fertilizer input[a] Manure | DAP | Urea | Estimated[b] yield |
|---|---|---|---|---|---|---|
| Heavy | 5 | 4.8 | 3.4 | 1.6 | 2.0 | 50 |
| Medium | 6 | 5.0 | 1.5 | 1.6 | 2.6 | 30 |
| Light | 4 | 5.5 | 0.0 | 2.0 | 3.0 | 20 |

[a] Quantities refer to bags of chemical fertilizer and cartloads of manure.

[b] Yield was estimated by farmers on the basis of standing crop and is computed in *maunds* per killa.

very dry light soil using extremely dry fertilizer (urea) results in too much struggle for the crop output to be abundant.

Hot season production principles follow those of the cool season save for one major difference. During the hot season soils are hot, not cold, and the lighter the soil texture the hotter the soil. Hence, during the hot season "there is no advantage in using chemical fertilizers on hotter and drier soils". Such use would "burn out" or "exhaust" the soil and, according to farmers, call for inordinate amounts of manure and water in order to temper the soil and preserve its fertility. Thus in the hot season it is unnecessary to apply increasingly hotter and drier fertilizer inputs to increasingly lighter soil. Increased cooler and wetter water inputs for lighter soils would be expected. And if more chemical fertilizer were to be used, even greater amounts of water would be required.

This pattern of relationships is illustrated in the hot season production of rice. Farmers were questioned on the details of their HYV rice production after the rice harvest. The results for various production mixes arranged by soil type are given in Table 4.

In accord with humoral agronomic principles, there is a pattern of increasing water usage as soil texture lightens. Unlike the case for the use of chemical fertilizer and manure with wheat, there does not seem to be a distinct pattern of overall fertilizer usage with rice, nor a correlation of particular fertilizers with soil texture types. Noteworthy, however, is the covariance of urea and manure use, indicating perhaps the attempt to temper hot and dry crop nutriment with cool and wet fertilizer in order to avoid what are perceived as the dangers of "burn out" in hot season soils.

Investigation of cotton and sugarcane production reveals similar patterns of interacting humoral relationships to those specified for wheat and rice production. In questioning farmers about their reason for altering in

**Table 4. Chakpuri Production Patterns for HYV Rice**

| Type of soil texture | Number of plots | Number of tubewell floodings | Fertilizer input[a] Manure | DAP | Urea | Assessed[b] yield |
|---|---|---|---|---|---|---|
| Heavy | 7 | 15 | 3.0 | 0.6 | 0.9 | 58 |
| Medium | 4 | 19 | 4.7 | 0.2 | 1.7 | 37 |
| Light | 2 | 25 | 4.0 | 1.5 | 1.5 | 20 |

[a] quantities refer to bags of chemical fertilizer and cartloads of manure.

[b] Yield was ascertained by farmers upon harvest.

puts the way they do, they are quite explicit about such principles — citing them as obvious, generally known, "natural" conditions of farming.

## HOT AND COLD AGRICULTURE

Traditional wheat and rice are both cooler and wetter than improved high-yielding varieties. Traditionally used manure is cooler and wetter than newer chemical fertilizers. Water from more traditional sources — shallow wells and canals — offers cooler and wetter effects than that from more modern tubewells. Differences between what might be termed the cool-wet and hot-dry forms of agriculture are apparent in the optimal production recipes of traditional and HYV wheat and rice as elicited from Chakpuri farmers. The modal recipes for the production of traditional and improved staples are given in Tables 5 and 6.

Comparison of the production recipes for traditional and HYV staples reveals a cooler and wetter production mix for the former and a hotter and drier mix for the latter. The production of traditional staples tends toward hypoactive growth resulting in lower yields, as farmers readily acknowledge, but such production is also perceived as resulting in the maintenance, and even enhancement, of soil fertility. The production of HYV staples tends toward hyperactivity, allowing for far greater yields, but also soil fertility depletion.

Chakpuris see advantages and disadvantages in both the cool and hot agriculture. The advantages of producing traditional varieties of staples are lack of risk, the soil fertilizing function, and their perceived nutritional values. Cool agriculture is viewed as stable, nondynamic, non-hyperenergized, and in agronomical terms, non-risky. Very little can go

**Table 5. Input-Output Contrasts in the Optimal Production of Traditional and HYV Wheat**

| Feature | Traditional wheat production | | | HYV wheat production | | |
|---|---|---|---|---|---|---|
| Seed | traditional wheat | C2 | W1 | HYV wheat | H2 | D2 |
| Fertilizer | manure | C1 | M | Urea | H6 | D6 |
| | | | | DAP | H2 | D2 |
| Water | Canal water | | | Tubewell water | | |
| | cold months | C2 | W3 | cold months | H2 | D1 |
| | moderate month | C1 | W3 | moderate month | H2 | D1 |
| Soil | heavy soil | | | heavy soil | | |
| | cold months | C2 | W3 | cold months | C1 | D1 |
| | moderate month | M | D1 | moderate month | M | D1 |
| Recipe | 7 cartloads of manure; 3 floodings of canal water; planting in October-November, harvesting in 6 months. | | | 2 bags of urea and DAP; 6 floodings of tubewell water; planting in October-November, harvesting in 5 months. | | |
| Outcome | 32 maunds/kilaa (2,841 kg/ha) soil enhancement/maintenance | | | 50 maunds/kilaa (4,595 kg/ha) soil depletion/maintenance | | |

**Table 6. Input-Output Contrasts in the Optimal Production of Traditional and HYV Rice**

| Feature | Traditional rice production | | | HYV rice production | | |
|---|---|---|---|---|---|---|
| Seed | traditional wheat | C2 | W2 | HYV rice | M | D1 |
| Fertilizer | manure | C1 | M | manure | C1 | M |
| | | | | DAP | H2 | D2 |
| Water | Canal water | | | canal water | | |
| | hot months | M | W2 | hot months | M | W2 |
| | moderate months | C1 | W1 | moderate months | C1 | W1 |
| Soil | heavy soil | | | heavy soil | | |
| | hot months | H1 | D1 | hot months | H1 | D1 |
| | moderate month | M | D1 | moderate month | M | D1 |
| Recipe | 7 cartloads of manure; 15 floodings of canal water; planting in June-July, harvesting in 3 months | | | 7 cartloads of manure; 1 bag of DAP; 17 floodings of canal water; planting in July, harvesting in 2-1/2 months. | | |
| Outcome | 62 maunds/kilaa (5,698 kg/ha) soil enhancement/maintenance | | | 71 maunds/kilaa (6,525 kg/ha) soil depletion/maintenance | | |

wrong, according to Nunaris, in traditional staple production mixes of this type.

The seed and the cool-wet inputs associated with traditional production provide power and strength to the soil, supposedly performing therapeutic functions. In fact, Chakpuri farmers find applications of manure, cooler and wetter seeds, and cool-wet water to be advantageous in nursing back saline soils subjected to the debilitating effects of excessive heat and dryness.

In addition, Chakpuri farmers and their wives argue that traditional wheat and rice are long-lasting energy givers — they are relatively cool and wet — providing nutritional power or strength over long periods of time. Several farmers claimed that in "the old days", they had to partake of only two meals a day, if made from these staples. "Nowadays", several lament, three meals a day are required as the new HYV staples do not have the long-lasting power of the traditional varieties.

Consistent with this view of the humoral properties of food made from traditional and HYV grains, housewives note that the new grains are hard to work with. Dough made from HYV wheat is seen as relatively less malleable (drier) and as requiring more kneading. HYV wheat bread is thought to be more apt to burn when cooking. Additionally, Chakpuris note that bread and rice made from traditional grains do not dry out as fast as that from HYV grains, and hence may be reheated for eating as "leftovers" without adverse effects or loss of taste. Flat breads made from HYV grain are often judged to be incapable of being reheated, and were broken up and commonly fed to birds and other animals on the morning after their preparation. Finally, foods made from traditional grain are commonly said to be tastier than those made from HYV grains.

In contrast to traditional grain production, the use of newer hotter and drier inputs to produce hotter and drier improved wheat and rice involves greater dynamism. Accordingly, Chakpuri farmers claim that HYV grains mature much faster than traditional ones — wheat one month faster, rice about two weeks faster. While the HYV grains are apt to result in greater output in terms of quantity, they are thought to be more risky to produce because of the agronomical potency that goes into their production. There are "more chances of error", according to Chakpuris, as miscalculations in assessing input interactions can result in crop "burn out".

The growing of hotter and drier crops is thought to deplete the soil's fertility. The use of chemical fertilizers is said to provide quick, intensive energy (heat) to the soil, which spurs production, but over the long run may wear out the earth "like a woman who becomes old before her time as a result of having too many children".

In order to prevent such "burn out" as a result of chemical fertilizer "intoxication", Chakpuri farmers speak of and act to temper the fertilizer input. This is done by several means: (1) restricting the use of chemical fertilizer, (2) mixing chemical fertilizer use with manure application, and (3) using additional water. In attempting to temper the effects of chemical fertilizer, farmers face several problems. Large quantities of manure may not be available. Additional water costs money. Even if additional floodings are arranged, more problems may result. For example, Chakpuris say that floodings mean more standing water, and hence more insect pests. In order to combat such insects, farmers must spray with pesticide. But, for Chakpuris, pesticide is accorded an extremely hot and dry disposition: "A can[ister] of pesticide is equal to one bag of urea". Hence crops and land become even hotter and drier as a result of the pesticide input. Therefore, say farmers, it is then necessary to add more water to cool and temper the crop, but this results in greater quantities of standing water and more pests.

Hotter inputs do, however, offer some advantages as Chakpuris see it. The greater yields of HYV wheat and rice offer Nunaris more grain for market as well as for intravillage *seipi* exchanges. Chemical fertilizer opens up lighter cold season soils for cultivation and to some degree can substitute for manure when the latter is in short supply. And tubewell water makes available irrigation to land that otherwise would not have it.

The hot agriculture is more energy and investment intensive, and as one farmer put it, the "new agriculture is like fire", expansive, dynamic, and risky. It is oriented toward hyperactivity and crop output. The cold agriculture is more conservative, both agronomically and economically. It is more stable and more oriented toward soil conservation. There are specific local conditions in Chakpur that would seem to promote such conservatism. Chakpur has a predominance of sandy soils — even those considered heavy are relatively sandy compared to other regions. Chakpuris also are heavily dependent on tubewells for irrigation. Furthermore, Chakpuris continue to have an adequate supply of firewood to fuel their hearths, and hence make full use of bovine manure as a fertilizer. Though they are sensitive to the perceived dangers of the hot agriculture, Nunaris do not see themselves as resisting it. Rather, they view its advantages and disadvantages in the context of their own agronomical framework and seek to exploit what seems to be beneficial. Chemical fertilizers, new HYV seeds, tubewell water, and pesticide are all accorded humoral dispositions, and their generally hot and dry properties provide a means by which they are conceptually accommodated, assessed, and utilized in purposive ways. In Chakpur those ways indicate a temperance of the new by the old, and hot-dry agriculture by the cold-wet agriculture.

Quite importantly for Chakpuris, the temperance involves the offsetting concerns of crop output and soil fertility. The farmers who served as informants in this study were a relatively homogeneous group of small landowners, hence it is not possible to compare how landowners would compare to tenant farmers with regard to the prioritization or means of dealing with these concerns. Similarly, none of the farmers in Chakpur are at just a subsistence level of production, hence the pressures for short-term crop production may not supersede more long-term interest in soil fertility.

## IMPLICATIONS

While farmer production strategies may differ and normative orientations diverge, they do so in terms of a conceptual framework defined in terms of the indigenous agronomy. This cultural system is not predictive in itself, although predictions may be generated in its terms. Farmers may pursue a wide variety of actions that make sense (to them) in terms of the meanings and relationships defined by this system.

Attractive to Indus Basin Project planners aware of this was the idea that attempts at innovation could be designed in concert with the indigenous agronomy to the extent that such innovation required the understanding by and participation of Pakistani peasant farmers. Lacking comparative studies, it is difficult to generalize beyond the Chakpuri data. Yet, given the statements of Pakistani agronomists and another anthropologist associated with the project, the Chakpuri case is not atypical, and served to indicate several ways in which the indigenous agronomy may be utilized for development purposes.

Given the findings, new strains of HYV seeds that are perceived as being cooler and wetter in effect might be expected to have greater adoption rates than those currently available. Similarly, the development of chemical fertilizers that may, in indigenous terms, cool and wet the soil might be expected to have greater and more popular impact than those hot and dry fertilizers currently available, especially for summer crop production. And water resource development might, if the Chakpuri case is any indication, more popularly succeed if tubewell water was perhaps channeled through canals or distys in order to pick up the coolness and wetness that would give it "power". The availability of such powerful water to temper hotter and drier inputs might stimulate the use of both HYV seeds and chemical fertilizers. In short, programs may be rationally developed so as to allow for the promulgation of innovations in a form and substance that accord with the meanings farmers attribute to their activities.

While institutional participation in the master planning process was unlikely for relatively poor illiterate peasant farmers, consideration of their agronomy could at least achieve some level of cognitive participation. Ignoring or dismissing the reality of farmers being planned for does not aid in the formation of decision-making models that attempt to understand agricultural behavior. The economic planners on the project thought it advantageous to take into consideration the information systems of farmers and the terms of their agronomy in order to construct models and programs that account for the motivation, intention, and goal-directed purposes of those involved. In short, the indigenous agronomy offered a framework for the analysis of decision making that could be articulated with other systems bearing on farmer behavior. Predictions about use and marketing patterns of fertilizer in relation to soil type could be made in the terms of the indigenous agronomy. Analyses of market incentives and restraints could be made in relation to production strategies cast in terms of the humoral agriculture.

The use of the humoral agronomy as an indigenous system of knowledge also had consequences for agriculture extension programs. To Chakpuri farmers, extension workers spoke a strange language — the language of Western biochemistry — that was meaningless in the context of the humoral agronomy. Several incidents in Chakpuri indicated that Nunaris thought extension workers and scientists ignorant about the "facts of nature". Chakpuris recognized such persons as powerful, but not necessarily knowledgeable. Perhaps, as has been the case with pharmacology in Pakistan (Said 1969), syntheses of indigenous and exogenous agronomical models are possible. If such is to be the case, extension personnel may be able to better communicate if they know the language of the farmers, understand his agronomy, listen, and disseminate knowledge in its terms.

Finally, cultural anthropology has a role to play in such efforts by investigating systems of meaning — such as the Chakpuri agronomy — that bear on development issues. The analysis of such cultural *systems as systems of symbols and meanings* would appear to be a particular contribution of the anthropologist, one that would not normally be made by any other social scientist. Such investigations, unlike perhaps those made by natural or applied scientists, are not made for the purposes of either validating or invalidating indigenous knowledge systems. Rather, the cultural anthropologist aims at elucidating the shared understandings by which members of a society act. Anthropologists have been relatively successful in doing this for systems of ritual (e.g., Turner 1969), mythology (e.g., Lévi-Strauss 1969), kinship (e.g., Schneider 1968), and state drama (e.g., Geertz 1981). In this case, such an attempt is directed toward understanding the cultural construction of the more mundane but no less symbolic domain of agronomy. That agricultural activities are symbolically constituted does not rule out economic, political, demographic, and other forms of analysis; to the contrary, it requires them, for a cultural understanding of any phenomenon is not the only goal of its investigation. Yet it is a unique form of analysis that cultural anthropologists have to offer, and it is one that concerns how action makes sense to those who engage in it — whether that action be worshipping a spirit or growing a plant. An anthropology of development that reduced "culture" to the mechanical reflection of "actual", "real", or "practical" behavior does so at the risk of both promulgating ethnocentrism and denying one of the more important concepts that anthropology can uniquely claim as its own.

# NOTES

1. Pakistan's population grew from 47 million in 1961, to 62 million in 1971, to an estimated 84 million in 1981, representing average annual increases of approximately 3.2%. At the same time, loss of surface water due to the Indus Waters treaty accounted for 32 thousand million $m^3$ or about 16% of Pakistan's available surface supply. Average rainfall is mainly in the 100-600-mm range in the Basin, and offers an undependable irrigation supply. In addition, fully 46% of canal command area suffers the effects of salinity (cf. Johnson 1979: 14, 53, 75, 88; Government of Pakistan 1978:5).

2. Prior to the green revolution era Pakistan's outlays for agricultural development were relatively small, representing 6% to 7% of the budgets of the six-year (1950-56) plan and the first five-year plan (1955-60). The proportion of funds for agriculture doubled in the second (1960-65) and third (1965-70) five-year plans. Expenditures for infrastructural development — water, power, transportation, and communication — have remained relatively high at between 35% and 45% of budget. While total funds for agricultural and infrastructural development continued to increase in absolute amounts through the 1970s, the percentage of funds devoted to agriculture had declined to between 8% and 10% by the end of the decade (cf. Johnson 1979: 42-45; Akhtar 1976:326-342).

3. The emphasis in agricultural development expenditures has been on government subsidies for the use of modern innovations, particularly chemical fertilizer. In 1976, for example, subsidies for the purchase of chemical fertilizer accounted for almost half of an agricultural budget of 770 million rupees. Almost 23% was budgeted for plant protection and 7% to storage facilities. Less than 4% was devoted to research and less than 3% to enhance agricultural credit funds. Seed development is included in the research budget and tubewell subsidies in the water budget. Funding for agricultural extension activities was miniscule (cf. Akhtar 1976:335-342).

4. Advances from 1965-66 to 1972-73 in the adoption of HYV seeds, use of fertilizer, and overall productivity of staples were much more dramatic than in the ensuing seven-year period. Quite revealing is the lack of change in the yield of HYV crops themselves since the mid-1960s. Average yields of HYV rice (at 1.950 kg/ha) and HYV wheat (at 1,650

kg/ha) have remained relatively stable since they were first introduced (cf. Government of Pakistan 1978, 1972).

5. In Pakistan most writers on the humoral system regard Ibn Cinna (Avicenna) as its master, and his book, the Qanoon [Canon] of Medicine, as its text. Both English (e.g. Shah 1966) and Urdu (e.g. Qarshi 1974) commentaries refer to Roman (Galenic) and Greek (Hippocratic, Ionian) sources. There are linkages with Ayurvedic systems of medical diagnosis and pharmacological treatment (cf. Said 1969; Leslie 1976). The non-medical application of humoral theory in south Asia is evidenced in the fields of magic, astrology and exorcism (Shurreef 1973), metallurgy (Mahdihassan 1976), and political sociology (Fazl 1975). Further afield, humoral theory was applied to architecture by Persians (cf. Ardalan 1973) and to anthropology by Europeans (cf. Kant 1974). Foster (1967) and others have reported its use in Latin America, and atomized vestiges continue in American folk usage.

6. Pakistani and Western physicians have suggested various correlates of humoral properties in terms of Western biology, chemistry, and physics. In one view, heat is regarded as a substance, akin to the medieval European notion of calorie. Of ten allopathically trained physicians in Karachi, six identified cholesterol as the heat substance, and two suggested a form of distilled semen. Other general views associate hot with protein, wet with the presence of fats and oils, dry with their absence, and cold with citrus fruits and green vegetables. Siddiqui (1969) associates nitrogen-based alkaloids with heat and dryness, sulphur compounds with heat and carboxyls, and terpanics with coolness. The interpretation adopted here is more consistent with Chakpuri discourse and is closer perhaps to notions of energy and matter in Western physics. As such, the calorie, as a unit of energy expenditure, is also somewhat associated with heat levels in the humoral system.

Humoral properties are not generally associated with temperature. An ice cube, for example, is commonly said to be hot. Nor should humoral heat be confused with the "heat" of spiciness. The hot spices used as a popular seasoning mixture in south Asian cuisine are considered hot because of their humoral properties, not because of the spiciness.

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# I.2

# NOTES ON THE EXPERIENCE OF DROUGHT PERCEPTION, RECOLLECTION AND PREDICTIONS

**L.P. Bharara**

The incidence of drought in arid and semi-arid regions has received attention from various angles. Generally, it has been studied as a natural calamity creating economic, social and physical disturbances, and the major topics have been its definition, its causes and effects, and the advantages and disadvantages of various relief measures and policies. The present study seeks to add a dimension to these studies, in a form that may be characterized briefly as a contribution to the ethnoscience of droughts. This chapter investigates the memory of drought over a period extending back to the limits of living memory in selected villages in western Rajasthan. An attempt is made to add to our understanding of how memory works in a cultural system which includes the synoptic perception of past droughts as all-encompassing phenomena — a perception on which is based the expectation and prediction of droughts to come. The material takes on additional significance from the changing context of drought, in consequence of population growth, technological development, and economic and social change.

It is easy to forget that the categorization of phenomena as, for example, climatic, biological and social, though convenient and useful, is an arbitrary product of a particular intellectual tradition. In some social situations, such as Rajasthan village communities in western Rajasthan, where these compartmentalizations of knowledge are not so automatically made, drought is not simply the dearth of rain (though everyone knows that rain would remove it) — it is the total quality of life, including, besides weather, animal behaviour and social relations.

The material presented in this chapter shows drought as a pathological condition that recurrently afflicts rural society in western Rajasthan. It represents memory as the *ad hoc* ordering of recollections and their common sense rationalization in the form of sayings. The value of this material should not require explanation; it is a key to understand the coping mechanisms and potential reactions of a rural population, which (despite certain distinctive aspects of Indian society) must be to some extent representative of a large proportion of the population of the world's drylands, to the droughts which are often harbingers of the severer and longer term process of desertification.

## RECOLLECTION

The correlation between the farmers' recollection of past harvests and the record of actual rainfall in western Rajasthan is very close. Living memory of the nature of previous years extended as far back as 1899 with substantial agreement. Each year was remembered in terms of *zamana*, a unit of measurement mainly for the kharif harvest. Full *zamana* is the level of production expected, given sufficient water. The classification of the years from 1899 to 1978 is given in terms of remembered *zamana* in Tables 1a and 1b. (Informants actually talked in terms of *annas* — the old one-sixteenth division of the rupee. Annas have been translated into percentages for convenience.) Out of 80 years 58 were perceived as drought or severe drought (up to 25% zamana); five were mild drought (25-50% zamana); five were average (50-75% zamana); and twelve were good or surplus years (75-100% zamana or more). Each decade witnessed from six to nine severe drought years, from one to three good years, and hardly one average or "normal" year. It is worth noting that the high average rainfall for years of severe drought in Table 1b shows that zamana correlates not with amount of rainfall alone but with a combination of amount, timing and intensity. In this connection it is worth remembering that we have no direct record of one particularly significant indicator of a bad year — the extent of damage from flooding.

Recollection did of course vary. Generally, food producers — farmers and pastoralists — scored better than members of non-food-producing caste groups, though no significant variation was evident in relation to mild drought or "average" years. Much of the variation altogether arose from factors such an uneven spatial distribution of rainfall, land holdings, fallow, and herds.

The basis of the memory of drought years can be related to various factors. Earlier disastrous years — 1812-13, 1868-69, 1877-78, 1791-

**Table 1a. Correlation of Rainfall Records and Recollection of Zamana: By Year**

| | *Rainfall Data* | |
|---|---|---|
| Year | Rainfall (mm) at nearest recording station | Zamana(%) |
| 1899 | — | 0 |
| 1900 | — | 100 |
| 1901 | 205.99 | 0 |
| 1902 | 193.50 | 0 |
| 1903 | 461.36 | 20 |
| 1904 | 331.00 | 20 |
| 1905 | 79.50 | 0 |
| 1906 | 274.83 | 20 |
| 1907 | 443.50 | 20 |
| 1908 | 644.00 | 100 |
| 1909 | 504.00 | 60 |
| 1910 | 339.85 | 20 |
| 1911 | 230.83 | 20 |
| 1912 | 307.85 | 75 |
| 1913 | 131.32 | 10 |
| 1914 | 243.33 | 10 |
| 1915 | 322.83 | 10 |
| 1916 | 462.30 | 100 |
| 1917 | 806.50 | 0 |
| 1918 | 62.99 | 0 |
| 1919 | 236.70 | 10 |
| 1920 | 172.97 | 25 |
| 1921 | 191.30 | 50 |
| 1922 | 313.70 | 10 |
| 1923 | 399.30 | 25 |
| 1924 | 198.37 | 25 |
| 1925 | 177.55 | 0 |
| 1926 | 304.80 | 100 |
| 1927 | 323.90 | 10 |
| 1928 | 468.90 | 0 |
| 1929 | 426.50 | 50 |
| 1930 | 327.90 | 0 |
| 1931 | 246.88 | 25 |
| 1932 | 180.34 | 10 |
| 1933 | 403.35 | 100 |
| 1934 | 377.90 | 0 |
| 1935 | 229.62 | 0 |
| 1936 | 304.40 | 0 |
| 1937 | 334.80 | 0 |
| 1938 | 165.86 | 0 |
| 1939 | 111.76 | 0 |
| 1940 | 454.10 | 100 |
| 1941 | 150.60 | 0 |
| 1942 | 514.30 | 100 |
| 1943 | 278.13 | 50 |
| 1944 | 382.80 | 25 |
| 1945 | 345.44 | 25 |

**Table 1a. (Continued) Correlation of Rainfall Records and Recollection of Zamana: By Year**

| | *Rainfall Data* | |
|---|---|---|
| Year | Rainfall (mm) at nearest recording station | Zamana(%) |
| 1946 | 209.30 | 25 |
| 1947 | 343.10 | 40 |
| 1948 | 86.81 | 0 |
| 1949 | 336.80 | 20 |
| 1950 | 429.77 | 100 |
| 1951 | 140.21 | 0 |
| 1952 | 135.38 | 0 |
| 1953 | 813.05 | 100 |
| 1954 | 276.35 | 0 |
| 1955 | 382.02 | 25 |
| 1956 | 382.78 | 75 |
| 1957 | 285.24 | 0 |
| 1958 | 522.70 | 100 |
| 1959 | 324.60 | 0 |
| 1960 | 175.20 | 0 |
| 1961 | 297.00 | 100 |
| 1962 | 342.70 | 10 |
| 1963 | 585.60 | 0 |
| 1964 | 586.10 | 25 |
| 1965 | 235.50 | 10 |
| 1966 | 147.50 | 10 |
| 1967 | 352.00 | 75 |
| 1968 | 285.50 | 0 |
| 1969 | 182.80 | 0 |
| 1970 | 571.20 | 100 |
| 1971 | 466.50 | 25 |
| 1972 | 331.10 | 0 |
| 1973 | 661.50 | 55 |
| 1974 | 295.00 | 0 |
| 1975 | 695.00 | 25 |
| 1976 | 438.00 | 10 |
| 1977 | 436.00 | 10 |
| 1978 | 367.54 | 50 |

**Table 1b Correlation of Rainfall Records and Recollection of Zamana: By Percent Zamana**

| % zamana | Mean annual rainfall(mm) (at nearest station) | Mean zamana | Years |
|---|---|---|---|
| 0% (severe drought) | 248.50 | 0% | 1899; 1901, 0 5; 1 917, 1 8; \1925, 28; 1930, 34, 35, 36, 37, 38, 39; 1941, 48; 1951, 52, 54, 57, 59; 1960, 63, 68, 69,; 1972, 74. |
| 0-25% (drought) | 298.66 | 18% | 1902, 0 3, 0 4, 06, 07; 1 910, 11, 13, 14, 15, 19; 1920, 22, 23, 24, 27; 1931, 32; 1944, 45, 46, 49; 1955; 1962, 64, 65; 1971, 75, 76, 77. |
| 25-50% (mild drought) | 353.82 | 48% | 1921, 29; 1943, 47; 1978. |
| 50-75% (average) | 441.62 | 65% | 1909; 1912; 1956; 1967; 1973. |
| 75-100% (good) | 515.20 | 100% | 1900, 08; 1 916; 1 926; 1 933; 1940, 42; 1950, 53, 58; 1961; 1970. |
| Overall mean | 371.56 | 46% | 1899-1978 (80 years) |

92 — were cited by a few old men on the basis of inherited information. Some severe droughts and famines, like 1899, 1901, 1918, 1959, 1960, 1968 and 1969 were remembered with accuracy due to reinforcement or feedback from documentation of migration, mortality, desertion of villages, or scarcity of grain, water, and fodder in sources such as the Rajputana gazetteers and State Administration and Famine Commission Reports. There was also a clear folk memory of good years in 1900, 1908, 1916, 1926, 1933, 1940, 1942, 1950, 1953, 1958, 1961 and 1970. For example, everyone knew that in 1940 the rains had continued till the month of Asoj (September-October) and the moth harvest had excelled all records; that a record bajra crop had been recorded in 1961; and that in 1921 the bajra crop had spoiled as a result of additional late rainfall but moth (Phaseolus aconitifolius) production had excelled.

There was an overall tendency to exaggerate the severity of the droughts as they receded into the past, especially on the part of food-producers. Moreover, earlier droughts were associated with not only less rainfall, but more intense storms, more soil erosion, shifting dunes, more crop losses, migration, livestock mortality, desertion of villages, as well as the lack of motorized transport, drinking water, and drought-resistant crop variations. On the other hand, there was a general awareness that population levels were lower, that there was less crop disease, that joint households were more cohesive and resistant to centrifugal forces, that vegetation was denser, and that land was more often fallowed, so that the effects of droughts were not so immediately disastrous, despite their intensity, because of the greater margin between exploitation levels and carrying capacity, and possibly also because of greater social cohesiveness.

Discussion of the causes of drought in Rajasthan ranges over a variety of factors from climatic and biophysical to social and religious. Although most informants related the occurrence of drought primarily to physical factors such as changes in wind direction, cloud cover, frequency and intensity of storms, and the overall quality of cold and hot seasons, many emphasized the role of bio-physical factors such as decline in forest and vegetation cover, increased wind erosion and shifting dunes, and silting of village ponds. There was a general consciousness that human activities lay behind these natural factors, particularly indiscriminate cutting for fuel and construction, over-grazing and lopping of trees for fodder, but considerable emphasis was also given to supernatural and moral factors such as luck, apathy, immorality and revenge of nature.

In discussion of the effects of drought most people first cited economic disorder, failure of crops, loss of livestock, reduction in the value of assets, and forced sale. But there was only slightly less emphasis on social disorder, migration, the failure of institutions, disintegration of social groups and of households.

Drought continues to be seen as a form of instability or disorder in both the natural and the moral world. But the context of instability has changed. Pastoralists may migrate long distances in search of land for grazing in a drought year and, although earlier there was enough vacant territory to absorb them, now farmers complain that they not only exhaust limited water and grass resources, but also destroy the standing crops, disrupt soil conservation measures and create conflict.

The problems caused by the instability have become more complex, not only because of the increased density of the population but because of recent socio-economic changes (see also Malhotra and Mann 1982). For example, symbiosis of food-producing and occupational caste groups has been disturbed. Members of occupational castes such as potters, leather-workers, oil-pressers, and retailers, have now acquired land and become partially dependent on cultivation, and have thus lost flexibility. While individual craftsmen may have gained flexibility through economic diversification, in many cases the crafts have gone into decline. Joint households have broken down into nuclear households causing greater pressure on scarce resources by division and fragmentation of property. Participation in social events has narrowed from the community at large to the smaller extended kinship group. There has been general decrease in family solidarity and increase in conflict, tension and insecurity. During the drought of 1968-69 people sold land, livestock, ornaments, houses and household articles, and the *jajmani* or *aat* system of payment in kind or cash between caste groups for services rendered was disrupted, with the result that the existing trend of socio-economic change was accelerated.

As the social and economic context of drought has changed, so has its meaning. The change in meaning is more difficult to reconstruct. But it is worth noticing that many biophysical effects reported from recent droughts derive from the responses of the weaker segments of the population. For example, particular trees and shrubs (khejri — *Prosopis cineraria* — for fuel, *phog* — *Calligonum pologonoides* — for charcoal, *banwarli* for tanning, *kumbat* for churns) were cut and sold in larger quantities.

Although the context of the experience and recollection of drought has been changing, the drought lore presented in the next section may not be changing in the same way. It is likely, however, that its use is changing. By analogy with equivalent processes elsewhere it might be expected that this lore will gradually be regulated to the epistemological status of superstition, but (as we also know from elsewhere) such a change in the form of knowledge does not prove a change in the manner of thinking. The study of this type of thinking can be expected to lead to a better understanding of non-scientific thought generally

## PREDICTION

Prediction of the nature of the coming year is considered a traditional skill. Its origin is traced to the thirteenth century, the time of the Rajput seer (*pir*) Harbuji Sankhla, who was Jagirdar of a village in Phalodi tehsil in central Rajasthan. Harbuji Sankhla is said to have observed birds and animals — which implies that they were assumed to be in some way closer to the physical processes of nature — in order to find ways of predicting droughts. Because of his success the skill to predict became the monopoly of the Rajput caste, some of whom cultivated it in each generation. The predictor was considered to be divinely guided. From the day of conception a Rajput mother would make the pious intent to rear her child as a predictor. Throughout pregnancy, each day she would put water in a pitcher by a tree where particular birds could drink from it. On birth a male child's first drink was taken from that pitcher. If the child survived, he was believed to command the language of the local birds and animals and became a *sugni*, an omen seer or predictor.

With the social change of the last few decades the cast monopoly of drought prediction has dissolved. Now the lore concerning drought prediction is a matter of general discussion and effort. It is based on observation of simple qualitative changes in climate and vegetation and behaviour. Arguments from Western science have no apparent impact on it. In the form of a collection of sayings it is widely used as a guide for the coming year. These sayings constitute a type of ethnographic material that lends itself to structural analysis. Here, however, the aim is simply to demonstrate their function in rationalizing a holistically perceived reality. Reality and recollection have been correlated above in relation to precipitation figures. Here the question of reliability is ignored and the focus is directed instead to the synoptic nature of common-sense rationalization.

## Winds

(i) *Savan men suryo cale, bhadurve purvai*
*asoj men pichvaha cale, bhar bhar gara layi.*
If the northwestern wind blows in Savan, the eastern wind blows in Bhadun, or the western wind in Asoj, they bring carts full of grain.
(ii) *Jad bahe hada hava kun*
*banjara lade lun.*
When the southwestern wind blows, the Banjaras load salt.
(iii) *Nada tankan balad bikavan*
*tu mat cale adha savan.*
O eastern wind, who cause people to hand up the rope that fastens the yoke and to sell the ox, don't blow up to mid Savan.
(iv) *Jeth biti pehli parva, kathak ambar haren*
*asad savan khet sukho, bhadar huve birkha kare.*
Thunder on the first day after the end of Jeth means two dry months and no rain before Bhadun.

## Stars

(v) *Diva biti pancmi, som, sukar, guru mul*
*dank kahe he bhadali, nipaje satun tul.*

On the fifth lunar day after the Divali holiday, if mul (an astrological position of the moon) falls on Monday, Thursday or Friday, then the Brahmin says all the seven grains will grow.
(vi) *Sudi asad men budh ko uday bhayo jo peth*
*sukra ast savan rahe maha kal ava rekh.*
If Mercury is seen rising in the bright half of the lunar month of Asad, or if Venue is sinking in Savan, a great famine will occur.
(vii) *Jeth badi dasami divas je saniscar hoy*
*pani hoy no dharan men birala jiven koy.*
If Saturday falls on the tenth day of the dark half of Jeth, there will be no water on the earth and only a few people will remain alive.

## *Clouds*

(viii) *Titar pankhi badali, bidhava kajal rekh*
*a barase a ghar kare, in men min no mekh.*
Clouds with wings like a partridge, and a widow with kohl in her eyes, bring rain, without doubt.
(ix) *Savan surangi khejri, kati biranga khet*
*savan birangi khejri, kati suranga khet.*
If the Khejri is colourful in Savan, the fields are colourless in Kati. If the Khejri is colourless in Savan, the fields will be colourful in Kati.

## *Animal Behaviour*

(x) *Din mensyal sabad jo kare*
*niscay hi kal halahal pade.*
When the jackal howls during the day, a great famine is certain.
(xi) *Agam sujai sandani duade thalan apar*
*pag patake baise nahin, jad menhavan har.*
The she-camel knows beforehand and runs to and fro. She stamps her feet and will not sit when rain comes.
(xii) *Cidi nahave dhul men, to pani ave jal men nahave cidakali, to pani jave.*
When the sparrow bathes in the dust the rain will come, when the sparrow bathes in the water the rain will go.

## *Social Relations*

(xiii) *Akhatij duj ki ren je acanak jace sen*
*kacak bic mange nath jay to janije kal subhay*

*hans kar dey nate nahin koy, mane sahi jamano hoy.*
The night before the Akhatij festival in March, if one should go suddenly to a friend's house and ask for something and it is refused, there will be famine. If he gives gladly the year will be good.
(xiv) *Pag pungal, sar merta, udraj bikaner*
*bhulo cuko jodhpur, thavo jaisalmer.*
Feet in Pungol, head in Merta, stomach in Bikaner. Famine may move to Jodhpur, stay in Jaisalmer

This small collection of sayings illustrates a concern with rationalization of out-of-the-ordinary events or coincidences such as wind direction, thunder, astrological coincidence, cloud formation, animal and bird behaviour and social relations, as well as the symbolization of drought in the intensification of the salt trade, empty grain carts, idle yokes, the sale of animals, and social monstrosities such as a painted widow, and finally personalization and personification of famine sprawled across the drought-prone region. In discussion the same informants cited many more examples of similar ideas, some of which are well known cultural preoccupations such as astrological coincidence, others the occupational concern of farmers such as unseasonal natural phenomena. The overall context is defined by an example that gives a perspective beyond the prospect of the immediate year: 7 famines (*kal*), 27 good years (*zamana*), 63 poor years (*kara kaca*), and 3 disastrous year (*ghisan*) — which fits very closely with the table of actual years.

This material is of course the type that is usually classified as superstition and although every effort was made to collect it from what was generally acceptable across the spectrum of caste, age, and sex differentiation in the communities studied, this sample can realistically be claimed only as characteristic, rather than representative. It is nevertheless important because it demonstrates the ways of thinking which may be assumed to be closely related to the behaviour patterns which programmes of ecological management and economic development set out to change — often unsuccessfully.

Much of the material — though not all — also falls under the heading of common sense (cf. Geertz 1975). It appears to derive from ad hoc rationalization which generates rules of thumb, and though arbitrary from the point of view of scientific argument, is self-perpetuating. It is important to note that it is also functional, in the sense that it goes towards satisfying the need for order. It serves to order experience and guide expectation. Science can never adequately satisfy that need at the level of everyday thought — there is too much that science does not adequately explain, and many of its explanations are beyond the grasp of people other than professional scientists. Faith in science and in technology, which is spreading and increasing, tends to take over from this type of common sense rationalization, often by discrediting it before replacing it. To the extent that the ordinary man has a limited grasp of scientific explanation he probably suffers some anomie as a result of this reduction or weakening of order caused by the spread of science. But judging from Western experience, faith in science and technology never entirely supplants this common sense or entirely changes this way of thinking. Insofar as this way of thinking survives, it deserves more serious and more intensive study.

# NOTES

1. The data derive from studies carried out in 1977 in selected villages in central Rajasthan, including two pastoral villages, Rohini and Bhojas in Nagaur tehsil (district), and a dry farming village, Rohina in Joyal tehsil, Nagaur district, besides various villages of Jodhpur district, specifically of Shergarh tehsil, which were covered in the process of routine socio-economic surveys. All of these may be considered typical Rajasthan "desert villages". Fieldwork consisted of participant observation, intensive interviews and a field schedule containing open-ended as well as fixed response questioning relating to social status, household composition, perception, memory and prediction of drought and its accompaniments. In addition, data on oral tradition, values, and beliefs were collected through informal and often group interviews. All the households of the selected villages were stratified on the basis of caste and from each caste stratum about 10% of the households were selected for intensive interviewing by a method of simple random sampling. Empirical investigations of drought prediction were made in Rohini and then supplemented with data collected from other villages. Here the sample included heads of households belonging to representatives of subcaste communities. The age range of sample heads of households included young (15-34 years), middle aged (35-54) and aged (55 upwards), all of whom had experienced frequent droughts in the area. In this type of sampling (sometimes referred to as "availability" sampling), which may be the only practical method of obtaining respondents, the investigator attempted to relate as many cases as possible to questions of theoretical interests.

2. Local and equivalent English months are:

| *Hindi lunar months* (with selected variants) | *English calender* |
|---|---|
| 1. *Chetra* | March-April |
| 2. *Baisakh* | April-May |
| 3. *Jyestha, Jeth* | May-June |
| 4. *Asadh* | June-July |
| 5. *Shravan, Savan* | July-August |
| 6. *Bhadrapad, Bhadun* | August-September |
| 7. *Asoj* | September-October |
| 8. *Kartik, Kati* | October-November |

| | |
|---|---|
| 9. *Mighsar* | November-December |
| 10. *Pos* | December-January |
| 11. *Magh* | January-February |
| 12. *Phalgun* | February-March |

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# I.3

# PERCEPTION OF AND AGRICULTURAL ADJUSTMENT TO FLOODS IN JAMUNA FLOODPLAIN, BANGLADESH[1]

Bimal Kanti Paul

## INTRODUCTION

Annual flooding in Bangladesh plays an important role in the agriculture of the country. A number of crops grown in the monsoon period, particularly rice and jute, cannot flourish without flood water. It supplies the moisture and fertility (silt) to the soil that are vital to crop production. Over the ages, the farmers of Bangladesh have successfully adapted their life-styles and agriculture to the annual floodings that commence and recede in due time and attain normal height. Any major fluctuation of floods with regard to timing, duration, and magnitude causes widespread damage to crops and properties and sometimes to animal and human lives. The agriculture of Bangladesh is, thus, both flood-dependent and flood-vulnerable.

A government report published by the Bangladesh Bureau of Statistics (1978) showed that over the previous 16-year period (1962-1977) floods caused an average annual loss of rice production of 427,000 tons. Bangladesh, a food-deficient country that has to import 1.5 million tons of food every year (Islam 1981), cannot sustain this recurrent loss. As a result, flood and flood control have become crucial issues in Bangladesh. Over the last three decades, the government has undertaken varied projects to prevent flood damages such as the construction of embankments and dams and the improvement of river channels by dredging. These government projects, however, deal with the problem of flood and flood control at the public level; no attention is paid to what has happened, what is happening, or what will happen at the private level. To date, only two empirical studies (Islam 1980; Ralph 1975) have been undertaken in Bangladesh on this aspect by individual initiatives. In order to better assess the complex problem of flood and flood control in

Bangladesh, more attention needs to be given to the individual, especially when the level of national flood damages remains enormous in the face of public expenditure for flood control (Islam 1980). Moreover, an understanding of how individuals have adapted to and are affected by floods may suggest new and less costly ways of reducing flood damages.

This study is an attempt to develop flood hazard research in Bangladesh. It focuses on farmers inhabiting the Jamuna floodplain in Bangladesh, particularly their perceptions of and agricultural adjustments to floods. Before dealing with the findings of the research, the study outlines briefly the cropping season of the study villages as an aid to understanding the relationship between crop and flood.

## METHODOLOGY

Four adjacent villages — Pao Kolaha, Kutubpur, Bahadipur, and Pakutia (West) — in the Jamuna floodplain of Ghatail thana (smallest administrative unit in Bangladesh), Tangail district (second largest administrative unit), were selected for the present study (Figure 1). The villages together have 733 households with a total population of 4250 in 1978. Jhinai, a small river, forms thé north and western boundary of the villages, and the nearest large river, Jamuna, flows 12 miles west of the study area. The occurrence and severity of floods in the study villages usually depend on the extent of the rise of water level in the river Jamuna. Due to their distant location from the major river and the relatively moderate local relief, the study villages are subject to moderate annual flooding and thus form part of a medium hazard zone.

Two important considerations led to the selection of the study area. First, the author, native to the locality, has considerable knowledge of floods in the area. Second, the study area was selected from a medium flood-hazard zone because there has been no systematic study of farmer's perception and range of adjustments to floods in such a zone. Empirical studies done in Bangladesh in the tradition of natural hazards research developed by Burton, Kates, and White (see Parker and Harding 1979) were based mainly on sample villages located in the high hazard zone. Islam and Khan (1974) and Ralph (1975) suggested the necessity of looking at a number of villages subject to a range of flood experiences. This kind of study, they observed, would present a clearer idea of the range of flood perception and adjustment, therefore providing a better basis for understanding the flood problem in Bangladesh.

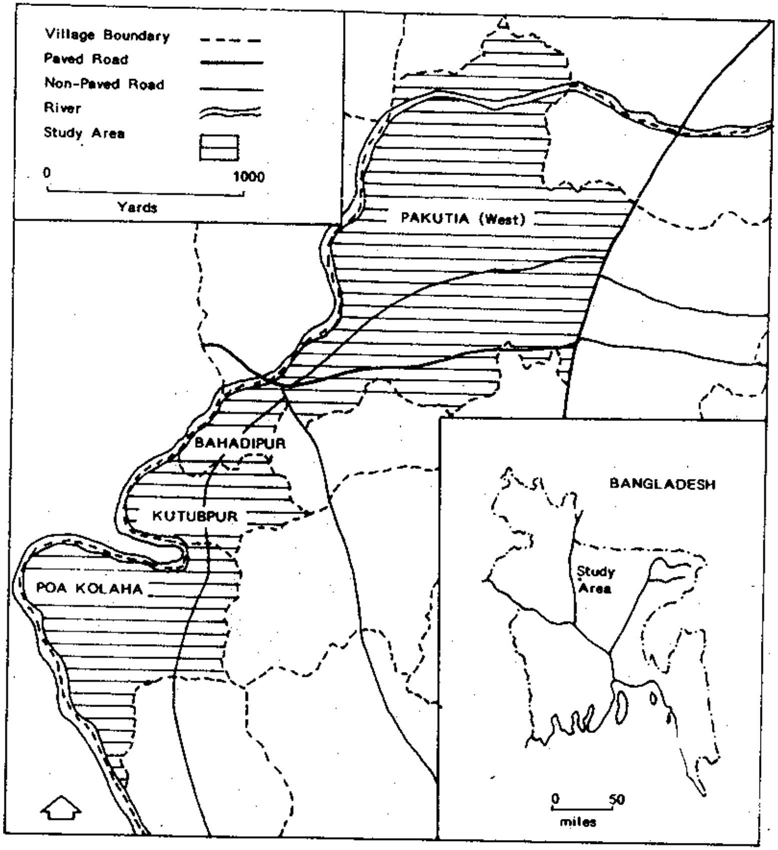



**Figure 1. The Study Area**

The present study is based on both field observation and intensive interviews. The former included collection of relevant information through informal group or private discussions. The interviews included a survey conducted in May-June, 1978. For this purpose, 15 percent (78) of the total heads of household (518) having cropland were selected randomly and interviewed with the help of a questionnaire.

## CROPPING SEASON IN THE STUDY AREA

Agriculture in the study villages, as in most regions of Bangladesh, is crop-oriented. A variety of crops are grown in different agricultural seasons and under different physical conditions (especially rainfall and elevation of land in relation to the flood level). As elsewhere in Bangladesh, three distinct but partly overlapping cropping seasons can be recognized in the study area. The Rabi crop season extends from late November or early December to March or April (Figure 2). Although nearly 15 percent of the cultivated land is cropped in this season, many crops are grown with or without irrigation. Boro rice, both local and high-yielding varieties (HYV), is the principal crop of the season, cultivated mostly in lowlands, which stay wet during the dry season or can be irrigated. This rice accounts for nearly 10 percent of the total cropland. Other crops — such as pulses, oilseeds, wheat, barley, wintervegetables, potatoes, and tobacco — are also grown in this season. The former four crops are generally cultivated in the lowlands, the latter three in the upper-middle or high land.

The *Bhadai*, or *Kharif*, season begins with scattered rains in late March or early April and lasts until the end of August or early September (Figure 2). Jute and *aus* rice (local and HYV) are the two important crops grown in this season. They are generally sown in relatively higher lands, since excessive rainfall or floodings is harmful to young aus and jute plants.

The *Aghani*, or *Haimantic* season, which roughly corresponds to the late monsoon period, extends from August to November or December. The main crop of this season is the rain-fed *aman* rice. There are two types of *aman*. The broadcast or floating *aman* is sown in March or April on lowlands that are prone to flooding (Figure 2). The other type, known as transplanted *aman* (local as well as HYV), is sown densely into nursery beds in early July. Then the seedlings are trans-planted into the

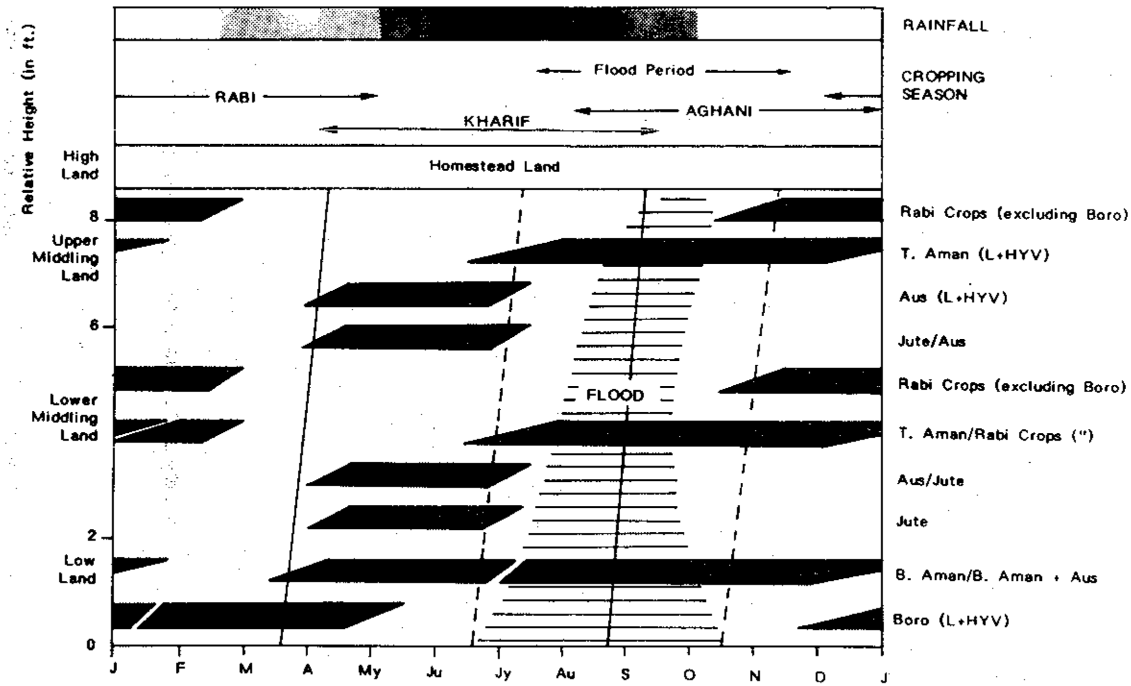



**Figure 2. Crop Calendar of the Study Area.**

L = Local, HYV = High-yielding Varieties, T = Transplanted, B = Broadcast.

lower-middle to upper lands at the end of July or early August, and harvested in late November or December.

As indicated earlier, most cultivated land in the study villages is subject to annual floodings. Floods usually commence in the months of June and July and last until October; that is, floods extend from the middle of the *Kharif* season to near the end of the *Haimantic* season (Figure 2). During this time, broadcast *aman* attains its maturity. The early part of the flood season usually corresponds to the harvesting period of aus and jute and to the transplantation of *aman*. Hence, any fluctuation in terms of the timing and duration of floods affects the harvest of aus and jute, the transplantation of *aman*, and the sowing of Rabi crops. If any deviation occurs with respect to the magnitude of floods, all standing field crops are either subject to inundation or their yields are lowered due to lack of sufficient flood water. If there is no flood at all, transplantation of *aman* tends to be hampered, and broadcast *aman* does not thrive well.

The relationships among cropping season, floods in the study area, and local relief shown in Figure 2 may be generally applicable to most regions of Bangladesh. Some differences may exist since farming activities differ from one region to another because of variations in seasonal rainfall. For the same reason, farming activities may also vary slightly from year to year in a particular locality.

# FINDINGS

The samples were drawn from the households having agricultural land. More than two-thirds of the respondents (71%) owned less than three acres of farmland. This indicates the subsistence nature of agriculture in the study villages. Most of the respondents were illiterate; only 31 percent of them had formal schooling. The age of the respondents ranged between 24 and 55 years; 67 percent of the respondents were 30 to 45. The overwhelming majority of the respondents had been living in the study area for generations. Only two respondents migrated into the area in recent times (after 1960), but they came from an area ecologically similar to their present residence.

## *Perceptions*

Perception of extreme events, albeit subjective in nature, plays an important role in agricultural decision making, especially in hazard-prone areas. In the natural hazards research context, the term perception implies the individual organization of stimuli to an extreme event and it is usually revealed in the language people use to describe the event, their ability to remember and describe past events, and their attitude towards its future occurrence (White 1974).

***Description of Foods*** It is evident from the field survey that all respondents of the study villages refer to annual floodings either as *barsha* or *bonna*. The former is a normal inundation, which is crucial for production of aus and *aman* rice. This type of flood is perceived by the respondents as a benevolent agent providing sustenance to the farmers, and thus it is an accepted and much-anticipated event. Usually in a year of normal flood, minimal damages to crops occur and farmers are able to harvest all of their *aus* and *aman* rice from the fields.

Floods that rise eight feet above the broadcast *aman* fields but do not overtop the village mounds or homestead land are called *barsha*. According to all the respondents, the flood of 1977 (the year immediately after the field survey was conducted) was a normal one.

*Bonna*, or an abnormal flood, on the contrary, is regarded by the respondents as a disastrous and damaging phenomenon. It causes widespread damage to standing crops and properties. While the farmers successfully adjust to normal floods and benefit from them, abnormal floods go beyond their ability to cope and result in considerable hardship. The flood of 1974, which was considered by all respondents to be abnormal, caused nearly 34 times the damage to crops and properties as the flood of 1977 (Table 1).

The overwhelming majority of the respondents (nearly 94%) described abnormal floods to be those in which the floodwater rises higher than eight feet above the broadcast *aman* fields and overtops the homestead land. Although abnormal floods are perceived primarily in terms of the height of the floodwater, a small number of respondents (6%) also mentioned other measures of abnormal flooding such as timing and duration of floodwater. This means they consider early or late floods and long- or short-lived floods to be abnormal.

Over the last four decades numerous studies have been done on various aspects of floodings in different countries in the tradition of a natural hazards research paradigm (e.g., Harding and Parker 1974; Kates 1962; Parker and Harding 1979; Payne and Pigram 1981; White 1945, 1961, 1964). In most of these studies, floods were perceived solely in terms of a damaging phenomenon. But flooding is an intimate part of rural life in the villages of Bangladesh, and it is deeply imbedded in their culture. Only the *bonna* is considered a hazard in the study villages. The *barsha*,

**Table 1. Extent of Flood Damages of the Respondents[a]**

| Year | Type of flood | Damages |
|---|---|---|
| 1977 | Normal *(barsha)* | 5-10% damages of *aus* paddy for 10 respondents (out of 78) 5-10% damages of jute for 10 respondents (out of 78). Some damages to plinths of two respondents (out of 78). Total damages, Taka 3,000.00[b] |
| 1974 | Abnormal (*bonna*) | 70% damages of *aus* paddy<br>65% damages of *aman* nursery beds<br>60% damages of *aman* paddy<br>60% damages of jute<br>Total crop damages, Taka 80,000.00<br>20% structural damages (values Taka 14,000.00)<br>Damage of storable goods (valued Taka 6,000.00)<br>Total damage, Taka 100,000.00 |

[a]Based on author's field survey

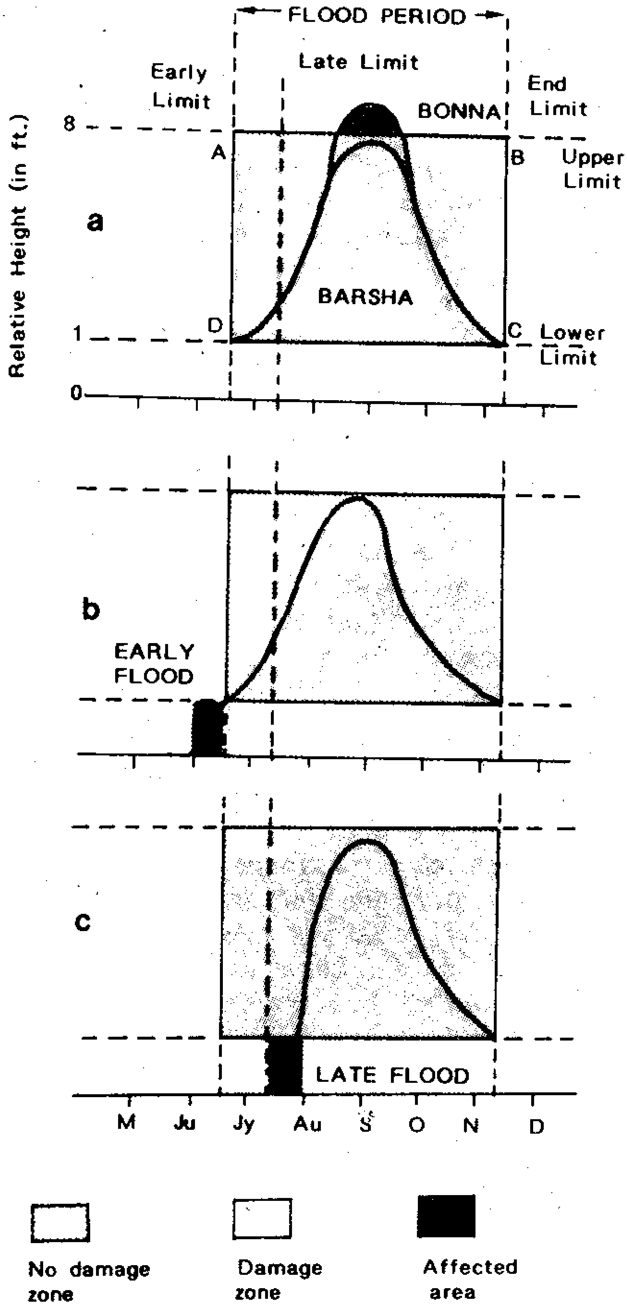
[b]One U.S.dollar was equivalent to Taka 18.00 at the official exchange rate of 1978

which occurs more frequently than *bonna*, is not considered to be a hazard at all, but rather to be necessary for survival. Islam (1980) and Ralph (1975) reported a similar perception among the farmers residing in the Meghna floodplain of Bangladesh.

It appears, then, that floods are considered to be beneficial (i.e., perceived to be a resource) only during a given time or duration, and given a particular magnitude. If flooding occurs either earlier or later than the normal time (June-July), if it stays for a longer or a shorter period than the usual duration or period (not more than four or less than two months and not beyond the month of October), or if flood water rises higher or lower than the usual height (not more than eight feet and less than one foot above the broadcast *aman* fields), it is perceived as abnormal.

The physical characteristics of both normal and abnormal floods may thus be represented by vertical (magnitude) and horizontal (timing and duration) thresholds with a view to drawing a distinction between hazards and resources (Figure 3). In the vertical thresholds, there are both upper and lower limits. The height of homestead land represents the upper limit of vertical threshold; the minimum height of floodwater required by broadcast *aman* plant for its growth (one foot) determines the lower limit.

Similar to the vertical thresholds are early, late, and end limits in the case of horizontal thresholds (Figure 3a). The early and end limits correspond with the flood season and represent, respectively, the onset and close of the season.


FLOOD PERIOD
Early Limit
Late Limit
End Limit
BONNA
8
A
B
Upper Limit
a
BARSHA
Relative Height (in ft.)
D
C
1
Lower Limit
0
b
EARLY FLOOD
c
LATE FLOOD
M
Ju
Jy
Au
S
O
N
D
No damage zone
Damage zone
Affected area

The early, late, and end limits occasionally vary from year to year, depending on the variation in sowing of crops. Seasonal patterns of farming activities differ slightly from one year to another on account of dryness in the *Rabi* season or excessive rainfall in the *Haimantic* season.

As can be seen from Figure 3a, the upper and lower limits and the early and end limits intersect each other to form a rectangle ABCD. As long as floodwater remains within the rectangle, it is useful and is considered a resource. If it exceeds any boundary of the rectangle a flood becomes a damaging phenomenon for that particular area adjacent to the rectangle. In Figure 3, the areas where floods become hazardous are shown by relatively denser shading. Therefore, the zone lying within the rectangle is the no-damage zone, while the outside area is the damage zone.

Floods, however, may occur during the proper time but exceed the upper or end limits, remain below the lower limit, or stay for shorter periods. These types of floods are harmful.

If floods occur before the usual time, the areas falling outside the early limit will be affected (Figure 3b). Sometimes these floods may stay for longer times and thus areas beyond the end limit may be affected. These types of floods are known as early floods.

Late flooding may also occur. In this case, the area immediately beyond the late limit is likely to be affected due to lack of flood water (Figure 3c).

The physical characteristics of floods of different regions of Bangladesh may also be expressed in a way similar to the one shown for the study area in Figure 3. Due to variation in local relief, slight variation may occur from region to region with regard to vertical thresholds. Similarly, horizontal thresholds may differ from one region to another because of variations in the sowing and harvesting of crops.

Based on the above facts, Table 2 lists 27 possible types of floods. The flood of the study area on any part of Bangladesh in a given year may represent any one of these 27 types.

***Past Severe Floods.*** When the respondents were asked about the previous severe floods, a range of answers was obtained. The flood of 1974 was considered by as many as 50 respondents (64%) to be the most severe flood in their lifetime. This may be partly due to recency of the experience, but it is also grounded in reality. Despite the blunting effect of time, the floods of 1954-1955 stand out clearly in the minds of one-third of the total respondents (21) of the study villages. In fact, the years

**Table 2 Types of Flood in the Study Villages[a]**

| | Timing | | | Magnitude | | | Duration | | |
|---|---|---|---|---|---|---|---|---|---|
| | Early | Usual | Late | Below | Normal | Above normal | Shorter | Normal | Longer then normal |
| Normal flood | | x | | | x | | | x | |
| Abnormal flood | | | | | | | | | |
| Type: | | | | | | | | | |
| I | | x | | | x | | x | | |
| II | | x | | | x | | | | x |
| III | | x | | | | | | x | |
| IV | | x | | x | | | x | | |
| V | | x | | x | | | | | x |
| VI | | x | | x | | x | x | | |
| VII | | x | | | | x | | x | |
| VIII | | x | | | | x | | | x |
| IX | x | | | x | | | x | | |
| X | x | | | x | | | | x | |
| XI | x | | | x | | | | | x |
| XII | x | | | | x | | x | | |
| XIII | x | | | | x | | | x | |
| XIV | x | | | | x | | | | x |
| XV | x | | | | | x | x | | |
| XVI | x | | | | | x | | x | |
| XVII | x | | | | | x | | | x |
| XVIII | | | x | x | | | x | | |
| XIX | | | x | x | | | | x | |
| XX | | | x | x | | | | | x |
| XXI | | | x | | x | | x | | |
| XXII | | | x | | x | | | x | |
| XXIII | | | x | | x | | | | x |
| XXIV | | | x | | | x | x | | |
| XXV | | | x | | | x | | x | |
| XXVI | | | x | | | x | | | x |

[a] Based on field observations by the author.

1954-1955 and 1974 had the most severe floods in Bangladesh in terms of both damages suffered and area flooded. However, two respondents also listed 1962 and 1966 as most severe flood years.

***Future Floods.*** The study reveals that all the respondents expect abnormal floods within the next 10 years. With respect to occurrence of a severe flood as many as 57 respondents (73%) expect it in their lifetime. Among them, 46 respondents (81%) justified their expectations by saying that *Allah/Bhagaban* (God) is displeased with people because the majority of them are involved in antireligious activities. For this reason *Allah/Bhagaban* will give *bonna* as a *gajab* (hazard). Rising of river beds due to deposition of silts was cited by the remaining 11 respondents (19%) as their reason for expecting future floods. Among the above 57 respondents, 37 respondents (65%) were unable to predict the time because, they said, "*Allah/Bhagaban* is the only one who knows it". Only 20 respondents (35%) expect it soon, the reason being their observation that severe flood usually occurs within a span of 2-4 years.

The ability to predict the future occurrence of a severe flood or the timing of the annual flood reflects the perception of the individual. This is also indicative of his ability to adjust to inundation. Most of the respondents (53) in the study area believed that they are able to predict the timing of the expected annual inundations. An even greater number (57) thought that they could predict how severe the flood would be in a given year. Predictions concerning the severity of floods were based on personal observations of phenomena such as weather, heavy cloud formation, and heavy rainfall, and on the availability of verbal information about the rapid rise of water level in the Jamuna river or in the nearby small river and about the current of the floodwater.

## *Agricultural Adjustments*

In natural hazards research studies, adjustments are defined as those human activities intended to reduce or minimize negative impacts of an extreme event (White 1974).

It is evident from the field survey that the villagers' responses to floods are of an individual nature that differs according to the type of flood. For the convenience of analysis, the various adjustments adopted by the respondents of the study area are discussed for two important flood types, normal and abnormal.

***Barsha [Normal Flood].*** Agricultural adjustments to normal floods are reflected in crop selection. Since aus and jute cannot tolerate excessive amounts of standing water, farmers cultivate these two crops in comparatively higher land. Broadcast *aman*, on the contrary, thrives best in deeply flooded land, hence, lowlands are given over to broadcast *aman*. This crop continues to grow as fast as the flood rises. The *aman* plants usually attain a height of 12-15 feet and keep their heads above the flood water. But sudden rises of water can overtop the plants, causing damage or destruction. Transplanted *aman*, although requiring flood water, does not grow on deeply flooded land. Farmers generally select poorly drained middle land for cultivation of transplanted *aman*.

***Bonna [Abnormal Flood].*** Agricultural adjustments to *bonna* in the study village are limited and practiced during the flood time. Among the four adjustments practiced in the years of abnormal flood *[bonna]*, only one is related to a crop (Table 3). As a protection against strong wind and water currents, farmers who cultivate broadcast *aman* in low-lying areas usually place bamboo sticks a few feet apart in the field to support the growing crop. Out of 35 respondents having broadcast *aman* fields, only 13 (37%) reported that they adapted this adjustment during the 1974 flood. Out of 48 respondents having draft animals, only 7 families (15%) built *machans* (platforms) for the draft animals using straw, water hyacinth, bamboo, and banana stalks. Although providing safety to the animals in less severe floods, this adjustment is ineffective in cases of very high water. In such a situation, the owners of draft animals move their animals to higher grounds, especially the nearby metalled roads. In the severe flood of 1974, only four respondents (8%) moved their animals to the road. Smaller animals are usually kept inside the main sleeping structure, on the *chowki* (wooden bed), or hanging in baskets locally called *shika*.

Apart from these, three adjustments are commonly practiced both for normal and abnormal floods. The most widely practiced adjustment is the interculturation of broadcast *aman* and *aus*. The practice of sowing two rice crops in the same field at the same time (March-April) is an agricultural adaptation to the risk of floods. Flood-sensitive *aus* matures much earlier and is harvested in July-August when the cropland is shallowly flooded. Flood-tolerant *aman*, on the other hand, continues to grow with the rising flood water and is harvested after the recession of flood water in October. Respondents noted that by practicing interculture

**Table 3. Agricultural Adjustments to Flood in the Study Villages[a]**

| Type of flood (year) | Adjustment | |
|---|---|---|
| | Pre-flood | During flood |
| Normal (1977) | Crop selection method | |
| Abnormal (1974) (*bonna*) | | Placing bamboo sticks for support of *aman* plants (13 respondents out of 35). |
| | | Building of *machan* for draft animals (7 respondents out of 48). |
| | | Moving the draft animals to higher ground or to metalled roads (4 respondents out of 48) Keeping the smaller animals on the *chouki* or *shika* (11 respondents out of 23) |
| Common to both normal and abnormal floods | Inter-culture of *aman* and *aus* | Protecting *aman* field from water hyacinth and movement of boats by building bamboo fences (16 respondents out of 35 in 1974 and 7 out of 35 in 1977) |
| | | Keeping *aman* field clear by pulling water hyacinth away either by hand or by boat (16 respondents out of 35 in 1974 and 15 out of 35 in 1977) |

[a]Based on author's field survey.

of *aman* and *aus*, they protect themselves against floods in that they are able to harvest at least one crop. If it is a year of drought and the floodwaters are below normal, the aus will survive and the *aman* will wither. If the floods are greater than usual, the *aus* will be destroyed and the *aman* will still flourish. And if it is a normal year, both crops can be harvested.

The remaining two adjustments are related to the flood-borne aquatic weed, water hyacinth, which comes along with floodwater and invades broadcast *aman* fields. To prevent water hyacinth invasion, 45 percent of the total respondents having broadcast *aman* fields in low-lying areas (35) built bamboo fences around their fields in 1974. The corresponding number was only 20 percent in 1977. This is also a protective measure against the movement of country boats in the *aman* fields. Another 45 percent of the respondents kept the *aman* field clear by pulling water hyacinth away either by boat or by hand in 1974. Almost the same number of respondents (15) did this in 1977 (Table 3).

# CONCLUSION

This study of the perception of farmers inhabiting the Jamuna floodplain of Bangladesh regarding normal and abnormal floods observed how individuals cope with annual inundation and how they respond to abnormal floods. Although the study borrowed heavily from natural hazards research in its working definitions, it differs in one important aspect: flooding is not always a hazard to the farmers. The annual inundation — i.e., normal flooding — is beneficial to and necessary for crop production. Abnormal flooding, in contrast, is considered a negative resource, a hazard. Thus, a good year to the villagers is one in which the flood is normal, enabling the harvesting of both *aus* and *aman* rice, two major subsistence crops of the farmers; a bad year is one in which the timing, duration, or magnitude of the inundation is abnormal, causing widespread destruction to crops and properties.

The respondents of the study villages have been living with floods since their births, and they are fully aware of the phenomenon. This high degree of awareness of flood in the village supports Kates' (1963) contention that in areas of greatest positive or negative certainty concerning the occurrence of floods, floodplain occupants exhibit the least variation in perception. The present study, however, does not support the idea of adjustment through habitation, which states that awareness of environmental problems decreases with length of residence (Preston et al. 1983).

The study observed that respondents cope successfully with the normal floods. In cases of abnormal floods, they practiced a few adjustments. This contradicts the notion that where the hazard is common, many adjustments are made (Sims and Baumann 1983). However, the adjustments practiced in the study villages concerning both normal and abnormal floods are of traditional types, which have been transmitted through generations. The low level of technology and absence of any public input in the study villages result in folk or preindustrial levels of adjustments (Kates 1970).

The findings of the present study are consistent with the studies done by Islam (1980) and Ralph (1975), which reported farmers' perceptions of, and range of adjustments to, floods in high flood-hazard zones. This suggests that farmers' perceptions of and agricultural adjustments to floods do not vary considerably from high to medium flood-hazard zones.

Finally, the study emphasizes the need to undertake more research of a similar nature in different regions of Bangladesh having variations in public flood-control measures. Such research will help in ascertaining the impact of existing public measures in reducing flood damages and thus provide a stronger basis for understanding the flood hazard in Bangladesh.

# NOTES

1. The author is grateful to Professor Bart J. Epstein, Professor Surinder M. Bhardwaj, and Abdullah Al-Mamun Khan of the Geography Department, Kent State University, Kent, Ohio, for their helpful comments and suggestions on earlier drafts of this article.

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# I.4

# PERCEPTIONS OF TREE SHADE AMONG FARMERS IN PAKISTAN

**Michael R. Dove**

## INTRODUCTION

In the arid plains of Pakistan, which should be and once were covered by a climatic climax thorn forest, trees are today conspicuous mostly by their absence. This is due to millennia of not only usage — especially as fuel and browse — but also active management. Whereas the natural growth of trees is largely ignored on common lands used for grazing, fodder, and fuel, it is carefully controlled on private lands where food crops are grown. The primary goal of this control is to reap the benefits of trees — fuel, timber, fodder, and shade — while mitigating their perceived deleterious impact on agricultural lãnd and crops. This impact is most often articulated as a problem of saia 'shade'.

The concept of shade in the West is of 'comparative darkness caused by a more or less opaque object intercepting the direct rays of the sun or other luminary' (*Oxford English Dictionary* 1971:2759). Insofar as this involves tree shade, it is conceived of as 'a piece of ground overshadowed by trees' (loc.cit.). Central to the Western concept, therefore, is the absence of sunlight, as revealed upon a two-dimensional surface.

Pakistani farmers have a fundamentally different concept of shade. They conceive of tree shade not as the absence but as the presence of something, something that the tree itself emits. This something has not two dimensions but four — height and duration in addition to length and width — and it also has density, temperature, and even taste. Each of these values varies according to tree species and — of most importance to the farmer — so too does the perceived impact of shade upon their food crops vary. This impact further varies according to the type of land and the season of the year. This impact can be partially distinguished from the other major impact of the tree — the absorption of moisture and energy by the roots. A variety of management techniques are employed to minimize the negative aspects of shade.

The object of this paper, based on a series of interviews with 1200 farmers (and various subsets thereof) in the Punjab, NWFP, and Baluchistan, is to present the basic dimensions of the concept of tree shade in Pakistan.[1] This analysis provides insight into humoral systems of agriculture, as well as the role of such systems in an Islamic society.

## THE CHARACTER OF SHADE

Pakistani farmers are acutely aware of the size — the length and width — of the area that is shadowed by any given tree. One of the explicit reasons for pruning, for example, is to reduce the extent of this area. They favorably compare the natural shape of a tree like *Olea ferruginea* — slender and casting less shade — with one like *Melia azedarach* — broader and casting more shade. In addition to length and width, some farmers assign a third dimension to shade, height, or at least vertical movement: speaking of a tall tree like, again, *Melia azedarach*, they say that its shade cools as it 'descends' to earth. Regarding the fourth dimension, time, farmers are very conscious of the duration of a tree's daily shadow on a given field: thus, they say that one of the reasons it is better to plant a tree at the edge instead of the center of a field, is because its shade will cover the field for only one-half of the day (e.g., morning if it is on the eastern edge, and afternoon if on the western edge) instead of the whole day.

The second important aspect of shade is its density — or the depth and uniformity of its darkness. Farmers say that *Dalbergia sissoo* and *Morus alba* have especially dense shade, for example, because their leaves are particularly thick (and opaque), as a result of which the amount of sunlight filtering through them is particularly limited and the ensuing shade is particularly dark. In addition, there are seasonal and diurnal dimensions to shade thickness: farmers say that shade is thicker during the summer than during the winter; and they say that it is thicker at midday than during the morning or afternoon. This latter reference is not to the actual but the comparative density of shade, which varies directly with the intensity of sunlight. Whatever its cause, farmers say that thick shade is generally bad for their crops.

The third important aspect of the Pakistani concept of tree shade is its temperature, which farmers say is immediately perceptible to anyone standing under the tree. Thus, they say that it 'feels cold' under a *Dalbergia sissoo* or *Albizia lebbeck*, while it 'feels hot' under a *Tamarix aphylla*. Farmers attribute variation in shade temperature, in part, to variation in shade density. Thus, they say that thin-leaved trees like *Melia azedarach* and *Zizyphus mauritania* have hot shade, while thick-leaved trees like *Dalberqia sissoo* and *Morus alba* have cold shade. But more generally, the temperature of a tree's shade is associated with the temperature of the tree itself — which they apprehend indirectly. Thus, farmers say that *Olea ferruginea* is cold, because it casts little shade, and its leaf litter enriches the soil. In contrast, *Prosopis juliflora and Acacia nilotica* are said to be hot trees, because they thrive not only in hot regions but in hot seasons as well, losing their leaves during the cold season.[2]

For people and animals, the appreciation of shade's temperature varies with the season. Thus, farmers say that they stake their livestock under the hot shade of the *Zizyphus mauritania* in the winter, but put them under the cool shade of *Dalbergia sissoo* in the summer. For most crops, on the other hand, hot shade is bad whatever the season. Any tree in whose shade crops fare particularly poorly is said, by inference, to have hot shade.

The fourth and final aspect of the Pakistani concept of tree shade is taste — the principal dimensions of which are bitterness and sweetness. Like the temperature of shade, the taste of shade cannot be perceived directly; it can be known only through inference from other parts of the tree, or from proximate crops. Thus, farmers say that they know that the shade of *Melia azedarach* is bitter, because its sap, fruit, and even crops growing under it all taste bitter. In contrast, they say that the sweet taste of *Zizyphus mauritania's* sap indicates that its shade is sweet. The taste of a tree's leaves similarly indicates whether its shade is bitter or sweet.[3]

## THE IMPACT OF SHADE

Farmers say that shade has positive as well as negative impacts on crops, but the latter predominate. These impacts are both direct — by blocking sunlight to the crops — and indirect — by exacerbating extreme soil conditions. Regarding the latter, farmers say that when the soil is overly wet (after rainfall or irrigation), shade keeps it from drying out (note that they do not claim that shade makes dry soil wet); and when the soil is overly cold and dry, shade keeps it from being warmed and energized. Both of these conditions — being overly wet or overly cold — are perceived as ones of soil weakness, associated with a lack of fertility.

The impact of tree shade is said to vary according to both land type and season. Farmers say that shade's maintenance of soil wetness has a worse impact on irrigated land (where waterlogging is frequently a major problem), while its de-energizing of the soil has a worse impact on rainfed land (where soil fertility is in general more of a problem). Similarly, they say that the cooling impact of shade is worse during the winter (while it is sometimes even beneficial in the summer).[4]

## TREE SHADE VS. TREE ROOTS

When discussing the impact of trees on crops, Pakistani farmers typically refer only to tree 'shade', as mentioned earlier. When questioned in detail regarding this impact, however, most can distinguish between the impact of the tree's shade and the impact of its roots.[5] A typical distinction is to say that while shade keeps the topsoil wet, roots make the subsurface soil dry. While root impact is glossed under shade impact at one level of discourse, therefore, at another level the two are often distinguished.

Unlike the case with tree shade, farmers believe the impact of tree roots to be uniformly negative. Their impact, as a result of utilizing soil moisture to absorb soil energy (the usual conception of relations between moisture and nutrients in Pakistan), is to reduce the amount of both moisture and energy in the soil. The reduction of the former is regarded as the more serious: farmers say that if the soil can be sufficiently irrigated, the impact of tree roots on soil fertility will be negated, or even transformed into a positive impact. It follows from this that the impact of roots is said to be worse in rainfed lands than in irrigated lands. The impact is also said to be worse from shallow-rooted trees like *Melia azedarach* or *Morus alba* than from deep-rooted ones.

Noting that even shallow roots penetrate to the subsurface soil, while crop roots remain in the topsoil (where the farmers believe that soil fertility is concentrated), a significant minority of farmers deny that tree roots have any impact at all on crops. These are invariably the farmers with irrigated lands, on which the constraining factor in agriculture is less lack of water than its overabundance; hence they tend to see the wetting impact of tree shade as worse than the drying impact of tree roots. Farmers with rainfed lands, on the other hand, for whom the chief agricultural constraint is lack of water, tend to view the impact of tree roots as worse than that of tree shade.

# THE MANAGEMENT OF SHADE

Pakistani farmers have a variety of ways of actively managing the deleterious impact of tree shade on their crops and soils. These include, in the first instance, selection of tree species with more beneficial and less destructive shade for planting; selection of planting locations and spacings that minimize the deleterious impacts of shade; and the weeding out or felling of all other tree species in all other locations on and about their fields. With grown trees, two other, important management strategies are employed: the first is watering, especially in rainfed lands; the second and more important is pruning, especially during the winter. Farmers maintain that pruning not only increases the amount of sunlight reaching the crops and soil, but it also adds to the energy and hence fertility of the soil, at the same time as it reduces the amount of energy that the tree draws out of the soil.[6]

# SUMMARY AND CONCLUSIONS

I began this analysis with the observation that Pakistani farmers view tree shade, and its management, as the chief challenge to the cultivation of trees on their farms. I suggested that their concept of tree shade is very different from the common Western one, incorporating as it does four dimensions, plus density, temperature, and taste. The perceived impacts of shade — maintaining soil wetness and reducing its temperature and strength — are said to vary on rainfed as opposed to irrigated lands, and to be generally more feared during the winter than the summer. I then noted that farmers partially distinguish this impact from the drying and weakening impact of tree roots, with the root impact being more feared by rainfed farmers, while the shade impact is more feared by irrigated ones. Finally, I noted that farmers attempt to mitigate these impacts by pruning, especially in winter, and to a lesser extent by watering, especially on rainfed lands.

This series of folk concepts regarding the impact of tree shade and its mitigation, can be seen to form a coherent system based on classical humoral principles. Just as analyzed by Kurin (1983) for Pakistani food crops, these principles involve the combination and segregation of opposing qualities of hot and cold, wet and dry, bitter and sweet, to attain desired agricultural outcomes. The desired outcomes in the present case are to mitigate, or at least not exacerbate, the constraining humoral properties of the land and season in which a farmer is working: too much wetness in irrigated land, too much dryness in rainfed land, and too much cold in winter. Farmers' attitudes towards and responses to shade are thus, in part, context-dependent. In most cases, a particular tree and its shade is neither absolutely good nor absolutely bad, but rather good or bad on a particular type of land in a particular season.[7]

This humoral system is whole-heartedly empirical. Pakistani farmers use sight; taste, touch and causal inference to substantiate and inform their concepts of tree shade. This appears to distinguish this humoral system from the Ayurvedic teachings from which they otherwise directly derive: Zimmerman, the preeminent Western analyst of the ecological and agricultural applications of Ayurvedic principles, maintains that they are essentially non-empirical, that the examination, study, or testing of these principles is explicity proscribed (1987:9,97,103,158,198). Perhaps, however, even in ancient India the day-to-day practices of Ayurvedic doctors were more empirical — more like the contemporary practices of Pakistani farmers — than is suggested by the normative, Sanskrit treatises that they left behind.

This pragmatic system of belief coexists in contemporary Pakistan with a very different set of orthodox Islamic beliefs on the topic: Islamic principles are widely interpreted in Pakistan as prohibiting the felling or destruction of trees under most circumstances. Most farmers freely admit that the active management of trees on their farms violates these principles, yet they experience little visible dissonance as a result. This is due to a distinction being made between ideological and secular beliefs. The Islamic principles regarding trees are treated as an ideological system, to which rigorous adherence is due in ideologically hallowed ground, principally cemeteries and shrines; while the humoral principles are treated as a secular, ecological system, more appropriate for the non-hallowed farmlands and grazing lands.[8] This sacred-secular distinction is enhanced by the fact that, while the former system is Islamic, the latter has Hindu antecedents (Zimmerman 1987; Kurin 1983:285). The Hindu roots of the humoral system probably contribute not only to the non-observance of humoral principles in places sacred to Islam, but also to the heightened observance there of Islamic principles.[9]

These humoral concepts of tree shade, or more broadly this indigenous system of agro-forestry, has obvious relevance to development scientists and planners in Pakistan as well as elsewhere in South Asia. While government departments of forestry are just beginning to develop their own science of agro-forestry, the farmers are already utilizing a practical science of their own, one that has been in use — and has been tested — for centuries (as it applies to the management of trees) if not millennia (as applied more generally to the natural world). To better ground their modern science of agro-forestry in the local physical and social realities, as well as to enhance their communications with and service to the farmers, the development community should study and adopt not just the practical principles, but also the logic and lexicon of this traditional system of knowledge.

# NOTES

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2. Farmers use not just tree shade but tree products according to these properties. They feed their livestock the leaves of the cold *Dalbergia sissoo* to counteract the 'heat' of illness and the leaves of the hot *Zizyphus mauritania* to counteract the 'cold' of winter or parturition. They eat the leaves of *Tamarix aphylla* themselves to counteract the 'cold' of sexual impotence.

3. Taste extends also to the wood: for example, farmers say that it is the bitterness of the wood of *Azadirachta indica* that makes it impervious to termites.

4. To a limited extent, farmers also say that the impact of tree shade varies according to the type of crop planted under it. For example, they say that 'hot' crops like *Capsicum spp.* can thrive under shade.

5. A minority of farmers identify a third aspect of the tree's impact on crops, namely leaf and flower litter. These farmers maintain that tree litter is rich in nutrients, which in the presence of abundant water supplies *may* benefit crops, but in the absence of water will hurt them. This is the same way that Pakistani farmers conceive of the impact of chemical fertilizers, namely that they require irrigation or rain in order to work effectively, in the absence of which they will 'burn' the crops. Some farmers carry this argument so far as to attribute all ill effects of trees to their litter, holding shade (or roots) to be irrelevant by comparison. The trees that are said to

have the worst litter are *Melia azedarach* and *Acacia nilotica. Olea ferruginea*, in contrast, is said to have good litter.

6. While most farmers state that they possess no techniques for directly reducing the impact of tree roots on crops, some acknowledge that pruning weakens them and reduces their drain upon soil energy.

7. See Zimmerman (1987:131-132) on the distinction between inherent 'essence' and circumstantial 'accident' in Ayurvedic thought.

8. The historic, genetic, and even economic value of the scattered oases of graveyard and shrine vegetation in Pakistan is a reminder, however, that ideological principles can also play longer-term ecological roles as well.

9. The remarkable tenacity of proscriptions against tree-felling within cemeteries and shrines is such that they often contain the only remaining natural vegetation in the Pakistani countryside, as witnessed by the development of a sub-field of Pakistani silviculture devoted to their study (Chaghtai et al. 1978, 1983, 1984).

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# I.5

# CULTURALLY RELEVANT SOCIO-ECONOMIC CATEGORIES OF RURAL LANDHOLDERS IN BANGLADESH

**John P. Thorp**

## INTRODUCTION

Any discussion of social change in modern South Asia, at some point, must address questions concerning the possession and use of agricultural land. Indeed, a great deal of interest has been shown in such questions, especially in regard to the issue of land reform. However, for any land reform scheme to work equitably, a great deal more thought needs to be given to the categories of analysis in terms of which the discussion of these issues proceeds. The intent of this paper is to contribute to efforts being made to establish socio-economic categories of persons for use in the analysis of land usage in rural South Asian societies, most particularly among the Muslims of Bangladesh. I approach this task from my understanding of the cultural conceptions about land ownership current among members of this rural society (Thorp 1978b). In this paper I hope to demonstrate why I believe the following categories of persons are needed in the analysis of rural society: landless (without homestead), homestead owners, marginal cropland holders, and small, medium, big and super cropland holders.

## DISCUSSION

### *Cultural Conceptions*

During the early stages of my fieldwork in October of 1975 in the area of Pabna District which I have named "Daripalla", I was often told that a particular head of household or landowning farmer whom I was attempting to interview had '*matite giyechen*'. At first, I literally mistranslated this response to mean he had 'gone into the earth' (*mati* = earth). My informants meant, however, that the particular individual whom I was seeking had gone out to examine or work in his fields. I soon realized that I too would have to go out into the fields if I were to interview these landowners. In retrospect, it is now clear to me that my going out into the fields was not at all the same activity that the Muslims farmer was involved in when he 'went into the fields'. I was involved in the pedestrian anthropological task of seeking out informants. The farmer, on the other hand, was involved in behavior of fundamental cultural importance in his life. 'To go into the fields' is an idiomatic expression which can only be understood in terms of the primacy which the possession and use of land has in the cultural beliefs of these farmers. To be a complete person in rural society, an individual must possess and productively use the earth. The model for this behavior is the first human being, Adam, whom Allah created from the earth *(mati)* to possess and cultivate the earth, that is, to be its *malik* or master (Thorp 1978a). The farmers of Daripalla believe that Adam was able to possess and cultivate the earth precisely because he was created from the earth. All of creation is seen as composed of different combinations of the four basic substances: earth, air, fire and water. Of the four, earth is considered to be particularly powerful. As the constitutive element in Adam's creation, earth caused Adam to be both physically strong enough and mentally able enough to possess and cultivate the earth. Adam's descendants in Daripalla share this strength and skill. They maintain it throughout their lives by consuming the food produced from this earth. To personally possess and use land, furthermore, makes an adult male a malik or master of earth, as Adam first was.

The idiomatic expression of 'going into the fields' refers to the habit which a *malik* (the 'head of the household' in western terminology) has of visiting each of his cultivated plots of land which may be scattered over a fairly widespread area of the countryside. A Daripalla farmer takes great pleasure in examining the progress of the crops in each of his fields, checking the conditions of the moisture in the earth, examining its need for fertilizer and possibly even insecticide. He makes no secret of his desire to acquire other fields. As the idiomatic expression for this activity indicates, the earth (*mati*) is the focus of his attention. He goes out to examine it because he draws his sustenance, his strength and skill, and his mastery from this earth. The earth not only stands for or represents to him the various meanings which he associates with it, but the earth actually effects for him these realities. The earth is both a symbol and a sacrament for him (Thorp 1979, 1982). Farming the earth is not simply a utilitarian occupation for such a farmer, but it is the activity by which he actualizes who he is. By possessing and farming the earth he produces Adam in himself.

In October, 1975 I understood none of this. The farmers I was seeking out had completed most of the activity involved in cultivating their second rice crop which would be harvested in December. It appeared to me at that time that these farmers had little reason to be spending their time wandering about the countryside. After all, I had research interviews to complete! During the early days of this research I did not think to inquire into the significance of this activity for these farmers. I was too involved in the humbling experience of discovering that my painfully prepared research categories and methodology were not going to produce the information about 'power', 'authority', or 'influence' that I was interested in. Only after I was re-educated through innumerable accountings of Allah's creation of the world and his establishment of Adam as the master of worldly creation with the express role of cultivating the earth, did I come to realize the cultural significance of 'going into the fields (earth)', for these farmers.

To be a mature, masterful person in rural Muslim society an individual must, first of all, possess land. Even the tiniest, homestead plot bestows this maturity or mastery. Secondly, a person must use this land productively, ordinarily by cultivating it himself. Every person who possesses and puts land to productive use is a *malik*, or master, a mature person in rural society. However, not all maliks are equally influential in village affairs. The more land a person possesses and uses productively, the more influential that *malik* can be in community affairs. The more productive, large landholders within a village are the influential people in the processes of public decision making, in village politics. Large landholders are the village 'bigmen' *(baralok)*. However, their influence does not make the small holders irrelevant in village life. All the *maliks* of a village area are part of a localized residential social unit known as a *samaj*, which I feel can best be translated as 'residential brotherhood'. These social units are made up of both big and small holders who are all aware of their brotherhood as Adam's descendants.

## Socio-Economic Analysis

The cultural reality of being a *malik* first, and a 'bigman' second among rural Muslims is an important cultural fact that must be kept in mind by any outside observer interested in rural social life in Bangladesh. The whole system of cultural conceptions, the worldview, of these farmers must be kept in mind by anyone interested in bringing about change or stimulating development in the agricultural sector of Bangladesh society. A number of organizations, both Bengali and non-Bengali, are interested in doing just that. My own research was funded by one such private development organization, Caritas-Bangladesh. The United States Agency for International Development has also demonstrated an interest in rural development. Furthermore, the government of Bangladesh is deeply concerned with rural development. Among many other activities, the newly independent government of Bangladesh in 1972 created the Integrated Rural Development Program (IRDP) to extend throughout Bangladesh the program of cooperative activity development at the Bangladesh Academy for Rural Development in Comilla. In different ways each of these agencies is staffed by individuals who are outsiders to rural Muslim life and its worldview. Caritas-Bangladesh is a predominantly Bengali Christian organization. USAID is a secular, western organization dominated by economists. Although the IRDP is staffed by Bengali Muslims, these officers are at least partially educated in the western tradition of empirical thought. Both the farmers and the Bengali government officers in Daripalla agree that the officers who staff the local branches of government in the countryside are not integrated into the rural social system. They are, rather, superior to this system of social organization, and able to place demands upon it.

An important concern for all the development agencies, both public and private, in Bangladesh is the question of land ownership. These agencies seem to approach this question, on the one hand, in terms of those farmers whom they can easily (i.e. quantitatively) identify, as large landholders, or, on the other hand, in terms of those members of rural society who are considered 'landless'. I have not found the observers of rural society taking into consideration the significance of being a malik for those farmers who find themselves in an intermediate position between the large landholders (who are also the 'bigmen' in rural society), and the 'landless' poor. Anyone with cropland, be it only 0.10 of an acre, engages in the culturally significant activity of 'going to the fields'. Somehow these farmers need to be represented in the analytic categories used to investigate rural Bangladeshi society. Without a doubt, who owns the largest amounts of land is of fundamental importance in this analysis. However, more attention has to be paid to the categories of lesser farmers who make up the bulk of the rural population. Using my understanding of the cultural conceptions of these farmers, I want to contribute to the elaboration of culturally adequate categories of analysis to be used in the investigation of rural society in Bangladesh.

Development agencies like to proceed on the basis of accurate, quantitative socio-economic data concerning a great variety of dependent and independent variables. The gathering of such data is beset by many handicaps in Bangladesh, from the problem of survey instrument design and translation, to the problem of enumerator skill. The processing of such data is handicapped by limited computer facilities. However, a prior and more serious handicap than these exists in that analysts have not defined quantitative, socio-economic variables which satisfactorily take into account the farmers' own cultural conceptions about rural life. My current research is an attempt to rectify this. I have been considering three separate bodies of statistical data: first of all, The *Benchmark Survey Program for Integrated Rural Development Microplanning in Bangladesh* (BMS) which was conducted in each of the 18 Districts of Bangladesh between November 1973 and June 1975 (IRDP 1973); and secondly, the 1977 *Land Occupancy Survey of Rural Bangladesh* (LOS) prepared by Januzzi and Peach (1977) for USAID; and thirdly, *Productivity and Equity in IRDP Cooperative Irrigation Schemes* (PEIC) prepared by Qadir, Emmert, Chowdhury and Dey (1978). The BMS is a comprehensive, multivariable survey intended to cover a wide range of socio-cultural and economic factors influential in rural life, and it is intended for active use in planning. The LOS is a single issue, random sample survey concerned only with tenancy relations in rural Bangladesh. It too is intended for use in planning. The PEIC is a multivariant analysis of government sponsored cooperative irrigation schemes in seven different villages of one *Thana*. I am concentrating upon the BMS and using the LOS and the PEIC as points of reference. I am interested in the BMS because the area which I have identified as 'Daripalla' was part of one of the blocks of villages that was surveyed for the BMS during January and February 1974. With the assistance of Professor S.A. Qadir, then of the Institute of Bangladesh Studies at Rajshahi University, who was also one of the designers of the BMS, I was able to obtain access to the specific data for Daripalla for the IRDP. Although I was aware that this statistical data existed prior to doing my own research, I did not use it in my own fieldwork. Only since returning from the field have I turned my attention to studying the statistics in the BMS for Daripalla. My own personal knowledge of this one area has been advantageous in this work.

Daripalla is the name I have given to one Ward of one Union Council (UC) in one *Thana* of Pabna District. This UC ward is composed of ten revenue units, or villages. It covers an area slightly larger than three square miles. Daripalla is a completely rural area, though Pabna and Ishurdi towns are easily accessible by bus. I have compiled some descriptive data in Table 1. Ten revenue units, or 'villages', are shown, but these 'villages' do not represent basic social units in rural life. Within these geographic areas the farmers have formed 17 identifiably separate Muslim *samaj*, or residential brotherhoods, and four Hindu *samaj*. A major problem for all quantitative research in Bangladesh since the first British census in the 19th century has been the use of geographic rather than social units of reference. The *samaj* are functioning social units of great importance to the rural population. However, unlike geographic areas whose boundaries are permanently fixed, *samaj* membership is variable over time and is not readily apparent to outside observers. From the anthropologist's point of view, the residential brotherhoods should be one of the social units of analysis. That they are not is regrettable, but understandable. To analyze the data in the BMS in terms of the revenue units would give a misleading picture of rural life. Elsewhere (Thorp 1978a:119f), I have discussed how the data for Rangpur must be amplified to discuss the samaj to which all the members of this revenue unit do belong, along with a number of others from the surrounding revenue units.

Presently, I am using data in the BMS concerning the religion and the sex of the householders, or maliks, to establish one set of categories (see Tables 2 and 3) which can be used in examining the socio-economic data contained in the BMS. In particular, I have been examining the data about the possession and use of cropland. The BMS contains extensive data about both of these variables. The data are recorded in increments of 0.33 acre between 0 and 1 acre; in increments of 0.50 acre between 1 and 9 acres; in increments of 0.75 acres between 9 and 9.75 acres; and in increments of 5 acres between 9.75 and 30 acres. Such an array of landholding or landusing units is unmanageable, and some way of reducing the number of units are needed. Januzzi and Peach (1977) in the LOS propose a number of categories. First of all, the LOS groups together as 'landless' farmers those who own or use less than 0.5 acres of cropland; secondly, in the LOS 'small farmers' have holdings of three acres or less. The first two categories in Tables 2 and 3 are approximately the same as the LOS categories of landless and small farmers. In order to establish the other categories in these tables I have used the farmers' own ideas about what it takes to be a larger farmer. In this, I depart from conventions of both the LOS and the PEIC.

**Table 1. Introductory Demographics**

| Revenue units | | Population | Household | Muslim | Hindu | Christian | Householder | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Male | Female |
| Sujanagor | | 119 | 21 | 21 | - | - | 19 | 2 |
| Rajganj | | 906 | 162 | 162 | - | - | 156 | 6 |
| Faridpur | | 292 | 45 | 45 | - | - | 45 | - |
| Sirajganj | | 283 | 51 | 51 | - | - | 50 | 1 |
| Santhia | | 421 | 67 | 52 | 14 | 1 | 49 | 3 |
| Kazipur | | 680 | 102 | 86 | 16 | - | 85 | 1 |
| Taras | | 175 | 31 | 25 | 6 | - | 24 | 1 |
| Uttarchak | | 627 | 91 | 71 | 20 | - | 67 | 4 |
| Rangpur | | 346 | 54 | 54 | - | - | 51 | 3 |
| Belkuchi | | 334 | 47 | 47 | - | - | 47 | - |
| Total | N | 4183 | 671 | 614 | 56 | 1 | 593 | 21 |
| | % | | | 92 | 8 | | 97 | 3 |

### Table 2. Householders' Religion and Sex by Cropland Possessed

| Householders | | Muslim Male N | Muslim Male % | Muslim Female N | Muslim Female % | Hindu Male N | Hindu Male % | Christian Male N | Christian Male % | Total N | Total % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Landless | N | 281 | 84 | 10 | 3 | 44 | 13 | - | - | 335 | - |
| (0-0.66 acres) | % | 47 | - | 48 | - | 79 | - | - | - | - | 50 |
| Small farmers | N | 153 | 93 | 7 | 4 | 3 | 2 | 1 | 1 | 164 | - |
| (0.66-3) | % | 26 | - | 33 | - | 5 | - | 100 | - | - | 24 |
| Medium farmers | N | 86 | 94 | 2 | 2 | 4 | 4 | - | - | 92 | - |
| (3-6) | % | 15 | - | 10 | - | 7 | - | - | - | - | 14 |
| Big farmers | N | 43 | 94 | 1 | 2 | 2 | 4 | - | - | 46 | - |
| (6-10) | % | 7 | - | 5 | - | 4 | - | - | - | - | 7 |
| Super farmers | N | 30 | 91 | 1 | 3 | 2 | 6 | - | - | 33 | - |
| (10-35) | % | 5 | - | 5 | - | 4 | - | - | - | - | 5 |
| No information | N | - | - | - | - | 1 | 100 | - | - | 1 | - |
| | % | - | - | - | - | 2 | - | - | - | - | - |
| Total: | N | 593 | | 21 | | 56 | | 1 | | 671 | |
| | % | | 88 | | 3 | | 8 | | | | 99 |

*Chi-square = 37.22099 with 15 degrees of freedom. Significance = 0.0012*

**Table 3. Householders' Religion and Sex by Cropland Used**

| Householders | | Muslim Male | | Muslim Female | | Hindu Male | | Christian Male | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % |
| Landless | N | 289 | 84 | 14 | 4 | 43 | 12 | - | - | 346 | - |
| (0-0.66 acres) | % | 49 | - | 67 | - | 77 | - | - | - | - | 52 |
| Small farmers | N | 149 | 94 | 4 | 3 | 4 | 3 | 1 | 2 | 158 | - |
| (0.66-3) | % | 25 | - | 19 | - | 7 | - | 100 | - | - | 24 |
| Medium farmers | N | 85 | 94 | 1 | 1 | 4 | 4 | - | - | 90 | - |
| (3-6) | % | 14 | - | 5 | - | 7 | - | - | - | - | 13 |
| Big farmers | N | 42 | 93 | 1 | 2 | 2 | 4 | - | - | 45 | - |
| (6-10) | % | 7 | - | 5 | - | 4 | - | - | - | - | 7 |
| Super farmers | N | 28 | 90 | 1 | 3 | 2 | 7 | - | - | 31 | - |
| (10-35) | N | 5 | - | 5 | - | 4 | - | - | - | - | 5 |
| No information | N | - | - | - | - | 1 | 100 | - | - | 1 | - |
| | % | - | - | - | - | 2 | - | - | - | - | - |
| Total: | N | 593 | | 21 | | 56 | | 1 | | 671 | |
| | % | | 88 | | 3 | | 8 | | | | 101 |

*Chi-square = 34.59335 with 15 degrees of freedom. Significance = 0.0028.*

The possession and use of 6 acres or more seems indisputably to constitute a person as a 'richman', and potentially a 'bigman' in rural society. A person owning and using between three and six acres is in a position to improve his situation, if the combination of circumstances involved in producing a crop and marketing it are all in his favour. The final categorization of the big farmers into two groups seems necessary to adequately represent the original data. Grouping together people who own and use six acres and those who own upwards of 30 acres does not seem justified. (My data shows the largest farmer owning 35 acres.)

A number of things are significant about Tables 2 and 3. First of all, Muslim females are householders, *maliks*, in Daripalla. Women are able to own land according to my informants, and I saw actual deeds for land in women's names. The females in Tables 2 and 3 are all widows who succeeded their husbands as householders either because there were no sons, or because their sons were minors. With the exception of actually 'going out into the fields' these women behave as the maliks of their families in all other respects. A second significant social act is hidden in the figures for male Muslim householders. An unfortunately unknown number of these men are married to women who possess land in their own names, usually as the result of inheriting it or having itbestowed upon them by their fathers. That women are maliks and that married women own land both run counter to commonly held conceptions about the status of women in rural society. A third social fact evident in these two tables concerned the size and the composition of the Hindu community in Daripalla. These Hindu householders represent only eight percent of Daripalla's households which is below the percentage of Hindus for all of Bangladesh (approximately 12%). Furthermore, a far larger proportion of the Hindu householders (79%) are in the landless category of farmers than are their Muslim neighbors (47%). Nevertheless, Hindus are represented in all the categories of larger farmers. Hindu society in Daripalla continues to exist, albeit on a considerably reduced scale than in the past.

In examining Tables 2 and 3 in light of my own experience in Daripalla, I am uneasy about the category of 'landless farmers' as it is now defined. Although it is empirically justifiable to categorize those farmers who possess less than 0.66 acre as functionally landless, I do not feel this categorization is culturally justifiable. To own as little as 0.01 acre of cropland makes a significant difference in a Daripallan's self-concept. To possess only a homestead plot also makes a considerable differences in the perception a person has of himself and in the perceptions his neighbors have of him. No matter how little, or what kind of land is possessed, to possess any land at all establishes a Daripallan as a true son of Adam. I believe these cultural conceptions should be, and can be, taken into account in preparing statistical data.

Tables 4 and 5 present a break-up of the farmers included in the 'landless' category according to the actual amounts of cropland possessed and used. Included in this landless category are seven percent of the householders, who actually do possess cropland. Having been shown these small plots by a number of very proud possessors when I 'went out into the fields' with them, I cannot be satisfied with categorizing them as 'landless'. This seven percent of the householders definitely distinguish themselves from those householders in the nil category in Tables 4 and 5. I would propose that another category of marginal landholders is necessary between the nil category and the category of small farmers in Tables 4 and 5. Recoding the data so that householders who possess upwards of 0.66 of an acre and those who possess between 0.66 acre and 1.5 acres are grouped together as marginal farmers, results in 124 householders who represent 18 percent of Daripalla's households. Thus, the totals for each category will be as in Table 6. These categories seem adequate to examine the possession and use of cropland.

However, I believe still more needs to be said about the definition of 'landlessness'. So far, persons in this category are defined by the absence of cropland which is the convention in the LOS and the PEIC. Table 4 shows there are at least 288 householders in this category in Daripalla. A majority of these persons, it must be noted, do possess some homstead land. From Daripallans' point of view this saves them from being entirely dispossessed of their birth-right as heirs of Adam. To make significant statements about the social organization of rural life those who own only a homestead site need to be distinguished from those members of rural society who do not possess even that. Fortunately, the BMS contains other variables which make it possible to pursue this distinction further. Table 7 contains information about householders' primary sources of income cross-tabulated by their sex and religion. The occupational categories in this table represent aggregations of the data as coded in the BMS into broad categories as follows: persons engaged in agriculture who possess cropland, agriculturalists who own only a homestead, agriculturalists without even a homestead, and female agriculturalists. There is also a category of persons whose occupations are non-agricultural. Thus, in Table 7 we see that 176 agriculturalists possess only their homesteads, while 50 agriculturalists do

**Table 4. 'Landless' Householders' Religion and Sex by Actual Cropland Possessed**

| Householders | | Nil | | 0 to 0.33 acres | | 0.33 to 0.66 acres | | Others | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % |
| Muslim Male | N | 239 | 40 | 21 | 4 | 21 | 4 | 312 | 53 | 593 | - |
| | % | 83 | - | 91 | - | 88 | - | 93 | - | - | 88 |
| Muslim Female | N | 8 | 38 | 1 | 4 | 1 | 4 | 11 | 52 | 21 | - |
| | % | 3 | - | 4 | - | 4 | - | 3 | - | - | 3 |
| Hindu Male | N | 41 | 73 | 1 | 2 | 2 | 4 | 12 | 21 | 56 | - |
| | % | 14 | - | 4 | - | 8 | - | 4 | - | - | 8 |
| Christian Male | N | - | - | - | - | - | - | 1 | 100 | 1 | - |
| | % | - | - | - | - | - | - | - | - | - | - |
| Total | N | 288 | | 23 | | 24 | | 336 | | 671 | |
| | % | | 43 | | 3 | | 4 | | 50 | | 99 |

**Table 5. 'Landless' Householders' Religion and Sex by Actual Cropland Used**

| Householders | | Nil | | 0 to 0.33 acres | | 0.33 to 0.66 acres | | Others | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % |
| Mulim Male | N | 244 | 41 | 21 | 4 | 24 | 4 | 304 | 51 | 593 | - |
| | % | 82 | - | 91 | - | 96 | - | 94 | - | - | 88 |
| Muslim Female | N | 13 | 62 | 1 | 5 | - | - | 7 | 33 | 21 | - |
| | % | 4 | - | 4 | - | - | - | 2 | - | - | 3 |
| Hindu Male | N | 41 | 73 | 1 | 2 | 1 | 2 | 13 | 23 | 56 | - |
| | % | 14 | - | 4 | - | 4 | - | 4 | - | - | 8 |
| Christian Male | N | - | - | - | - | - | - | 1 | 100 | 1 | - |
| | % | - | - | - | - | - | - | - | - | - | - |
| Total: | N | 298 | | 23 | | 25 | | 325 | | 671 | |
| | % | | 44 | | 3 | | 4 | | 48 | | 99 |

**Table 6. Categories of Landholders**

| Categories | N | % |
|---|---|---|
| Landless | 288 | 43 |
| Marginal (0.01-1.5 acres) | 124 | 18 |
| Small (1.5-3 acres) | 87 | 13 |
| Medium (3-6 acres) | 92 | 14 |
| Big (6-10 acres) | 46 | 7 |
| Super (10-35 acres) | 33 | 5 |
| No information | 1 | - |
| Total | 671 | 100 |

not possess even that. This only accounts for 226 of the 288 householders in Table 4 who are without any cropland. The remaining 62 householders are to be found in the categories of female agriculturalist and non-agriculturalist. Unfortunately, the status of particular individuals in these two categories has to be reconstructed from the data scattered in other variables in the BMS, and from my own ethnographic knowledge of the area. First of all, of the 16 female agriculturalists five are without any cropland, but they do possess their own homesteads. Five other women are included in the non-agriculturalist category. Three of these women are without cropland and support themselves through begging. As far as I know, they do not own the sites where their homesteads are located. Thus, we now have 181 homestead-possessing agriculturalists, and 53 householders who possess no land of any kind. Of the 110 remaining non-agriculturalists, 54 own no cropland. To the best of my knowledge, all 54 do own their own homesteads. Thus we now have 235 householders who are without cropland but do own their homesteads. They represent 35 percent of the householders in Daripalla. In a minimal sense at least, these householders are maliks because they possess some land.

The 53 householders who are without even their own homestead represent 8 percent of the householders. These persons are the truly 'landless' in terms of the cultural conceptions of their peers. They cannot 'go out into the fields'. They do not have even the security of their own green vegetable garden or a fruit bearing tree near their dwelling. They are not masters, *maliks*, of anything. Their residence in Daripalla is at the pleasure of some other householder, upon whom they are dependent. These are the truly powerless in rural Bangladeshi society.

To summarize, I am proposing that the following culturally relevant categories of persons are necessary for an in-depth investigation of rural Bangladeshi society:

**Table 7. Primary Occupation (Income) by Religion and Sex of Householders**

| Primary occupation (income) | | Muslim Male | | Muslim Female | | Hindu Male | | Christian Male | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % |
| Farming | N | 299 | 97 | - | - | 10 | 3 | 1 | - | 310 | - |
| owner | % | 50 | - | - | - | 18 | - | 100 | - | - | 46 |
| Farming | N | 165 | 94 | - | - | 11 | 6 | - | - | 176 | - |
| homestead | % | 29 | - | - | - | 20 | - | - | - | - | 26 |
| Farming | N | 37 | 74 | - | - | 13 | 26 | - | - | 50 | - |
| landless | % | 6 | - | - | - | 23 | - | - | - | - | 8 |
| Farming | N | 0 | - | 16 | 100 | 0 | - | - | - | 16 | - |
| female | % | 0 | - | 76 | - | - | - | - | - | - | 2 |
| Non- | N | 88 | 77 | 5 | 4 | 22 | 20 | - | - | 115 | - |
| farming | % | 15 | - | 24 | - | 40 | - | - | - | 17 | - |
| No | N | 4 | 100 | - | - | 0 | - | - | - | 4 | - |
| Information | % | 1 | - | - | - | - | - | - | - | - | 1 |
| | N | 593 | | 21 | | 56 | | | | 671 | |
| Total | % | | 88 | | 3 | | 8 | | | | 100 |

Chi-square = 565.44189 with 15 degrees of freedom. Significance = 0.0000

**Table 8. Culturally Relevant Categories of Landholders**

| Categories | N | % |
|---|---|---|
| Landless (without homestead) | 53 | 8 |
| Homesteaders | 253 | 35 |
| Marginal cropland holders | 124 | 18 |
| Small cropland holders | 87 | 13 |
| Medium cropland holders | 92 | 14 |
| Big Cropland holders | 46 | 7 |
| Super cropland holders | 33 | 5 |
| No information | 1 | - |
| Total | 671 | 100 |

These categories take into account the conceptions of landholders themselves concerning the possession of land, and they are also empirically verifiable in the field. At least, they are verifiable for Daripalla. With minor adjustments in acreage ranges they would also be verifiable throughout Bangladesh. Similar culturally relevant categories could and should be created for use in other non-Muslim areas of South Asia.

# CONCLUSION

The figures in Table 8 for landlessness run counter to the prevailing 'wisdom' about landlessness in Bangladesh. Persons who are outsiders to rural Bangladeshi society regularly refer to a rate of 'landlessness' of better than 40 percent of the rural population. As the discussion of Tables 2 and 3 above shows, this figure is usually arrived at by considering anyone who owns less than 0.5 or 0.33 acre of cropland as 'landless' (see Januzzi and Peach 1977:xxii, 39-41; and Qadir et al.1978:33-34). This approach to the categorization of landholders and non-land holders is an oversimplification which might be useful for convincing aid-giving agencies of the urgency of supporting development schemes. However, 'landlessness' so defined is not an operative category for the implementation of planned social change. Forty percent of the rural population is not disaffected with their situation, ready and waiting for the implementation of land reform and cooperative schemes.

The significant figure in Table 8 is that 35 percent of Daripalla's householders are in the category of 'homesteader'. They can and do consider themselves complete, masterful persons, *maliks*, according to their age-old cultural conceptions. Nevertheless, they are concerned about their sons' and daughters' futures when it comes time to divide an already severely reduced patrimony. The farmers of Daripalla, at least, know significant change is coming. Although they do not distinguish social change (such as land reform schemes) from cultural change (such as redefining a *malik*), they are aware of both possibilities. They vehemently dislike the idea of any government-imposed rearrangement of land holdings through land reform. Even the homesteaders of Table 8 seem opposed to such efforts at social change. On the other hand, these farmers have already begun the process of redefining their cultural conceptions about being a *malik*. Outsiders to this society need to pay attention to, and accommodate their development schemes to, these cultural realities. Unless outside change-agents at least acknowledge that Bangladeshi farmers have ideas of their own about changing rural society, they will be part of the farmers' problems instead of being part of the solution. A basic starting point for this kind of cultural sensitivity should be the use of culturally relevant socio-economic categories for data collection. The categories elaborated here are meant to be such.

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# II. COMMON MANAGEMENT OF NATURAL RESOURCES

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# II.1

# IRRIGATION AND HONOR: CULTURAL IMPEDIMENTS TO THE IMPROVEMENT OF LOCAL LEVEL WATER MANAGEMENT IN PUNJAB, PAKISTAN[1]

Douglas J. Merrey

"Social organizations are the central vehicles through which water management technologies are delivered, utilized, improved, and maintained." (Freeman and Lowdermilk 1978:704)

## INTRODUCTION

In recent years the organization of irrigation systems has become an important research topic among social scientists. No adequate theoretical perspective, either for understanding the structure and operation of single systems, or for making useful comparisons among systems, has yet been developed (Hunt and Hunt 1976; Freeman and Lowdermilk 1978). However, organization and management have come to be recognized as of central importance, not only in terms of their political implications (Wittfogel 1957), but as major constraints on the productivity, stability and efficiency of irrigation systems.

Pakistan has one of the largest and most complex irrigation systems in the world, and the country is heavily dependent on its irrigated agriculture. This system is operating at a very low level of efficiency, whether measured in terms of world-wide agricultural production standards, or in terms of its potential productivity (Corey and Clyma 1975; Government of Pakistan, Planning Commission 1978). In addition to the large number of reports identifying the technological deficiencies in the system, there have been several recent sociological studies on organizational problem (cited below). Inadequate and inappropriate organization appears to be the major constraint retarding the efforts to improve Pakistan's irrigation system.

As useful as these recent studies are, they remain incomplete as explanations of the management of irrigation in Pakistan for two reasons:

(1) All of these studies are focused on the village/watercourse level, that is, the primary informal relationships among irrigators at the village and watercourse level. There are as yet no studies of the workings of the Provincial Irrigation Departments themselves, or how these departments relate in practice to the users of the water and to other related departments such as Agriculture and the Water and Power Development Authority (WAPDA).[2]

(2) All of the studies to date focus on social structural attributes of the local system. However, none has discussed the culture of irrigation, that is, the rules, goals, assumptions, and beliefs of the actors in the system; nor have they discussed the strategies pursued by these actors.

If planners and policy makers wish to develop effective programs, they must have a thorough understanding of the culture of their clients. If it is assumed that farmers in rural Pakistan, for example, share with the planners the same set of values, goals, and assumptions, any program developed based on this assumption is likely to fail. Therefore, in this paper a brief summary of the recent sociological research on local level water management in Pakistan is presented. Then, after presenting a working definition of culture, and briefly describing what happened during the course of reconstruction of one watercourse, the fundamental theme or focus in rural Punjabi culture and its implications for improving water management in Pakistan is discussed. This is the concept of "izzat" which may be glozzed as "honor", "prestige", or "reputation". The discussion is based on detailed field work in one village, supplemented by experience with a broader study of watercourse organizational problems (Mirza and Merrey 1978). The goal is to identify and discuss the implications of a major feature of Punjabi rural culture that must be considered if effective forms of social organization for water management as well as other productive purposes are to be developed. Throughout the paper Punjabi culture is discussed specifically, as most of the research has been done in Punjab; but the major conclusions and their implications are relevant for the other provinces of Pakistan as well.

# SUMMARY OF SOCIOLOGICAL FINDINGS

## *Terminology*

Before proceeding further, a few comments on terminology seem necessary. In general, Punjabi villagers recognize several ranked categories of people. The three major categories are *sayid, zamindar*, and *kami. Sayids* are believed to be descendents of the Prophet Muhammed, and are therefore supposed to be respected; when they own land, they may, for the purposes of this report, be included with *zamindars*. In Punjabi, "zamindar" is best translated as "agriculturalist", and includes "castes" such as "Jat" and "Rajput" who traditionally are farmers or at least land owners. *Kamis* are traditionally non-agriculturalist "castes" who may have a skill (carpenters, blacksmiths, potters) or be unskilled laborers (e.g. *Masali*). Their caste and their profession overlap and are hereditary both in theory and to a large extent in practice. *Kamis* traditionally work for particular farmers and are paid at harvest time and have certain ceremonial roles; these ties are however weakening and being replaced by purely cash relationships. Though *kamis* do sometimes play important roles, village politics and water management are mainly the concern of *zamindars*. Therefore, this report, like the other studies to be discussed, will not discuss the role of *kamis*.

Sociological studies of rural Pakistan tend to use "caste" (the usual translation for *zat* and *qaum*), "subcaste" and "brotherhood" (i.e., *biraderi*) rather loosely and inter-changeably. In fact, certain "castes", such as Arains and Gujars, tend not to be further subdivided within villages, though there are exceptions; but the local group is still best referred to as a "biraderi". Jat and Rajput "castes" on the other hand, often, but not always, are further subdivided into local groups, also referred to as *biraderis* by the people themselves. "Caste" is in quotation marks because it is an open question as to whether this is even the appropriate term to use here.

Alavi (1972), who presented the best discussion of "biraderi", says that kinship, not caste, is the major basis for rural Punjabi social organization, and "biraderi" is the basic kinship institution. The term *biraderi* has several referents depending on context, but its most significant referent for the purpose of this report is what Alavi (1972) terms the "biraderi of participation", whose members generally reside in one village. Although common patrilineal descent is the premise of this group, horizontal (fraternal, including cousin) ties receive special emphasis; these are reinforced by marriage relationships and ritual exchanges (*vartan bhaji*) on certain ceremonial occasions. Brothers and cousins of all types exchange sisters and daughters in marriage, both ideally and in practice, leading to a high degree of *biraderi* endogamy. The terms "caste", "subcaste", and "biraderi" from the literature are all used in this report as "briaderi" and mean the *biraderi* of participation. It is important to keep in mind that since "biraderi" has different referents in different contexts, they are not necessarily bounded groups (see Alavi 1972).

## *Sociological Conclusions*

All of the studies reviewed here have been carried out under the auspices of the Colorado State University Water Management Research Project in Pakistan. All have focused specifically on the local level organizational factors enhancing or inhibiting the introduction of programs for watercourse reconstruction and maintenance. This issue is important as Pakistan has launched an On-Farm Water Management Pilot Project, whose key element is watercourse reconstruction. In this project, the government provides technical advice and materials (bricks, cement, and cement water-control structures); the shareholders on a watercourse are expected to provide all labor and keep the watercourse maintained after it has been rebuilt. If this project is successful millions of acre-feet of water, now wasted, can be saved and utilized to improve production at a relatively low cost (see Eckert, Dimick, and Clyma 1975). However, its success depends on effectively organizing farmers to reconstruct, maintain, and manage their own watercourses.

The major conclusions of the sociological studies under review are:

(1) The "central mobilizing social unit" at the village and watercourse level is the *biraderi* (Lowdermilk Freeman, and Early 1978 Vol. IV:184-85; also see Lowdermilk, Clyma, and Early 1975:32-42; Freeman and Lowdermilk 1976:653-58; Mirza 1975; Mirza and Merrey 1978). *Biraderis* play an important role in mosque and school construction as well as traditional watercourse maintenance.

(2) A high level of polarization and conflict in a village makes organizing such communities for watercourse improvement a risky business (Freeman and Lowdermilk 1976:693-705; Lowdermilk, Freeman, and Early 1978 Vol. IV:199-201; Mirza and Merrey 1978)[3]. Such conflict is generally between *biraderis*, or if within a *biraderi*, tends to split it into two *biraderis*.

(3) Communities characterized by two (or more) *biraderis* of agriculturalists of about equal size and power will exhibit more tendency toward

polarization and be more difficult to organize for collective projects (Mirza 1975:96)[4]. Conversely, communities dominated by a single *biraderi*, or having a number of small *biraderis* none of which are dominant, may be better candidates for collective projects (Mirza and Merrey 1978). It is important to note here that the number of *biraderis*, and the degree of polarization of a community, are not permanent characteristics of a community; rather they are points on a longer development cycle. This has not been explicity recognized by any of the studies under review except Mirza and Merrey (1978).

(4) Communities with a relatively equal distribution of power and influence (and/or landholding) and a high percentage of people recognized as influential are better candidates for cooperative projects than those dominated by a few powerful people, or those having no influential people. This is still an hypothesis and not conclusively confirmed (Lowdermilk, Freeman, and Early 1978 Vol. IV:225-27; Mirza 1975; Mirza and Merrey 1978).[5] However, preliminary analysis of the Water Users Association data supports this view (Mirza and Merrey 1979).

(5) Not only are large landlords generally less cooperative in cleaning and maintaining the watercourse and more prone to factionalism (Mirza 1975), but also they tend more often to violate sanctions (such as for non-participation in watercourse cleaning) than smaller farmers (Lowdermilk, Freeman, and Early, 1978 Vol.I:71). These observations are contrary to the assumptions often made by policy-makers.

(6) Power and influence are significantly associated with size of landholdings, mass media exposure, and high adoption of improved technology (Freeman and Lowdermilk 1976:706-709). Other factors such as personality and official contacts are also very important.

(7) Previously existing forms of cooperation or a previous history of successful cooperation on community projects are important predictors of likely success in watercourse improvement projects (Mirza 1975; Lowdermilk, Clyma, and Early 1975:41-42; Mirza and Merrey 1978).[6]

(8) Cooperation for watercourse improvement is more likely to be successful where there is a single government-sanctioned watercourse branch (*sarkari khal*) (Mirza and Merrey 1978).

(9) Cooperation for watercourse improvement is also more likely to be successful on watercourses with fewer shareholders (Mirza 1975).

(10) Farmers at the tail of a watercourse are more likely to support cooperative efforts at watercourse improvement since their potential gains are greater than those at the head (Mirza 1975).

(11) Equality of influence on all sections of the watercourse, or concentration of influence at the middle and tail, seem to be conducive to

successful cooperation for watercourse improvement (Mirza and Merrey 1978). That is, if the influential people stand to gain substantially they are more likely to support and get others to support the project.

(12) A high level of "progressiveness" as measured by educational level, exposure to mass media, etc., seems to be an important predictor of cooperation on community projects (Mirza and Merrey 1978).

## STRATEGIES, RULES, AND GOALS: THE CONCEPT OF CULTURE

The sociological factors affecting the ability of Pakistani farmers to cooperate on a watercourse improvement program that have been summarized above seem likely to be confirmed in a study presently being conducted on water users associations (Mirza and Merrey 1979). One could criticize the list of findings or at least add to it; nevertheless they provide very useful guides, especially on choosing communities where the likelihood of a successful watercourse program will be greater (Lowdermilk, Freeman, and Early 1978; Freeman and Lowdermilk 1976; 1978). However, they do not tell us why people behave as they do; that is, why are *biraderis* so competitive? Why do Pakistani farmers find it so difficult to cooperate on projects they themselves recognise as beneficial? Why is there such a dearth of "constructive" and effective civic-minded community leaders? The answers to these questions may be sought at several levels of abstraction; but since our purpose is to identify factors relevant to planning effective forms of farmer irrigation associations, given present social conditions in rural Pakistan, I shall focus on specific cultural factors that underly the sociological ones described above.

By "culture" I mean all of the precepts, concepts, recipes, skills, values, standards, goals, etc. that people learn and in terms of which they behave and interpret others' behavior. What has been learned must be clearly distinguished from its material manifestation: overt behavior, and statistical patterns of behavior that may be observed and counted. In these terms, the locus of culture, since it is learned, is within individuals; social and economic systems which we observe in operation "are created and maintained as products or by-products of culturally guided human action and, as such are artifacts of culture" (Goodenough 1963: 271).

There are, then, two orders of phenomena here toward which a prediction is directed (Goodenough 1963:269; 1971: 20-21). One is actual behavior, a statement of probabilities based on a sample of past events, such as "a watercourse whose members are divided into two opposing *biraderis* are prone to conflict". The other type of prediction is based on standards of behavior, that is culture: the rules and standards in terms of which people operate, judge others, and predict, the goals people pursue, and the strategies used to achieve their goals. A description of a culture is a predictive statement in the same sense as a grammar is for language: it does not tell us what people will do, necessarily, but what things are regarded as appropriate under particular circumstances.

There is a complex feedback relationship between these two levels of phenomena (Goodenough 1963; 1971) whose ramifications are beyond the scope of this paper.[7] This relationship is an important consideration in understanding social and cultural change, and in planning innovations. Even if a new form of organization is introduced, people are likely to continue behaving within it in terms of their previous culture, and will assume others in their society will too. If these rules and standards are inappropriate for the successful operation of the new form, it will fail, or at least be transformed into something quite different from the original intentions of the initiator. On the other hand, if behavior in terms of the old rules proves disadvantageous (psychologically as well as materially) to the people involved, and behavior in terms of the new is seen as advantageous, people can and do change their culture.

# WATERCOURSE RECONSTRUCTION: A CASE STUDY

## *Canal Irrigation: Its Initial Impact on One Village*

As part of a larger study of the relationship between the introduction of canal irrigation and social organization[8], the author had an opportunity to observe an experimental attempt at carrying out a watercourse improvement program. The village studied, "Gondalpur" (a pseudonym), is located in Central Punjab, on the Ghaj "doab" (the area between the Jhelum and Chenab Rivers). This part of the *doab* has traditionally been called "Gondal Bar" because historically the Gondal "tribe" dominated the area.

Before 1901 there was no canal irrigation in this area. The ancestors of many of the present inhabitants of Gondalpur had herds of camels, sheep, goats, cows, and water buffalo; they also had one Persian well (*chai*) irrigating 18 acres of land as of 1857, and practiced some rainfed agriculture. As the accompanying table (Table 1) shows, during the 49 years between the first British land settlement (1857) and the arrival of

**Table 1. Changes in Population and Cultivated Area in Gondalpur Since 1857[a]**

| Year | Population | Area sown once a year in acres | | | |
|---|---|---|---|---|---|
| | | Rainfed | Irrigated | | Total |
| | | | Well | Canal | |
| 1857 | 67[b] | 46.5 | 18 | 0 | 64.5 |
| 1881[c] | 215 | - | - | - | - |
| 1888/89 | - | 125 | 44 | 0 | 169 |
| 1891[c] | 310 | - | - | - | - |
| 1901/02 | 568 | 186 | 47 | 0 | 233 |
| 1904/05 | - | 152 | 36 | 86 | 274 |
| 1909/10 | - | 1 | 0 | 605 | 606 |
| 1911[c] | 565 | - | - | - | - |
| 1921[c] | 767 | - | - | - | - |
| 1931[c] | 758 | - | - | - | - |
| 1936/37 | - | 374 | 0 | 492 | 866 |
| 1951[c] | 914 | - | - | - | - |
| 1955 | 1027 | 104 | 0 | 654 | 758 |
| 1961[c] | 1117 | - | - | - | - |
| 1968/69 | - | 87 | 0 | 668 | 755 |
| 1972[c] | 1246 | - | - | - | - |
| 1977[d] | 1444 | - | - | - | - |

[a] Source: unpublished village records.

[b] The 1857 settlement record gives the following population data:

| Households | People | zat | |
|---|---|---|---|
| 10 | 56 | Gondals | |
| 1 | 2 | Mochi | (leatherworkers) |
| 3 | 9 | Cuhra | (non-Muslim, very low status, untouchables) |
| ------ | ------- | | |
| 14 | 76 | Total | |

[c] Census figures taken from unpublished village records to 1951; 1961 and 1972 figures are from *District Census Reports* (Gujrat) for these years.

[d] Based on complete household census. The number of *zats* had increased to 24 in 1977.

the canal water in Gondalpur (1904/05), there was a substantial rise in population, much of it because of immigration, and a gradual extension and intensification of agriculture. There was also a fairly large-scale transfer of control over land to outsiders — and a concomitant increase in tenancy; and a large increase in the number of "castes" represented.

The Lower Jhelum Canal was officially opened in 1901, but its water did not reach Gondalpur until the 1904-05 *rabi* (winter) season. Its impact was immediate: hundreds of acres of land came under cultivation during both the summer (*kharif*) and winter (*rabi*) growing seasons.

Former herders and part-time farmers became full-time farmers, either on their own land or as tenants on others' lands. The area available for grazing animals declined so that even a few years after the canal was introduced most farmers were devoting a substantial percentage of their land to growing fodder for their animals. Other changes since the introduction of canal irrigation include a further rise in population, increasing fragmentation of land holdings, and increasingly intensive agriculture. As is true elsewhere in Punjab, the water table has also risen 40 to 60 feet so that today nearly everywhere it is less than 20 feet below the surface. In some areas it is less than five feet, and a large low-lying tract in Gondalpur has become waterlogged and an adjacent previously productive area saline and unproductive.

Gondalpur land is irrigated by three watercourses, all of whose heads are located in other villages, and controlled by other farmers larger and more powerful than any Gondalpur farmer. On two of them, most of even the Gondalpur land is owned by outsiders and cultivated by Gondalpur tenants. The third watercourse, where the improvement project was done, has several separate branches, as the accompanying map shows (Figure 1). One branch passes through the center of "Chak Aziz" (a pseudonym). The main branch follows the line between Chak Aziz and yet another village into Gondalpur, then divides into three sub-branches which primarily irrigate the holdings of Gondalpur farmers.

## Watercourse Social Organization

The Gondals are the dominant land owners in Gondalpur. As Table 2 shows, they are divided into four major named *biraderis*, the Khudaya (branch D), Khizarane (branch B), Muradke (branch C), and Miane. The first three named so dominate particular branches of the watercourse that these are known by their names. Members of other *biraderis* also have land on various branches. A few Awan have very small holdings on B and C; two Bhattis have some land on branch B, as do three Sayid refugee families; and some Muradke and Khudaya have land on branch B[9]. On branch D, aside from the Khudaya, a few Pindi farmers also have land, as do the religious leaders of Gondalpur, the Miane. The Numberdar[10] and his family, having relatively large holdings (50-80 acres), are Khudaya; the Miane holdings are also relatively large (25 acres for each of three households) while the other two Gondal *biraderis* are mostly small farmers (5 to 20 acres).

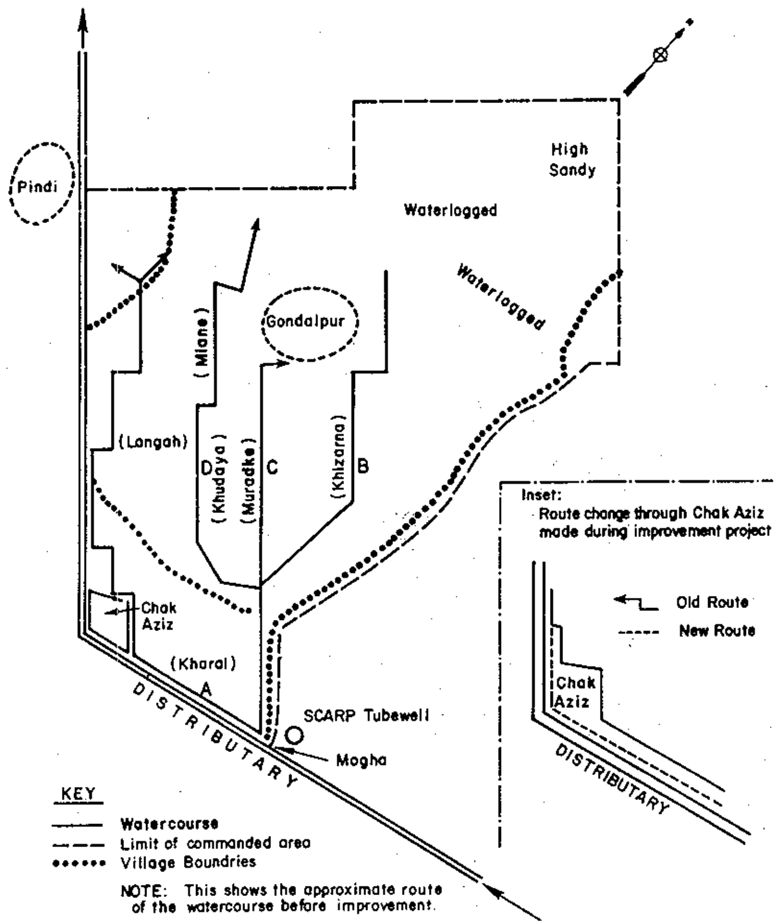


**Figure 1. Sketch Map of Watercourse Gondalpur**

**Table 2. Zamindar Biraderis Involved in Watercourse Reconstruction**[a]

| *Biraderi* | Number of Households | Number of People | Watercourse branch[b] | Position on branch |
|---|---|---|---|---|
| Gondal-Khudaya | 11 | 70 | mainly on D; a little on B. | Head; Middle; Tail |
| Gondal-khizarane | 21 | 105 | B | Head; Middle; Tail |
| Gondal-Muradke | 7 | 43 | C; a little on B. | Head; Middle; Tail |
| Gondal-Miane | 5 | 36 | D; a little on A | Tail; Middle; |
| Langah | 5 | 36 | A | Middle |
| Awan | 11 | 47 | B and C - very small holdings | Middle |
| Bhatti-Rajeane[c] | 18 | 78 | B (2 house-holds) | Middle |
| Sayid | 3 | 25 | B | Head; Middle |
| non-Gondalpur *biraderis:* | | | | |
| Kharal (Chak Aziz) | 3 | ? | A (a little on B) | Head |
| Pindi *Biraderis*[d] | under 10 | ? | A & D | Tail on both |

[a] This is not a complete list of all *biraderis* in Gondalpur; only those having land irrigated by the watercourse reconstructed are listed. Figures are based on 1977 complete household census.

[b] See sketch of watercourse.

[c] Only two households of this *biraderi* have land on this watercourse. There are 7 Bhatti *biraderis* in Gondalpur with a total of 90 households and 416 people as of 1977.

[d] These *biraderis* did not play an important role in the improvement project — their major holdings are on other watercourses; they generally acted together on this project.

At the head of branch A are four related households of Kharal *zat.* One has become a very large landowner (about 300 acres), having bought much land elsewhere. He has about 50 acres on this watercourse. His brother also has about 50 acres on branch A and their half-brother's two sons have about 50 acres between them. Though these two half-brothers' sons often quarrel with each other they did not do so during the watercourse project; they are referred to here collectively as the "step-nephews". Following the Kharal, on Gondalpur land, branch A irrigates the land of several small Langah farmers (one to ten acres). The members of this *biraderi*, though poor, have marriage relations with the Khudaya, Muradke, Kharal, and a large Pindi landlord. Some land belonging to the Gondalpur Miane is irrigated after the Langahs', then at the tail branch A irrigates small portions of the relatively large holdings of several Pindi families.

## *Watercourse Conditions Before Improvement*

Pakistan's irrigation system is a continuous flow system. Farmers have a right to water proportional to the size of their holdings. Usually they get water at a fixed time on a weekly basis. From the beginning, government policy has been to interfere as little as possible in local water management; the Irrigation Department directly manages the headworks, canals, and distributaries, but not the watercourses. When the system was built the government laid out the route of the watercourses, but their building and maintenance was the responsibility of the shareholders. The government retains residual powers activited by appeals from farmers to set water rotations, settle disputes, or change the route (see Johnson, Early, and Lowdermilk 1977: 1237; Michel 1967, Jahania 1973).

At the time of the study (1976-77) the level of the maintenance of all the branches on the watercourse studies was extremely poor. A Salinity Control and Reclamation Program (SCARP) tubewell had been installed at the head of the watercourse in the mid-1960s, doubling the amount of water flow through the watercourse. As is generally the case in the SCARP areas, the intensity of cultivation increased substantially as a result of increased water supplies.[11]

However, the capacity of the watercourse was not increased; further, for some years after the installation of the tubwell, there was no perceived water shortage. According to informants this led to a decrease in maintenance efforts, atrophying the already weak sanctions enforcing participation in watercourse cleaning. Further, fragmentation of plots had led to increased numbers of "illegal" (i.e. not sanctioned by the Irrigation Department) cuts in the main water channels. The watercourse, on all branches, was choked with grass, bushes and trees; leaked through rat holes, thin banks, and at junctions; and water remained standing in many low sections after irrigation. On branch A, since the Chak Aziz lands are relatively high, the Kharal owners actively sabotaged efforts to clean the head of the watercourse. Silting raised the water level, and thus their ability to irrigate their high land; but it blocked a large percentage of the water from reaching the middle and tail farmers.

This lack of maintenance, combined with increasing pressure to raise production (limited by water) had created considerable dissatisfaction with the condition of the watercourse by 1976.

## *The Improvement Process*

In response to this dissatisfaction the author was instrumental in arranging for the Mona Reclamation Experimental Project to choose this watercourse for an experimental improvement program[12]; in this program the Government supplies technical advice and supervision, and materials such as concrete outlets (*nakkas*); the farmers are responsible for supplying all labor for the earthen improvements, masons for installing *nakkas*, etc., and for subsequent maintenance. Some Gondalpur farmers had heard about the success of the improvement program in other villages; a survey by the author indicated that the farmers were actually aware that the losses from their watercourse were high and were eager to improve it.

The improvement program on this watercourse undoubtedly faced more problems than is usually the case on a single watercourse; but this makes it an important case to study as all of the problems encountered characterize other watercourse reconstruction efforts to various degrees. A description of all that happened during the six months of active improvement work would constitute a book in itself; a brief summary will show the kinds of problems faced by the project. At a farmer meeting in June 1977 two committees were set up. The one for branch A included a Kharal representative from Chak Aziz (the youngest of the two "step-nephews"), a Gondalpur Langah, and the Pindi *numberdar*. For the "main branch" and branches B, C, and D, one Khudaya, one Khizanrane and an Awan were chosen. The branch C Muradke refused to take part in the improvement program on their branch and therefore had no committee member. There were several reasons for their refusal: they did not perceive much of a water shortage; they preferred to continue cutting the watercourse freely; and they were angry at the Awan over unrelated issues and opposed any program the Awan supported.

Work began on branch A — but on the same day as an announcement of land allotment under the land consolidation program in Gondalpur; therefore only Chak Aziz shareholders were present at the work site and they successfully pressured the government engineer to start work on a new route for the watercourse, parallel to the distributary around their village (see insert on Figure 1). This route had been discussed previously and opposed by the middle shareholders, but now it became a *fait accompli* and they could not oppose it. Since the old route had passed through the step-nephews' land and another Kharal's courtyard, while the new one was on government land and higher than the old one, the Kharal benefitted substantially from this change.

Over the next few months work continued, fitfully, on branch A, and the engineer had branch B and D begun even though he had not yet done a survey to indicate the route, width, and depth. The farmers on D and B discovered their water supply was reduced as a result, leading to considerable tension between them and the engineer. At a meeting with the farmers the engineer accused the farmers of not cooperating with him and gave them an ultimatum — to follow his instructions without argument or he would abandon the project; the farmers were angry but agreed to his demands. These branches were then surveyed and the work redone.[13]

A number of disputes broke out among the farmers (aside from continuing disputes between the farmers and Government officials):

(1) On branch D, two Khudaya, the *numbardar* (supported by the Miane), whose land was at the head and middle and his paternal cousin, a watercourse committee member most of whose land is at the tail, disputed over how far towards the tail the improvement work should go. The *numbardar* and Miane wanted the work to stop about 1,000 feet short of the cousin's land so that no improvement work would be done on the section through their land. When the tail cousin refused to cooperate unless his demands were met the *numbardar* agreed, though the Miane continued to protest and refused to cooperate on the work.

(2) The Miane, near the middle and tail of D, continued to dispute with the Khudaya over how far the improvement should go, and over the route of the watercourse. The engineer, based on his survey, wished to straighten it. Since it skirted the edge of the Mianes' land and over the years had been shifted, increasing their land, moving it would reduce their land slightly. It was straightened, finally, but over their continuing protest.

(3) On branch B, the Khizarane leader frequently argued with Muradke, Khudaya, and Sayid shareholders over division of the work.

(4) On branch A the Pindi shareholders and the Miane were lax about doing their share of the work, leading to conflict with the others and long delays in completing each section.

(5) The Langah committee member and the Kharal member disputed over route changes demanded by the Kharal and division of work shares; because of his weak position, the Langah pursued these issues more with the engineer than the Kharal directly. In every case, the Kharal won, because both the government officials and other farmers feared the consequences of the Kharal not cooperating, given their strategic position on the watercourse.

(6) The Kharal "step-nephews", who had traditionally taken "unauthorized" water from the main branch, successfully sabotaged the work on that branch, including preventing the removal of trees and straightening the route. There seemed to be three reasons for their obstructionism: they realized taking illegal water from the main branch would be more difficult; they would lose a little of the land they occupied if the watercourse were straightened; and they were jealous. They opposed any program that would benefit the weaker Gondalpur people, perhaps fearing it would lead to their becoming more independent of them.

(7) The Kharal demanded, and by threatening to sabotage the project, obtained extra *nakkas* and double-sized culverts for their land; but even after getting these the two "step-nephews" in particular continued to sabotage the work.

A project that was expected to be completed in less than two months was not finished in December 1977, the sixth month. In fact, in May 1978 some sections still had not been reconstructed, especially in the middle and tail sections of A and B; some of the sanctioned *nakkas* had not been installed, and several of the installed ones had been damaged; and there had been no cleaning and maintenance done. All the branches were choked with weeds and silt and leaked from new "unauthorized" cuts in the rebuilt banks. Even in October 1978, the normal watercourse cleaning in preparation for the *rabi* season had only been haphazardly done.

The sections completed up to December 1977, immediately after reconstruction, did not leak, and farmers enthusiastically reported up to five times as much water reaching their fields as before. However, by November 1978 the water delivery had drastically declined, though farmers said not quite to pre-improvement rates. I observed that the sides, because of both poor construction and very poor maintenance, had deteriorated considerably and were leaking badly; much water remained standing in the ditch after irrigation; and many farmers felt discouraged about the prospects of maintaining even the present levels of efficiency.

## PUNJABI CULTURE: THE CONCEPT OF *IZZAT*

There is no doubt that one source of the problems faced by this watercourse improvement project was the relationship that developed between the farmers and the government officials supervising the program.[14] Another factor was that the potential benefits of the program were not perceived as equally distributed (Doherty and Jodha 1977). Indeed equal distribution of benefits in a watercourse reconstruction program is impossible to achieve because of differences in size of landholdings, differences between owners and tenants, and most crucial the relatively greater benefits accruing to farmers with land at the tail than to those with land at the head of the watercourse. However, the active attempts by the step-nephews to sabotage the program in order to prevent others from benefitting, and the disputes that developed among persons whose benefits were about equal, suggests these factors are insufficient as explanations of the problems encountered. In fact, the major source is to be sought within the socio-cultural organization of rural society. Punjabi rural society is characterized by a set of values and mechanisms which encourage conflict, make conflict endemic and unavoidable, and thus tend to discourage cooperation on a long term basis.[15]

The most fundamental concept, or theme, in rural Punjabi culture, in terms of which much of Punjabi behavior can be understood, is the concept of *izzat*.[16] *Izzat* may be glossed as "honor", "esteem", "reputation", "status", or "face". It is a "limited good" (Foster 1965): one acquires more *izzat* only at others' expense. As in a zero-sum game, the success of one person is a threat to all the other players, a characteristic that generates competition and jealousy. For example, when Government officials agreed to a very reasonable request for a double-width culvert for truck access to one of the Kharal's brick kiln, his step-nephew demanded a double-sized culvert for himself. Informants said his *izzat* was at stake: if he got less than his step-uncle he would lose *izzat*. Government personnel, not accepting the rules of the local *izzat* game, rejected his demand, which led to further problems with the man.

All men wish to avoid losing *izzat*, but many men also attempt to increase their own *izzat*, or reduce others'. One acquires and increases one's *izzat* by several different strategies. First, one must have the ability, and more important the willingness, to use force. There is a famous Punjabi saying: "Whoever holds the stick owns the buffalo". This does not mean force is necessarily frequently resorted to; it is enough to create the impression that one is willing and able to do so, and in times of tension, much calculation and speculation revolves around this issue. The Kharal step nephews were feared because they had demonstrated their willingness to use force in previous fights. The Bhattis of Gondalpur, mostly tenants and poor, in the past had also had a lot of *izzat* for the same reason. On the other hand, the Khudaya *numberdar*, despite land holdings, his government contacts, and several adult brothers, had less *izzat* than he might have had because it was known that he feared violence (this was not an unreasonable fear since his father has been murdered).

A second means of acquiring *izzat* is possession of influence with government officials, and willingness to use it for one's supporters and against one's "enemies". The *numberdar* had some *izzat* from this source but was not willing to use it against "enemies"; the Kharal step-nephews, some Pindi landlords, and a recently deceased poor and landless Bhatti leader, all had a substantial amount of *izzat* from this source (as did the author). A third source is willingness to entertain guests lavishly, whether they are government officials or relatives at a wedding — even if one bankrupts himself in the process. The deceased Bhatti leader mentioned above kept himself bankrupt but high in *izzat* by this means.

Success in competition, whether organized games such as *kabadi* or a stick fight, is another source of *izzat*. Winning, not a valiant loss, is the key. Another source is generosity, not to the general public, but toward individuals (who are obliged then to render support).[17] Finally, successful one-upmanship, including getting revenge for a previous defeat or insult, is important. For example, disputes are often taken to the police; and the person or group that can avoid jail or beating by the police, while getting the opponent punished, and spend the least money on the case, "wins". Such cases often become very long, involved, and expensive; but they continue even when people are aware that after so much trouble and expense they will have nothing tangible to show.

In order to improve one's *izzat* one must have *taqat* (strength, power), but *taqat* alone is insufficient; one must use this power to help one's clients or defeat one's enemies. The richest of the Kharals has less *izzat* than one would predict from his wealth and government contacts because he was unwilling to use his position in this way. A person whose *taqat* and *izzat* are increasing attracts followers and allies who hope to benefit; but he also attracts the jealousy and fear of others who are likely to band together behind the scenes to plot strategies to limit or reduce him. If it is a group (such as a *biraderi*) or several brothers who are getting too powerful, efforts will be made to sow dissention and thus weaken their unity; because individuals' primary loyalties are to themselves and each one assumes this to be true of others, efforts to divide groups, even two brothers, often succeed.

People recognized as "leaders" are supposed to work for the benefit of their followers as a group; but more often than not, such persons keep their own interests in mind first and attract clients by aiding individuals (against the police or an enemy for example) who are then obligated to them. Only infrequently do leaders work for the benefit of a group or community as a whole — and even when they do, others may accuse them of seeking only their own benefit.

Opposition is often expressed verbally in terms of issues, but in fact the issue is nearly always a pretext: men oppose or support decisions and programs based on their perceptions of their competitors' position. For example, even though all farmers were suffering the exactions of a corrupt tubewell operator, they did nothing because, informants explained, if one man or group proposes petitioning for his removal, others will oppose, not out of love for the tubewell operator, but to prevent the others from utilizing the issue to gain some advantage, or to pursue some longstanding grudge. This can be carried further: the non-cooperative behavior of several Kharal on branch A during the watercourse reconstruction was interpreted by informants as based on a desire to prevent others from benefitting — even if it meant foregoing their own benefits.[18] Opposition is also not "legitimate" in the western parliamentary sense: opposition is always personal (or interpreted by others as personal), and aimed at weakening others or strengthening one's own position.

There is a strong ethic of loyalty to one's kinsmen; one ought to be prepared to make sacrifices for their benefit — and on occasion people do. Marriage within the *biraderi* — siblings and cousins exchanging children — is intended to cement their affections and relationships. Divisions within the community, in Gondalpur and other villages, are usually between *biraderis*; this was the case for most disputes over the watercourse improvement program. There is a feeling of a *biraderi's izzat*, which must be protected from others' attack; and if a man's *izzat* suffers at the hands of a member of a different *biraderi*, all of his close kinsmen will unite in opposition to the "enemy" (*dushman*).

Nevertheless, despite the emphasis on loyalty to one's kinsmen, tensions among *biraderi* members are always present; patrilateral cousins and brothers often have tense and competitive relationships and do not completely trust each other. One's brother's or cousin's personal *izzat* is not necessarily one's own; hence a man is apt to be jealous of and feel threatened by a brother's success. Tension is also generated among *biraderi* members by joint potential rights in land. One of the worst cases of conflict in Gondalpur history, resulting in two murders and three executions, occurred within the Khudaya *biraderi* over land; one branch attempted to deprive another branch of rights to some land; tensions bu[illegible] up and the latter finally took action, by murdering the *numberdar* and h[illegible] brother. The amount of land involved was in fact not great; the real issue was *izzat*. If the second group had allowed themselves to be deprived of the land, their *izzat* would have been severely damaged.[19]

During the improvement process there was much petty conflict among *biraderi* members over work shares and the like; the Kharal are seriously divided, and the Khudaya only slightly less so; the Awan and Muradke, though separate *biraderis* in many senses, are closely intermarried — yet at the time of this study were involved in conflict over several issues. These data suggest that the sociologists discussed above have overemphasized the unity of *biraderis*.

The sense of community within the village is real, but also intertwined with *izzat*. In opposition to outsiders villagers will act together in a stick fight or a competition game (such as *kabadi*), to preserve the *izzat* of their village. However, cooperation within a community to achieve a mutually beneficial goal is very difficult as people fear others may benefit more than they, or the leaders will gain undue influence. In some villages there are leaders who are sufficiently trusted (or feared) to insure that farmers cooperate to maintain their watercourse (Mirza and Merrey 1978), but this is not true of most communities, and is not a permanent characteristics of any community.[20]

## THE IMPLICATIONS OF *IZZAT* FOR ESTABLISHING LOCAL LEVEL ORGANIZATIONS

Punjabi villages exhibit considerable variety in observable social organization: single, double, multicaste villages; villages with strong leaders and villages with no leaders; villages with no recent history of serious conflict, and villages where murders occur yearly; villages inhabited by descendents of the original (pre-canal system) inhabitants; colonists who came at the time of the building of the canals; and recent refugees from India. However, in contrast to the variation at this level, there is relatively less cultural variation: the concept of *izzat* described here is shared to a very large extent by rural Punjabis. However, it leads to somewhat different sociological patterns under different circumstances.

For one thing, people pursue different strategies depending (aside from personality differences) on the larger social context in which they find themselves. Pindi village for example is dominated by a number of very large landlords; they are all Gondal, but are subdivided into several *biraderis*. Tension among several of these has led to a number of murders over the years. Members of other Gondal *biraderis* attempt to remain neutral, or temporarily ally themselves with one or another side, or try to stir up incidents among others in order to weaken them. Many Gondalpur farmers are clients of the Pindi landlords; they work as tenants for the landlords, or help them when a show of force, or in the past at least, votes, are needed; in return they expect their patrons to help them against their enemies when needed. Normally the Gondalpur people do not compete directly with the Pindi landlords; they may be said to be operating in different political "arenas".

Everyone is concerned about his *izzat*; but not all men play the game of *izzat* actively. Many are content to avoid losing *izzat* by not initiating confrontations. If they retreat whem someone forces an issue, they lose *izzat*, but avoidance of confrontations does not always mean weakness. The Langah, for example, being a small *biraderi* with relatively few resources, are rarely involved in conflict, but when another group attempted to grab some of their land during the land consolidation program they faced the issue squarely. The grabbers backed down, losing considerable *izzat*, and the Langah gained. Nevertheless, since the Langah do not initiate confrontations, their *izzat* is limited.[21]

In contrast, the Awan, with a slightly larger number of men but less land than the Langah, have closely allied themselves with the Kharal step-nephew, and exhibit a willingness to use force to achieve their ends. People are therefore reluctant to annoy them and their leaders have more influence and *izzat* in the community than one would predict from the size of their landholdings or numbers.

The process of collective decision-making is also conditioned by concern for *izzat*. Several *paryons* (panchayats, i.e., informal "councils" of men) have been observed attempting to settle disputes, as well as meetings at which decisions regarding the watercourse improvement program were made. At all of these meetings, discussion seems interminable to the outside observer; people usually "shout" (by American standards), often get excited, and often drag in seemingly extraneous issues. At *paryons*, after the disputing parties have had their say, and there has been considerable public discussion, the few men who are to make the decision withdraw to discuss the case privately; their decisions are always presented as unanimous, and one suspects they are influenced by the trends in the public discussions.

Similarly, at the meetings on watercourse improvement, a "consensus" was arrived at on each issue (sometimes meaning those opposed kept quiet — though they did not always accept the decision). On some issues, such as selection of the members of the "executive committee", the more important men, representing the various *biraderis*, withdrew to discuss the issue privately. Their decision was then announced to the group and extension officer, and accepted with little further discussion.

An important function of this "consensus" form of decision-making is to preserve the *izzat* of all the participants. If a consensus, or at least the appearance of consensus, is not achieved, decisions are often postponed, even when a large majority are agreed. To press for a decision when some remain opposed is to attack the *izzat* of the opposition. This may lead to an escalation of the conflict. If a formal process such as voting or an election is used, someone must suffer a public defeat and thus lose *izzat*, creating bitterness and potential obstructionism. Since one's *izzat* is at stake, aside from the office or decision in dispute, people are likely to resort to "unfair" means to avoid losing. Given this orientation it would be folly to insist on formal voting and majority rule as the mechanism for decision-making in any institutions established on watercourses.

Of course people may make decisions by consensus, then "ratify" them by formal voting; but the voting rule is also apt to be utilized by persons bent on increasing their *izzat* by forcing votes and thus causing opponents to lose publicly. This would ultimately subvert the organization.[22] Secret balloting does not completely solve the problem either: someone still loses *izzat* in a public way; and in a small community it is not difficult to figure out how particular people voted.

When villagers and government officials interact, both are concerned about their *izzat*. In villages with several competing leaders, they often compete for the "privilege" of entertaining visiting officials — especially potentially important ones. Part of the reason is an ethic of the importance of honoring a "guest" of the village; it is "beizzati", i.e. a loss of *izzat*, for the village not to treat a guest properly. Another aspect is that the person who (publicly) treats a guest well gains points in the game of *izzat* over his opponents. If he is able to translate this into influence, or even the impression of influence, with the official, then his *izzat* is further improved.

Officials are also concerned with their own *izzat* both in the villagers' and their colleagues' eyes. This often leads them to avoid delegating authority (especially to villagers but including such people as extension workers) and to try to give an inflated impression of their own authority. Although they often flatter and cater to big landlords, they also try to maintain social distance between themselves and ordinary villagers by wearing western clothes, and by using speech that is sprinkled with

English terms, authoritarian, and sometimes rude. This includes use of familiar verbal and pronoun forms of address towards villagers. Villagers on the other hand are expected to be polite, to accommodate themselves to an official's needs, and to accept his point of view without argument. Publicly villagers are often obsequious, but behind the official's back, they may ridicule him. Some officials seem to be aware of this; at any rate they are very insecure and vulnerable, and several very strong outbursts by officials when villagers have criticized them publicly have been observed. These factors obviously inhibit government workers' abilities to work effectively with rural people.[23]

Perhaps because of this social distance, and the concomitant lack of awareness of the divisions and competing concerns of the people they work with, government officials sometimes make decisions that seem "fair" to them, but are seen as *izzat*-threatening by some of the community people. The example of the conflict over the double-sized culverts discussed above illustrates this point. It is important for officials to make themselves aware of these factors and consider the likely consequences of decisions; this can only be done if they understand the relationships among the people involved, and the culture in terms of which they operate. It should be a cardinal rule that no one should lose *izzat* as a result of a seemingly reasonable decision. In the above case, either both should have been given a double culvert, or the person needing it should have been asked to pay for the extra width.

Finally, a major consequence of the concern for *izzat* is that a "civic" sense is very rare. The step-nephews from Chak Aziz are not unique in Punjab: there are many individuals who will actively sabotage a program to keep others from benefitting, even if it means foregoing benefits for themselves. Other people have no mechanism to neutralize or control determined obstructionists, even when a large majority favor a particular program. It may be possible to solve this problem by strong government intervention, but this creates other, perhaps more serious, problems.

## CONCLUSION

This report is by no means a complete discussion of the role of *izzat* in Punjabi social life; nor is the concept of *izzat* the only characteristic of Punjabi culture relevant to understanding why conflict is so endemic and cooperation so rare. A complete discussion would have to dissect the social and economic structure of rural Punjab, the dynamics of family and kinship, and the profound changes that have occurred in Punjabi society during the last one hundred years. All these would have to be related to the historical and general cultural context of South and Southwest Asia. The discussion would have to include an analysis of the assumption of hierarchy and inequality in social relations that is only superficially overlaid by the Muslim ideology of equality; and it would have to include a discussion of attitudes toward land. This brings the discussion full circle back to *izzat*: hierarchy is expressed in the idiom of *izzat*, and possession of land and cattle are perceived as primary sources of *izzat*.

To reiterate, not all men actively "play" the game of *izzat*; but all those involved in "politics" in its broadest sense do. This includes a large number of men who are not "leaders" by any definition of the term. All Punjabi communities exhibit these same characteristics, but some more than others, and some are able to overcome them temporarily in order to accomplish community-wide projects; but these latter are a small minority.[24] The game may have been adaptive under pre-canal social conditions. During the period immediately preceding the building of the canal, population pressure seems to have been building — perhaps explaining why canal irrigation was adopted so quickly (Boserup 1965). After the canal there was no shortage of land, no severe population pressure, and no pressure from the larger system to "develop": hence the minimal level of cooperation required to operate the system at a low level of efficiency was sufficient.

Now the pressure is again increasing: the demands of the larger system require increased production; the local sub-system too is under increasing local pressure as productivity on a per capita basis is probably not even being maintained. Water and its management is a key constraint. Large-scale capital-intensive projects such as dams, canals, and tubewell schemes will continue to be constructed and operated in order to maintain and improve the productivity of Pakistan's irrigation system; but it is now recognized that many of the major problems — low productivity, water-logging, and salinity, among others — are the result of local-level mismanagement. Increasing attention and investment are therefore being focused on improving local water management practices, by involving local water users in projects to improve the efficiency of their watercourses, as well as their cultivation practices.

There are two possible strategies: either the government can intervene directly and rebuild or enforce the reconstruction of watercourses and use of better cultivation practices; or it can encourage local initiatives. The former strategy, in which the government itself would line all watercourses with brick and mortar for example, has been considered. Many farmers find it attractive. In theory at least it would require less maintenance. However, aside from the prohibitively high cost (Eckert, Dimick, and Clyma 1975), such a strategy would constitute further centralization, reducing the responsiveness of the system to local-level problems, and ultimately risking its viability.[25] Its effective administration would also be problematic.

The administrative and social impediments to the strategy being pursued are also substantial. Nevertheless, from an ecological perspective, a decentralized approach is most viable. In fact, paradoxical as it may seem, it should be argued that the current program has not gone far enough toward encouraging local organization and initiative: not only should the Government encourage the organization of local water users to manage their own local sub-systems, but these local organizations ought to be integrated into the operation of the system at higher levels (as in Spain, for example; see Radosevich 1975). This decentralization would increase the responsiveness of the larger system to local needs and perturbations.

Given the sociocultural characteristics summed up in the concept of *izzat* that seem to prevent rural Punjabis from organizing and cooperating, how can local organizations succeed? In the discussion of "culture" and its relationship to behavior the complexity of this relationship was emphasized. It is not a fixed, one-to-one or one-directional relationship. Since patterns of behavior are "generated" by a mixture of material and cultural constraints and rewards, changes in these constraints and rewards should generate changes in behavior patterns (Barth 1966; 1967; Goodenough 1963). It cannot be assumed that people will alter their customary behavior patterns and cultural values in the absence of compelling constraints and/or rewards to do so. Mere exhortation will not suffice.[26]

The solution is to create such constraints and rewards, designed with the specific cultural characteristics and material resources of the population in mind. A three-pronged strategy is suggested here:

(1) Legal and administrative mechanisms are required to facilitate organization (such as an enabling law for local watercourse organizations, and their federation into a larger organization). These organizations ought to be given real responsibilities.[27]

(2) Sufficient rewards need to be built in to attract farmers to organize, and continued rewards held out to maintain the organization over the long run (for example free materials for watercourse reconstruction, credit and agronomic inputs at special rates for members of successful organizations, special public recognition for communities with effective organizations).

(3) Sanctions need to be applied initially to individuals and groups who sabotage organizational efforts and local improvement projects, and evantually to local communities who lag behind in organizational efforts or do not fulfill their responsibilities (such as watercourse maintenance). Such sanctions will have to be applied by an external authority, to avoid their becoming another weapon in the game of *izzat*, and will have to be swift, certain, severe, and just. The "external authority" should not be another arm of the Government bureaucracy; rather, it should be a body deriving its authority from local communities, but above any particular community.[28]

The facilitating mechanisms, rewards, and sanctions must be designed to fit the local milieu; what works in the Phillipines may not work in Pakistan. For example, formal voting and elections ought not to be overemphasized at least initially in the operation of an association as this requirement may lead to its being sabotaged in the game of *izzat*. Communities that organize themselves effectively ought to receive public recognition aside from the material benefits that will hopefully accrue. In time such a strategy may encourage, if not a redefinition of *izzat*, at least a recognition of more constructive behaviors as sources of increased *izzat*.

# NOTES

1. The research in "Gondalpur" on which much of this report is based was done under a Social Science Research Council Foreign Area Fellowship. I thank SSRC for its generous support. I am also grateful to the Mona Reclamation Experimental Project for their aid during my research. I hope no comments in this report will be misunderstood as criticism of this organization, or its employees. This report has been written with the support of Colorado State University's Water Management Research Project in Pakistan which has been carrying out research under the United States Agency for International Development contract Number AID/ta-C-1411. Under this contract I was closely involved in the Water Users Association Research Project being done at the University of Agriculture, Faisalabad. Needless to say, the views expressed here are my own and not those of any of the above organizations. My wife, Karen Merrey, has commented on the paper and most of her suggestions have been incorporated. Ashfaq Hussain Mirza and Dr. John Reuss have also commented on the paper; Dr. Sherry Plunkett has suggested substantial improvements and forced me to clarify my thinking, for which I am grateful. I alone am responsible for any remaining weaknesses in the report.

2. Mirza (1975) and Lowdermilk, Freeman and Early (1978) do have some comments on the relationships between water users and the Irrigation Department bureaucracy, but neither are systematic studies of this issue. A partial exception, focusing on India, is Gustafson and Reidinger (1971).

3. See Freeman and Lowdermilk (1976 and 1978) for a method of determining degree of polarization in terms of extent of overlapping versus cross-cutting of conflict structures.

4. But Mirza (1975:73) also says, "There is nothing conclusive about single and multiple castes..." in villages.

5. See Freeman and Lowdermilk (1978) for a method of determining "centrality" and "concentration" of power and influence.

6. To qualify this: since there is variation over time in a community's ability to cooperate, communities which had cooperated previously may later become conflict-ridden.

7. Goodenough (1971) has also distinguished several levels or senses of the term "culture", depending on the perspective of the observer, which cannot be pursued here. Culture as defined here is not the traditional "superorganic" conceptualization of sociologists and anthropologists.

8. See Note No.1.

9. Most of this latter is either waterlogged or saline, or not commanded because the land is high and on the other side of the low-lying waterlogged area (see Figure 1).

10. "Numberdar" (*nambardar, lambardar*) is a hereditary position created by the British: he collects the land revenue and irrigation fees for the government, keeping a percentage for himself; and he acts as the intermediary between the villagers and government officials.

11. Previously informants say there had been little double-cropping. Now most of the land — especially that of small farmers — is double-cropped.

12. The arrangement was that the author would observe, but not participate in, the process; in fact, people often sought the author's intervention to influence the engineers and upon occasion suggestions were offered to the Mona personnel — which were never followed.

13. There were significant differences among the branches in the labor organization for improvement and the efficiency of the work. Except for a few portions of branch D done collectively, the work on each portion of all the branches was divided among the shareholders proportional to the amount of land irrigated. The large farmers at the head and tail of branch A had their tenants and servants do the work, while the small farmers in the middle did their own share — and did it more quickly. Most of branch D was done by tenants, *Kamis*, and hired laborers — and more time was spent smoking and gossping than working, significantly slowing the work. All but a few of the branch B shareholders did their own work, and their's was completed very quickly.

14. Although some of these engineers and extension workers have rural backgrounds, their education has seemingly made them unfit for rural work; possessing a degree, and a respectable position in the government

bureaucracy, they are "officers". They create barriers between themselves and their clients by wearing western clothes, speaking an urban dialect, and doing all they can to create the impression they possess a superior knowledge and position whigh ought to be respected. When the clients assert themselves, and refuse the "officer" the "respect" (read "obeisance") he claims, conflict arises, and the officer's low opinion of his clients is confirmed in his mind. This kind of relationship between government and farmers is not confined to Pakistan.

15. The author is not arguing that there is no cooperation; Lowdermilk, Clyma, and Early (1975:41-47), for example, discuss several forms of cooperation. But the patterns they discuss are among a few individuals, usually relatives, and tend to be on a short term basis. These authors (p.47) minimize the importance of the factors discussed here as major impediments to organization.

16. This is the most common and broadest term; there are others but they tend to have more restricted meanings. The term has obvious affinities, conceptual and historical, with the Middle Eastern and Mediterranean concept of "honor". This report does not pretend to be a complete discussion of *izzat*, which has important ramifications in many areas of Punjabi life.

17. Religious generosity such as building a mosque earns one "respect" (*abad*) for piety, but is not itself a source of *izzat*; pious acts score points in a different game.

18. There is a Punjabi saying, "If my neighbor's wall falls it is good — even if it falls on me".

19. The *numberdar* and the cousin with whom he argued over the extent of work on the watercourse are the sons of the two murdered men; their relations are tense in part because of jealousy and dissatisfaction over the subsequent partitioning of their fathers' land; and in part because each fears the other will gain an advantage. An exchange of sisters would seem to be called for here, but each branch is marrying matrilaterally (outside the village), accentuating the division.

20. One commentator on an early draft of this paper, as well as one of the Gondalpur informants with whom the conceptualization of *izzat* was discussed, suggested a confusion with what he calls "false *izzat*" with

"true *izzat*". True *izzat* refers to the more "positive" characteristics included in the concept, while "false *izzat*" includes more "negative" behaviors such as undercutting others, and creating fear in others. It is important to note that my informant here is a Langah, and they are not active participants in the main game of *izzat*. Other Gondalpur informants, while understanding the distinction, insist nevertheless that obstructionists like the step-nephews do have *izzat* in most peoples' eyes; men who are feared and referred to as "badmash" ("bad character", trouble-maker, bully) are also respected (even admired) and regarded as having *izzat*; and the "badmash" themselves believe they are increasing their *izzat* by their behavior.

21. The Langah illustrated another strategy for maintaining their *izzat*: as noted above they have marriage relations with the Khudaya, Muradke, Kharal, and a large Pindi landlord. None of these other groups have direct marriage relations with each other. The Langah are proud of these connections. These marriages strengthened their position and were a source of more *izzat* than their small size and lack of involvement in politics would lead one to expect. However, this strategy has a double edge: since they were mostly women-givers in these transactions, they were also affirming a certain inferiority.

22. Something like this may have happened in many cooperatives.

23. The On-Farm Water Management Project workers are a notable exception to this, which may be one reason for their generally good reputation among villagers.

24. See Pettigrew (1978) for a discussion of the role of *izzat* in East Punjab. Many of the characteristics of Punjabi rural society are found to varying degrees throughout north India and Pakistan; many of the implications of this report for organizing farmers apply to these areas too; see also Sharma (1978).

25. See Rappaport (1971); Flannery (1972); Lees (1974). This perspective is being developed in another paper presently being written by this author, and is discussed briefly in Reuss, Skogerboe and Merrey (1979).

26. Although the emphasis in this report has been on cultural factors as the independent variables "explaining" particular forms of behavior, this is an oversimplification. In fact, at a more abstract level than patterns of

individual behavior, culture — including the set of values and strategies summarized by the term *izzat* — should be seen as a product of a particular social structural, economic and ecological context. Attempts to change only cultural values (by "education", "preaching", etc.), without changing the basic social structure and the constraints and rewards built into it, are not likely to succeed (see Silverman 1968).

27. Gustafson and Reidinger (1971) seem to be among the first advocates of establishing water users associations; see also Water Management Research Project Staff (1976); and Reuss, Skogerboe, and Merrey (1979).

28. The federation of local organizations into larger bodies is probably a necessary component of a successful decentralized water management organization; settling disputes and imposing sanctions would be only one of the higher-level functions.

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# II.2

# POPULATION GROWTH AND THE DECLINE OF COMMON PROPERTY RESOURCES IN RAJASTHAN, INDIA

N.S. Jodha

Common property resources — community pastures, forests, wastelands — although rare in Western countries today, are still an important form of natural resource endowment in the rural areas of developing countries. Broadly defined, common property resources are those used by an entire community without any exclusive individual ownership or access rights. In the absence of regulatory institutions, rapid population growth may lead to degenerative patterns of use (e.g., overgrazing) and the gradual depletion of common property resources. Indeed, as popularly conceived, depletion of such resources is a straightforward consequence of rapid population growth.[1] Several recent studies have suggested, however, that the impact of rapid population growth on natural resources is not at all straightforward.[2] These studies indicate that the effects of rapid population growth are mediated by institutional factors and often overshadowed by pressures arising from changing market conditions.

This paper examines the decline of common property resources in the arid zone of Rajasthan in India and the factors underlying the decline. In Rajasthan, the introduction of land reforms in the 1950s disrupted traditional arrangements that protected and regulated the use of common property resources. Commercialization, population pressure, and large-scale adoption of tractors have played important roles in the resource depletion process, but their impact has been greatly magnified by the circumstances created by various provisions of the land reforms program.

## THE SETTING

The arid zone of western Rajasthan, part of the great Indian desert, is spread over 202,000 square kilometers and accounts for 62 percent of the tropical arid area of India. The agriculture of the region is characterized by crop and livestock-based farming. Studies have repeatedly emphasized the comparative advantage livestock farming enjoys over crop farming in the region, and the region's comparative advantage over other regions in the matter of livestock farming.[3] This comparative advantage is the product of two factors: (1) the agro-climatic and land resource base of the arid region, and (2) formal and informal institutional arrangements governing the usage of the natural resource base.

Low and erratic rainfall, highly erodible and infertile sandy soils, and a variety of hardy grasses and bushes make most of the region more suited to pasture-based livestock raising than to sustained arable farming. Livestock, because they are mobile, are less subject to the adverse impact of localized droughts than crops are. This advantage is lost, however, if a farmer's livestock must depend solely on his own forage and water resources. In other words, the mobility-linked advantage of livestock becomes a reality only when they have easy and unrestricted access to spatially differentiated land resources. It is in response to the need for unrestricted mobility of livestock that common property resources or common access resources emerged as the dominant form of resource ownership and usage by village communities in this region, as in many other parts of the world having similar ecological conditions.[4] In dry areas of Rajasthan, the village-level common property resources that have effectively supported livestock farming since the feudal period include:

(1) Community grazing lands, including permanent pastures, uncultivable and cultivable wastelands, and fallow lands contributing to the grazing area of the village.
(2) Village forests and woodlands, including *Orans* (forests protected on religious grounds).
(3) Private croplands available for public grazing after harvest of crops
(4) Community threshing and waste-dumping grounds.
(5) Community ponds and animal watering points.
(6) Migration routes and facilities.
(7) Community facilities for stock breeding.

## METHODS AND DATA SOURCES

This paper uses evidence from selected villages of Jaisalmer, Jodhpur, and Nagaur districts in Rajasthan for the early 1950s to the early 1980s. The three districts represent three subzones within the arid region in terms of aridity and density of human and livestock populations. Annual rainfall averages 179mm, 264mm, and 310mm in Jaisalmer, Jodhpur, and Nagaur, respectively. The population density (according to the 1971 census) is 4, 50, and 71 persons per square kilometer in Jaisalmer, Jodhpur, and Nagaur, respectively. The number of cattle, sheep, and goats — the key categories of livestock sustained by common property resources in the area — expressed in terms of animal units is 6 per 100 hectares of area and 164 per 100 persons of rural population in Jaisalmer. The corresponding figures for Jodhpur are 41 and 124, and for Nagaur they are 70 and 111. Mixed farming based on annual cropping and livestock raising is common to all three districts, although the importance of crop farming increases as one moves from areas of lower to higher rainfall.

Most of the data presented were collected during the period 1963-66 when the author worked for the Central Arid Zone Research Institute (CAZRI). An important objective of the field studies was to examine the existing pattern of land resource use and to compare it with the potential pattern emerging from CAZRI's resource conservation and development technologies.[5] In 1973 and 1978, the author visited the same villages again and documented changes through quick surveys in Nagaur and Jodhpur districts.[6] In 1983, during a short visit, data were updated on specific issues. Six villages from which data were collected in all four rounds are the principal focus of this paper.

Considering the total size of the arid zone, findings from six villages can only be suggestive. It should be noted, however, that the broad pattern of change, closely observed and documented in the selected villages, was also evident more widely in the areas to which these villages belong.

## DECLINE OF COMMON PROPERTY RESOURCES

From the early 1950s to early 1980s, common property resources in the arid zone declined in area and deteriorated in quality.

### *Grazing Lands*

Village forests, permanent pastures, uncultivable and cultivable wastelands, and croplands fallowed for longer periods broadly constitute the total grazing area in the villages. This area is supplemented by cropland that acquires the character of a common property resource in the post crop season when anyone can graze his animals there. The changing sit

**Table 1. Changes over Time in Common Grazing Areas as a Percent of Total Geographic Area in Six Villages in Three Districts of Western Rajasthan**

| | Percent of total area in study villages | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Nagaur | | | | Jodhpur | | | | Jaisalmar | |
| Grazing area | 1953-54 | 1963-64 | 1972-73 | 1977-78 | 1953-54 | 1963-64 | 1972-73 | 1977-78 | 1953-54 | 1963-64 |
| Forests | 2 | 1 | 0 | 0 | 3 | 2 | 2 | 2 | 0 | 0 |
| Permanent pastures | 6 | 3 | 1 | 1 | 7 | 3 | 3 | 3 | 3 | 1 |
| Uncultivable wastelands | 17 | 13 | 12 | 11 | 13 | 10 | 10 | 9 | 38 | 35 |
| Cultivable wastelands | 18 | 10 | 7 | 6 | 15 | 7 | 4 | 3 | 26 | 12 |
| Fallow lands (other than current fallows) | 15 | 10 | 8 | 6 | 18 | 13 | 10 | 9 | 16 | 13 |

SOURCES: From patwari records during successive rounds of field work. The data relate to two villages in each district. Data for 1953-54 were culled from village records.

uation of croplands, including current fallows, as a source of grazing will be discussed separately. Table 1 provides relevant information on all other grazing areas. The proportions of common property resources used for grazing in the total land area of the study villages is fast declining. Despite differences in the extent of decline between districts and communities, a few common features are revealed in Table 1.

Significantly, the decline in area of common property resources was greater during the decade preceding 1963-64 than in the succeeding years. This was the peak period of land reforms in the region. Forests and permanent pastures, which were already small in area, declined the most. The fallow lands declined mainly through a fall in the practice of long-fallow rotation.

The trends in the decline of common property resources are also evident for the arid zone as a whole. Land utilization trends for all 11 districts comprising the arid zone of western Rajasthan are shown in Table 2. The common property resources (grazing areas) in the region have been declining consistently since 1951-52, the first date for which district-level data on land utilization are available. Again, the decline was greatest during 1951-52 to 1961-62 — the period of land reforms.

**Table 2. Changes over Time in Characteristics of Common Property Resources (CPRs) in western Rajasthan, 1951-78**

| Characteristic | 1951-52 | 1961-62 | 1971-72 | 1977-78 |
|---|---|---|---|---|
| Area (million ha) | 11.3 | 9.8 | 9.2 | 8.7 |
| Area as a percent of total geographic area | 60.5 | 51.1 | 47.9 | 45.1 |
| Percent decline in CPR area over previous period | | 12.4 | 6.7 | 4.5 |
| Livestock per 100 ha of CPRs (no. of animal units) | 39 | 86 | 94 | 105 |
| Population per sq. km. in the zone[a] | 30 | 39 | 51 | N.A. |

NOTE: Common property resources include forests, permanent pastures, uncultivable and cultivable wastelands, and fallow lands other than current fallows.

[a] The population density was 18 per sq. km. according to the 1901 census. At the time of the last census before Independence (1941), the population density was 26 per sq. km.

SOURCE: For 1951-52, Deputy Director of Land Revenues (Records), Government of Rajasthan, Ajmer. For all other years, Statistical Abstracts of Rajasthan for different years.

One consequence of the decline in grazing space is the increase in density of animals per unit of common grazing land. In the arid zone as a whole, the density of livestock expressed in terms of animal units increased from 39 animal units per 100 hectares of grazing land in 1951-52 to 105 during 1977-78. This increase was due in part to an increase in livestock population. According to livestock census reports, the number of animals in the arid zone increased by 41 percent between 1951 and 1961 and by 14 percent between 1961 and 1971. The slower growth of livestock during the latter decade is due partly to two severe droughts during this period and partly to declines in grazing area.

## Animal Watering Points

Animal watering points are resources important to the support of pasture-based livestock farming. Ponds and tanks are scattered throughout grazing areas in the villages. They are filled by runoff from their respective catchments, which are also used for grazing. Depending upon their capacity, these ponds supply drinking water requirements of animals and humans. They help in the even distribution of grazing incidence and ensure some degree of rotational grazing. They were dug by the village communities and, at least in the past, were maintained (desalted) through the voluntary or enforced labor of the villagers, as well as by investing part of the revenue collected through periodic auctioning of rights to collect dung and top feeds from around the watering points.[7]

Details of the history, current status, usage, and management of these watering points were collected from two villages[8] and are presented in Table 3. The number of watering points and the catchment areas of the ponds declined dramatically between 1953-54 and 1972-73.

Watering points were depleted because of reductions in their catchment areas and neglect of their desalting requirements. The decline in the upkeep of the ponds is also indicated in Table 3. Expenditures in terms of labor days on desalting of ponds and their inlets for three-year periods ending 1953-54, 1963-64, and 1972-73 are presented. Whether one looks at the total expenditure or the average expenditure per existing pond, the investment on upkeep of watering points declined substantially over time. More revealing is the change in source of expenditure, which also partly explains the decline in expenditure. Not only did overall expenditures on upkeep of ponds decline, but the people's contribution and common property resource revenue (generated through auctioning of trees, etc.) disappeared as sources to support the upkeep of common property resources. Government grants or relief has proven to be poor substitute for these traditional sources of upkeep.

**Table 3. Changes over Time in Selected Measures of Status and Upkeep of Animal Watering Ponds in Two Villages in Two Districts of Western Rajasthan**

| | Nagaur | | | Jodhpur | | |
|---|---|---|---|---|---|---|
| Item | 1953-54 | 1963-64 | 1972-73 | 1953-54 | 1963-64 | 1972-73 |
| Number of watering ponds | 19 | 10 | 8 | 17 | 9 | 9 |
| Area of catchments (ha)[a] | | | | | | |
| Total | 358 | 213 | 181 | 411 | 282 | 275 |
| Average per pond | 19 | 21 | 23 | 24 | 31 | 30 |
| Range | 2-86 | 4-57 | 1-58 | 3-90 | 5-75 | 2-60 |
| Modal value | 15 | 35 | 30 | 25 | 40 | 40 |
| Water retention capacity (range in months) | 1-12 | 3-8 | 1-8 | 2-12 | 4-9 | 1-9 |
| Desalting expenses (in terms of labor days) during preceding 3 years | | | | | | |
| People's contribution[b] | 788 | 0 | 0 | 722 | 0 | 0 |
| Reinvestment of CPR revenue | 450 | 25 | 0 | 675 | 190 | 0 |
| Government Grant/relief | 0 | 238 | 120 | 0 | 240 | 300 |
| Average total expenses per pond | 65 | 26 | 15 | 82 | 48 | 33 |

[a] Represents areas of catchments not occupied by private individuals.

[b] People's contribution estimated on the basis of labor days for each household multiplied by number of relevant households in the case of each tank desilted during three years. The amounts of reinvested revenue of common property resources and government grants were converted into labor days using wage rates for the relevant period.

SOURCE: Based on old and current village records.

### *Private Croplands: Seasonal Common Property Resources*

Public grazing on private croplands in the post-crop season is an important informal arrangement helping stock raisers. Because of this practice of periodic common access, the cropped area could be described as seasonal common property resources. Depending upon crop and soil moisture conditions in a given season, the available forage consists of crop leftovers, undergrowth, resprouting of harvested crops, and bushes, The net sown area in the arid region as a whole has increased from about 6.6 million hectares in 1956-57 to 8.3 million hectares during 1977-78. Despite an increase of about 25 percent in the seasonal common property resources for grazing, their contribution to total forage supplies for grazing seems to have declined in recent years. The large-scale introduction of tractors during the period under review has meant that soil preparation for the next season is finished soon after the harvest of the previous crop.[9] This deprives the animals of any post-harvest grazing in the seasonal common property resources. Use of tractors has also led to a decline in the grazing space available from long fallows, cultivable wastes, and the like, because tractors are not subject to the constraint a very short wet period imposes on soil preparation by draft animals — a constraint that in the past restricted cropping to a limited area.

### *Qualitative Degradation of Common Property Resources*

Qualitative degradation of common property resources is partly a consequence of their quantitative decline and unregulated use. Degradation of resources is easier to see than to quantify. It is difficult to find any official records covering qualitative aspects of common property resources. Yet such phenomena as conversion of pastures into barren patches near habitations, and substitution of perennial edible species by annual nonedibles have been documented through detailed surveys in the arid zone.[10] According to these surveys, the carrying capacity of such lands has declined far below the present rate of stocking.

Indirect and rough indications of qualitative degradation of common property resources in the study villages were revealed by case histories of a few selected common property resources. Since common property resources constituted important sources of revenue for the *Jagirdar* or *Thikanedar* (landlords in the pre-Independence period), some useful records were available as early as 1945. They indicated the volume of products collected from common property resources and the revenue generated by their auction. Details for four locations, whose area has remained unchanged, are reported in Table 4 to illustrate the decline in the productivity of common property resources due to qualitative deterioration. Availability of timber, top feeds, perennial grasses, and gum declined in all four locations. Felling of mature trees and the growth of stunted and bushy trees, elimination of useful bushes, and a decline in superior perennial grasses were features of the environmental degradation in these areas.

# CAUSES OF THE DECLINE OF COMMON PROPERTY RESOURCES

The decline of common property resources is a result of multiple forces. It is often not easy to measure the role of specific factors in the process of change. However, a description of the circumstances influencing people's decisions and actions regarding the status and usage of common property resources can shed light on the relative roles of different factors. Three factors that seem to have contributed significantly to the decline of common property resources in the arid zone are: (1) institutional change in the form of land reforms during the early 1950s; (2) population growth; and (3) increased commercialization of the desert economy in general and of common property resource-based activities in particular — aided in part by technological innovation.

## *Land Reforms*

The introduction of land reforms during the early 1950s constituted a major institutional intervention in the rural sector of the arid zone. The reforms encouraged the privatization of common property resources for use as croplands, drastically reduced the private cost of cultivating submarginal lands (including common property resources), and dismantled the traditional arrangements that protected and regulated the use of common property resources.

Prior to the introduction of land reforms, the feudal landlord was the sole custodian or "owner" of the village lands.[11] All farmers except his kinsmen were the landlord's tenants. They paid him substantial rent in kind (one-fourth to one-half of farm produce) for the land they cultivated. Although the common property resources belonged to the landlord, villagers had access to them in return for certain charges. While a

**Table 4. Decline in Productivity of Common Property Resources as Illustrated by Histories of Four Forests and Grazing Plots in a Village of Nagaur District, 1945-65.**

| | Production | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Plot 1 (6 ha) | | Plot 2 (10 ha) | | Plot 3 (120ha) | | Plot 4 (12 ha) | |
| Product | 1945-47 | 1963-65 | 1945-47 | 1963-65 | 1945-47 | 1963-65 | 1945-47 | 1963-65 |
| Timber (*babul* and *indok* trees) | 12 | 3 | 11 | 1 | 3 | 0 | 17 | 0 |
| Top feed (*loong* from *khejri)* | 8 | 4 | 10 | 3 | 21 | 8 | 12 | 3 |
| Top feed (*pala* from *ber* bushes) | - | - | 7 | 3 | 12 | 4 | 15 | 2 |
| Fuel wood (*khejri*, *ker*, etc.) | 8 | 2 | 5 | 2 | 18 | 6 | 21 | 4 |
| Cut grass (*kared* and *dhaman* perennials) | 13 | 3 | 18 | 4 | 27 | 9 | 21 | 0 |
| Cut grass (*bharoot*,etc. annuals) | 3 | 5 | 5 | 7 | 10 | 8 | 13 | 9 |
| Dung collection | - | - | - | - | 15 | 0 | 17 | 0 |
| Gum (*babul* and *indok* trees) | 40 | 0 | 10 | 0 | - | - | - | - |

NOTE: Gum is measured in kilograms. All other products are measured in cartloads. The weight of a cartload ranged from 5 to 10 quintals depending upon the produce (e.g. fuel wood versus top feeds) under question. By 1958 due to introduction of rubber-tired bullock carts *(chhakada)* the standard of carload changed. Compared to earlier wooden-tired bullock carts, the *chhakada* could accommodate 50 percent more product by volume and weight. However, the figures reported in the table are in terms of load carried by wooden-tired bullock carts.

SOURCE: Auction records of ex-Jagirdar and the village Panchayat. In the post-land reforms period, the practice of auctioning has declined mainly because there is not enough material to auction. This in turn is a result of elimination of most of the trees and complete destruction of even roots of perennial grasses.

fixed proportion of land revenue from cultivated land went as payment to the ruler of the state, revenue from the common property resources went to the landlord's own exchequer. (At times, a part of the revenue would be reinvested to increase or sustain income from the land.) Methods of revenue generation from common property resources included a fixed grazing tax per head of animal, the auctioning of produce from common property resources, a number of different levies on the users of the land, and penalties for violation of a variety of regulations imposed on users. The number of different levies and taxes imposed in the princely State of Jodhpur in 1941 varied from 50 to 150, depending on location, of which 64 were considered legitimate by an enquiry committee appointed by the ruler of the state.[12] Many of these related to common property resources. Through levies and penalties on the use of common property resources, the landlord exploited the peasants. However, as a by-product of this exploitative mechanism emerged a management system that protected, maintained, and regulated use of common property resources. Table 5, based on details from study villages as well as other studies,[13] lists the practices that were essential parts of the management of common property resources in the past and indicates which are still prevalent.

Following land reforms the Jagirdari system and its variants were abolished. Peasants were made owners of the lands that they formerly cultivated as tenants. The land revenue tax payable annually to the government on these lands was drastically reduced (Table 6). Vast areas of common property resources, mostly submarginal lands unsuited to cultivation, were distributed as croplands to the landless as well as to those who already had land. Within a decade of land reforms, in the arid region as a whole, 3.4 million hectares of common property resources were transferred to private ownership for the purpose of arable farming. This meant an increase of nearly 50 percent in the land put under the plow in the arid zone. It also meant a decline of between 7 and 26 percent in common property resources for grazing.[14]

The ownership or custodianship of the remaining common property resources was transferred to the village community, represented by village Panchayats (elected councils). The provision of common access continued as in the past, but the old system of management of common property resources disappeared (Table 5). the village Panchayats in practice did not impose grazing taxes and levies on users of common property resources, despite the fact that they were legally empowered to do so. The maintenance and upkeep of common property resources suffered as the Panchayats depended more and more on assistance from the gov

**Table 5. Management of Common Property Resources in Western Rajasthan: Whether Past Practices Continue following Land Reforms**

| Practice | Practice continues |
|---|---|
| **Indicators of private cost of CPRs** | |
| Grazing tax *(ghas mari)* | No |
| Fee for grazing in some CPRs on priority basis | No |
| Livestock-related levies *(laag baag)* | No |
| Compulsory labor contribution for desalting ponds *(beggar)* | No |
| Penalties for disregarding grazing regulations[a] | No |
| **Indicators of regulated use of CPRs** | |
| Evenly scattered watering points | Yes |
| Deliberate rotation of grazing around different watering points | No |
| Periodical closure of parts of CPRs (e.g. *chaitrakhai*) | No |
| Periodic restriction on entry of animal category (e.g. sheep/cattle) to parts of CPRs | No |
| Posting of watchman *(kanwaria)* with power to enforce regulations | No |
| Village *phatak* (enclosure) to impound animals violating regulations[b] | Yes |
| **Indicators of revenue earnings** | |
| Auction of dung-collection rights from CPRs | No |
| Auction of top feeds from CPRs | No |
| Auction/sale of wood from CPRs | Yes |
| Penalties for breaking grazing regulations | No |
| Cash and kind taxes and levies from users of CPRs | No |
| **Indicators of investment in CPRs** | |
| Periodic desalting of ponds[d] | Yes |
| Payment to watchman *(kanwaria)* | No |
| Maintenance expenses of community bulls[e] | No |
| Support to scouts to survey water and fodder situation on migration routes before animals migration during drought | No |

[a] Panchayats also have provisions for imposing penalties, but such cases relate to trespassing by persons on migration routes during droughts, or to complaints of damage to one's crop by another's animals, which are brought to officials for impounding.

[b] Each Panchayat also maintains a *phatak*, but animals impounded are those that enter somebody's cropped field.

[c] Feudal authorities collected substantial revenue from CPRs but reinvested only a small proportion.

[d] Periodic desalting of ponds now takes place through government relief expenses during drought years.

[e] Some Panchayats have provisions toward maintenance of community bulls.

SOURCE: N.S. Jodha, "Causes and consequences of decline of common property resources in the arid region of Rajasthan," progress report. ICRISAT, Economics Program, Patancheru (A.P.), India.

**Table 6. Data Relating to Private Costs of Land Use Before and After Land Reforms: Selected Villages of Western Rajasthan, 1950-65.**

| | Pre-land reforms (1950-51) | Post-land reforms (1964-65) |
|---|---|---|
| Better cropland *(chahi)* | | |
| Pearl millet yield (kg/ha) | 520 | 520 |
| Times cropped in 5 years[a] | 4 | 5 |
| Land rent (Rs/ha)[d] | 83 | 6 |
| Submarginal land *(barani)* | | |
| Pearl millet yield (kg/ha) | 200 | 200 |
| Times cropped in 5 years[a] | 2 | 3 |
| Land rent (Rs/ha)[b] | 16 | 1.50 |
| Pearl millet-average cost of production (Rs/ha) | N.A. | 285 |
| Grazing land *(gochar)* | | |
| Grazing tax (Rs/animal) | 1.25 | 0 |
| Other livestock-related levies/penalties (Rs/household) | 23 | 0 |
| Value of contribution to protection/maintenance of pasture/tank, etc. (Rs/household) | 18 | 0 |
| Animal-product prices, etc.[c] | | |
| Wool (Rs/100 kg) | 90 | 480 |
| Ghee (Rs/kg) | 5 | 18 |
| Milk (Rs/litre) | N.A. | 0.60 |

NOTE: Money values calculated at 1976-77 prices.

a Frequency of cropping due to the practice of periodic fallowing of land. This also indicates the number of times when rent (25 percent of crop produce) was paid during pre-land reforms period.

b Land revenue during the pre-land reforms period was charged in the form of 25 percent of the grain yield of the plot whenever it was cropped. The annual rent has been calculated by multiplying the money value (at 1976-77 prices) of crop share by number of years when land is cropped and dividing by five. Land reforms fixed the land revenue on a permanent basis at a much lower rate, as indicated in the table.

c Prices as obtained in the villages.

SOURCE: Jodha, cited in note 15. Details relate to a cluster of three villages in Nagaur district. Data were collected from village records and interviews during field work in 1963-66 (see Jodha, cited in note 5).

ernment for this purpose. The main reason for the ineffectiveness of Panchayats, despite their domination by ex-feudal landlords in some cases, is that they were neither as authoritarian as Jagirdars, nor bold enough to take hard decisions (such as imposing taxes) that would displease their voters.

Over-exploitation and depletion of common property resources resulted largely because there was (and remains) no private cost to using these resources. Estimates based on detailed investigations in some villages of Nagaur district[15] indicate that prior to land reforms the animal grazer had to pay Rs 41 per household in cash or kind (at 1976-77 prices) plus Rs 1.25 grazing tax per animal per year (at 1976-77 prices; US $1 = 12.50 Rupees). After the land reforms this cost was reduced to zero (see Table 6).

## *Population Growth*

Increased population pressure is widely considered an important contributor to shrinkage and depletion of common property resources. The relative resource scarcity created by increased population density is thought to induce privatization of resources for reasons of efficiency and internalization of gains from resource use.[16] In the case of the arid zone of Rajasthan, however, the role of population in the decline of common property resources does not appear to be dominant. Although no long-term records are available to measure the relationship, scattered and circumstantial evidence supports this view.

In the arid zone as a whole, population grew from 3.6 million in 1901 to 10.2 million in 1972, a growth of 183 percent. This is a greater increase than that registered for Rajasthan State, 150 percent, or for India as a whole, 132 percent, during the same period.[17] However, there are no data on land utilization prior to 1951 against which to assess the consequences of this growth.

Privatization of common property resource in the arid zone has invariably meant conversion of common property resources land into cropland. Hence, the impact of population growth can be judged in terms of increase in the area of cropland as well as the decline in the extent of common property resources. The population of the arid zone increased by 29.8 percent from 1951 to 1961 and by 27.9 percent from 1961 to 1971. Croplands increased by 50 percent and 7 percent respectively during the same periods. The area of common property resources (on a larger base), as calculated from Table 2, declined by around 16 percent and 7 percent respectively. Crude as they are, the above figures do not indicate a correspondence between population trends and land use trends.

***Historical Evidence*** Indirect and circumstantial evidence suggests that traditional management systems prevented rapid population growth from exerting a corresponding pressure on the land during the feudal (pre-land reform) period. As reported and documented by Rai,[18] one of the major problems of peasants in the princely State of Jodhpur (covering five out of eleven arid districts) was that despite substantial increases in the peasant population (as high as 50 percent in some villages mentioned by Rai) during 1910-40, the Jagirdars did not allow additions to cropland from common property resources. Instead, they raised the levies from one-fourth to one-half of the produce on the already-established and overcrowded croplands, and proposed to charge the same (increased) revenue rate for the submarginal (common property resources) lands, if and when any peasant agreed to accept such lands for cropping.

Examination of records relating to land revenue collected by Jagirdars in our study villages also reveals an insignificant extent of conversion of fallow land into cropland. The area of cropland (including net sown area, current and long fallow) increased by only 1-3 percent during 1935-51. The population of the same villages increased by 43-45 percent during this period.

In the face of exploitation by the Jagirdars, the peasants could satisfy their increased demand for cropland only through reduction in the extent of long fallow. (Boserup describes such intensification of land use in response to population density at the global level in prehistoric times.)[19] However, as indicated in Table 1, long fallow represents only a small fraction of total common property.

The terms and conditions governing the use of cropland during the feudal period were not conducive to the conversion of submarginal grazing lands into cropland. Most of the lands of the arid zone are submarginal in physical terms and not suited to cultivation. During the feudal period they were submarginal on economic grounds as well. Since the Jagirdar took one-fourth to one-half of the farm produce as rent, the tenant's share was not enough to compensate for the cost and effort of raising crops on poor land. Furthermore, the Jagirdar imposed more levies on crop producers than on animal raisers. Hence, despite increased population pressure, there was not enough incentive for tenants to extend crop farming by exploiting common property resources.

Besides the harsh terms and conditions imposed by Jagirdars on tenants, the traditional occupational structure contributed to lower pressure on cropland despite increases in population. The traditional caste occupations — services and crafts under the *Jajmani* system and, outside it, exclusive engagement in livestock raising, petty trading, and so on — kept a substantial proportion of village populations away from the croplands.

### *Demographic Factors in the Post-land Reforms Phase.*

The introduction of land reforms, combined with other post-Independence changes, unleashed the forces of population growth. The land reforms of the early 1950s not only liberally distributed submarginal lands (common property resources) to the people, they also changed the economics of land use. Land was granted to people for annual rents payable to the government. In Nagaur district, rent payable as crop share to the Jagirdar was Rs 16 per hectare (at 1976-77 prices); following land reforms, fixed rent on submarginal lands was Rs 1.50 per hectare (see Table 6). The low fixed rent reflected the low crop productivity of these lands as compared with fertile lands in well-endowed areas. The reduced cost of submarginal lands, accompanied by the government's liberal approach to their distribution (partly to project a democratic image in areas formerly ruled by feudal lords), induced people to acquire private lands at the cost of common property resources.

Changes in the occupational structure of villages also increased dependence on, and therefore demand for, cropland. The Jajmani system governing patron-client relationships had tied many rural households to their traditional caste occupation (services and crafts). This system was disrupted following the introduction of the land reforms, and no substitution emerged for the Jagirdar's authority to oversee and enforce norms of intergroup relations.[20] Perpetuation of dependence on traditional caste occupations now appeared less economically attractive than farming land available for a very nominal charge. Subsidies, credit, and other forms of assistance available mainly to land owners under various development programs were further incentives to land ownership. This induced traditionally non-cultivating households to acquire cropland.[21]

A little-publicized social reform movement among low-caste craftsmen *(chamars, regard, bhambis)* was another important development beginning in 1949. Entire communities gave up caste occupations (leatherwork, weaving, etc.) — jobs that, according to the caste leaders of Untouchables, were responsible for their lower social status. Throughout northwestern Rajasthan, crop farming was adopted in place of crafts.

During the feudal period, an important category of absentee landlords consisted of land owners from the Rajput caste who worked in the military forces of princely states. With the merger of princely states in the Indian Union during 1950-52, most of these army units were disbanded. These people returned home to find their lands already transferred to their tenants. The rehabilitation of these and other absentee landlords who lost their lands during the reforms again led to distribution of lands once held as common property resources.

As these examples illustrate, demographic factors have exerted increased pressure on common property resources largely through the opportunities for cultivation created by various provisions of the land reforms program. Unfortunately, the categories used by census reports are too broad to be able to quantify occupational and other shifts in a way that would demonstrate the changes caused by land reforms.

## *Commercialization of Community Property Resource-Based Activities*

Because of the harsh desert conditions and the absence of even a minimal transportation network, most villages in the arid zone, until recently, were physically isolated from wider markets. Whole village economies were subsistence-oriented. Due to improved infrastructure and transportation facilities, the villages are now better linked with the market centers. Barter has been replaced by a largely monetized economy; visiting caravans of traders have been replaced by regular marketing arrangements. Consequently, the subsistence requirements of producers and local demand are no longer important determinants of demand for several products of the arid lands, particularly animal products. Marketability and value of products have increased substantially, especially in the case of wool, mutton, milk, milk products, and so on. Prices of such products, net of inflation, increased by roughly 350-550 percent during the 15 years ending 1964-65 (see Table 6). The resulting adoption of sheep and goat raising (an occupation traditionally followed by low-caste poor groups) by high-caste rich farmers in recent years has added to the pressure on common property resources.[22]

Profitability rather than concern for upkeep of common property resources has become the guiding force behind the choice of enterprises and usage pattern of common property resources.[23] Privatization of common property resources, through legal processes or illegal seizure, and over-exploitation by increasing the number of animals on common property resources have been the major consequences.

***Technological Innovation*** The introduction of irrigation, fertilizers, and improved seed varieties has affected a few parts of the arid zone. The most important technological change influencing the status of common property resources, however, was the widespread introduction of tractors. The introduction was initially supported by government subsidies to farmers and subsequently gained momentum due to its commercial profitability. For the region as a whole, the number of tractors almost tripled, from 2,251 in 1961 to 6,652 in 1971,[24] and it has increased further since then. In our study of the arid zone, in a cluster of six villages the number of tractors increased from 0 in 1964-65 to 50 in 1973-74, and the proportion of net cropped area to total land area increased from 44 percent to 81 percent during the same period.

Besides the poor soils, a major constraint to successful cropping on arid lands is the shortness of the wet period required for sowing. Using draft animals (i.e., bullocks and camels), it was difficult to sow large areas in the time available. The introduction of tractors eases this constraint enormously. Even small farmers rent tractors. This has induced businessmen to acquire tractors for hire.[25] These practices reduce the extent of short and long fallows and promote conversion of submarginal common property resources into cropland.

# CONSEQUENCES OF DECLINE IN COMMON PROPERTY RESOURCES

The decline in common property resources has several implications. Among the most significant are the long-term implications of increased intensity of use of submarginal lands, the distributive implications of privatization of common property resources, and the impact of livestock farming.

## *Long-term Implications*

Increased intensity of use of submarginal lands (i.e., through crop farming instead of animal grazing) is not a consequence of privatization of common property resources per se, but rather of the usage practices that accompany privatization. In the case of the arid zone of Rajasthan (unlike the situation in Europe following privatization of common property resources), privatization has invariably meant putting the land under plow. This practice strains the limited use-capability of the land. The ex pected (and in some cases already visible) consequences are soil erosion and decline in overall crop yields. An analysis of area and production data from the early 1950s to the early 1970s for the region as a whole reveals that the successive additions to the area devoted to rainfed crops have led to corresponding declines in yields per hectare.[26] The decline in the productivity of remaining (overused) common property resources was illustrated in Table 4.

## *Distributive Implications*

Distributing common property resources to the poor deprives them of collective gains, while improving the position of individuals who receive the land. We do not have enough data to assess the net gain or loss to the poor following the privatization of common property resources. But limited evidence suggests that privatization has helped well-endowed land owners more than the poor. As shown in Table 7, in the study villages farm households owning more than 10 hectares of land prior to privatization acquired 59 and 62 percent of total privatized lands in the villages of Nagaur and Jodhpur districts, respectively. On average they added more land to their existing holdings than did poor households. Furthermore, virtually all the common resources with more fertile soils (e.g., forest, tankbeds, etc.) were acquired by large farmers. Most of the poor received their land following official action on their formal application. Large farmers' principal mechanisms for obtaining common property resources lands were either fabricating proof of title to certain pieces of land or gaining legal recognition of de facto (illegal) occupancy.

## *Impact on livestock farming*

Since livestock farming is the key activity sustained by common property resources, the impact of the decline of these resources would be expected to be greatest on this enterprise. In view of a number of other developments, however — such as improved marketing facilities for animal products, changes in the relative profitability of different livestock enterprises, and institutional change facilitating or obstructing the migration of different types of animals — it is not easy to isolate the impact of declining common property resources on livestock raising.

Table 8 compares several aspects of livestock farming in 1963-65 and 1977-78. The average size of livestock holding expressed in terms of animals units has declined. This is true in the case of both small and large farmers. The ratio of unproductive animals (young stock, dry cattle, etc.)

**Table 7. Distribution of Land Acquired Through Privatization of CPRs in Two Villages in Two Districts of Western Rajasthan**

| | Average size of land holding per household before and after new land acquisition | | | | | |
|---|---|---|---|---|---|---|
| | Nagaur | | | Jodhpur | | |
| Size of land holding prior to new land distribution (ha) | Before (ha) | After (ha) | Percent of new land acquired[a] | Before (ha) | After (ha) | Percent o new land acquired[a] |
| None | 0 | 2.8 | 13(-) | 0 | 3.1 | 11(-) |
| Up to 5 | 3.9 | 5.4 | 10(1) | 3.6 | 5.5 | 13(-) |
| 5-10 | 7.8 | 11.5 | 12(-) | 8.2 | 10.2 | 9(2) |
| 10-15 | 12.6 | 19.6 | 25(27) | 13.1 | 20.9 | 23(32) |
| Above 15 | 25.5 | 35.1 | 34(63) | 20.5 | 30.4 | 39(58) |

NOTE: Data were collected during the first phase of field work (1963-64). They relate to one village each in Nagaur and Jodhpur districts. Total number o households and area involved in the Nagaur village are 281 and 74 (ha), respectively; the corresponding figures for the Jodhpur village are 307 and 7 (ha), respectively. The table excludes a few cases in which land went to people from neighbouring villages; hence the percentages do not sum to 100.

Figures in parentheses indicate the percent share of each group in superior type of CPRs privatized, including forest lands and areas near watering point: etc., that have good soils. They are not submarginal lands.

**Table 8. Changes over Time in Livestock Farming in Two Villages in Two Districts of Western Rajasthan, 1963-78**

| | Nagaur | | | | Jodhpur | | | |
|---|---|---|---|---|---|---|---|---|
| | 1963-65 | | 1977-78 | | 1963-65 | | 1977-78 | |
| Item | Small farmers[a] | Large farmers[b] | Small farmers | Large farmers | Small farmers | Large farmers | Small farmers | Large farmers |
| Average size of livestock holding (animal units) | 15 | 13 | 13 | 9 | 16 | 14 | 15 | 9 |
| Share of sheep/goats animal units (percent) | 38 | 6 | 42 | 22 | 40 | 9 | 46 | 31 |
| Proportion of buffalo in milch stock (percent) | 5 | 23 | 13 | 46 | 6 | 27 | 15 | 51 |
| Unproductive animals per productive animal (no.) | 7 | 4 | 6 | 2 | 5 | 3 | 5 | 1 |
| Cattle regularly stallfed (except in monsoon) (percent) | 6 | 25 | 11 | 49 | 5 | 23 | 18 | 57 |
| Proportion of animal grazing days depending on CPRs (percent) | 81 | 59 | 76 | 31 | 85 | 62 | 76 | 29 |

NOTE: Data relate to one village in each district. Details of the first four items relate to the whole village, while the last two items relate to sample households. The details of only two farming groups are presented to indicate the contrast or comparison.

[a] Those owning up to 5 hectares of land.

[b] Those owning 10 or more hectares of land.

to productive animals has declined. The extent of stall feeding has increased, while the dependence on common property resources for grazing has declined. These changes are more pronounced in the case of large farmers. Such changes could be attributable to both the decline of common property resources and the increased commercial importance of ivestock farming. Discarding of unproductive animals and greater emphasis on stall feeding help improve efficiency and profitability of livestock production.

Of the remaining two indicators of change shown in the table, the increased proportion of buffalo is surely a result of improved mechanisms for milk marketing. Buffalo milk fetches a higher price than other milk in these villages because of its higher fat content. The increased proportions of sheep and goats in livestock holdings are a response to a decline in common property resources and to higher wool and mutton prices. Cattle find it difficult to graze in the poorer quality common property resources, but sheep and goats can manage. Similarly, it is easy for sheep owners to migrate: they are welcome in the canal areas of Punjab and Haryana for sheep penning. Cattle owners do not have this opportunity.

# CONCLUSION

The process of change described in this paper suggests that well-intentioned public programs like land reforms can deprive a region of its comparative advantage in a key economic activity (in this case, livestock farming). Privatization raises the cost of livestock raising and, hence, erodes the region's comparative advantage. The adjustments to the decline in common property resources in Rajasthan suggest the directions that will characterize the future of livestock farming in the region. The continuing shrinkage and degradation of common property resources is likely to force further reductions in the size of livestock holdings and changes in their composition. This has already happened to some extent, as indicated by the decline in the number of cattle and unproductive animals and the increased emphasis on sheep and buffalo raising. Another likely consequence is increased dependence on stall-feeding of cattle and a greater incidence of seasonal out-migration of sheep. However, the lasting consequence of all these changes could be the erosion of comparative advantage that the arid zone enjoys in livestock farming.

Another conclusion from this study relates to the future of common property resources in general. Considering their several advantages —

such as promoting the economic activity best suited to the natural resource base of a region, sustaining the rural poor, and ensuring the use of arid lands according to their capabilities — there is a strong case for protecting and developing common property resources. A government strategy along the following lines might reverse the trends illustrated in this paper: a strict ban on further curtailment of common property resources through privatization; regulated use of common property resources, achieved by introducing some element of private cost for the users; and designation of common property resources as a source of revenue for the Panchayats, to induce them to conserve and systematically manage them as productive resources.

# NOTES

1. See Garrett Hardin, "The tragedy of the commons," *Science* 1962, No. 859 (1968).

2. For differing opinions on resource depletion in developing countries, see C.F. Runge, "Common property externalities: Isolation, assurance, and resource depletion in a traditional grazing context," *American Journal of Agricultural Economics* 63, no. 4 (1983); S. Sanford, *Management of Pastoral Development in the Third World* (London: ODI-John Wiley and Sons, 1983); and R. Repetto and T. Holmes, "The role of population in resource depletion in developing countries," *Population and Development Review* 9, No.4 (1984).

3. Studies comparing livestock farming to crop farming in Rajasthan are found in *Agriculture and Livestock in Rajasthan* (New Delhi: National Council of Applied Economic Research, 1965); and in N.S. Jodha and V.S. Vyas, *Conditions of Stability and Growth in Arid Agriculture* (Gujarat, India: Agro-Economic Research Centre, Sardar Patel University, Vallabh Vidyanagar).

4. For further discussion of resource ownership by village communities, see A.E. Nyerges, "Pastoralists, flocks and vegetation: Process of co-adaption," in *Desertification and Development: Dryland Ecology in Social Perspective*, ed. B. Spooner and H.S. Mann (London: Academic Press, 1982); and W. Weissleder (ed.), *The Nomadic Alternative* (Chicago: Beresford Book Service, 1978).

5. See N.S. Jodha, "Capital formation in arid agriculture: A study of resource conservation and reclamation measures applied to arid agriculture," Ph.D. Thesis, University of Jodhpur (1967).

6. Field visits during 1973 were in connection with the preparatory work of the World Bank's project proposal for drought-prone areas. The 1977-78 round of field work was conducted on behalf of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). The main objective was to examine the extent and type of farmers' group action in watershed-based pasture development promoted under the Drought-Prone Area Program (DPAP) and in milk marketing cooperatives promoted under the Operation Flood Project.

7. For further description of animal watering points, see *Socio-Economic Survey of Livestock Breeders in Anupgarh-Pugal Region of Western Rajasthan* (Jodhpur: CAZRI, 1965); see also Jodha, cited in note 5.

8. The purpose of the study was to compare the watering points with *Tanka* (underground water storage tanks) tried by CAZRI in its rangeland development and management experiments at 52 locations in different arid districts. Findings are described in M.C. Prajapati, N.S. Vangani, and L.D. Ahuja, "In the dry range lands of western Rajasthan 'Tanka' can be the answer," *Indian Farming* 22, No. 11 (1973); and in L.D. Ahuja and H.S. Mann, "Rangeland development and management in western Rajasthan," *Annals of Arid Zone* 14, No. 1 (1975).

9. Tractorization is discussed in N.S. Jodha, "A case of the process of tractorization," *Economic and Political Weekly (Quarterly Review of Agriculture)* 9, no. 52 (1974).

10. These studies, conducted by CAZRI are discussed in M. Prakash and L.D. Ahuja, "Studies in different range condition grasslands in western Rajasthan," *Annals of Arid Zone* 2, nos. 1, 2 (1964); and in K.A. Shankarnarayan, "Impact of overgrazing of the grasslands," *Annals of Arid Zone* 16, No.3 (1977).

11. Minor variations existed from place to place, especially in *Khalsa* villages — those directly under the administration of rulers of princely states.

12. For further discussion of regulations imposed on users of common property resources, see H. Singh, "Caste and Kisan movement in Marwar: Some questions to the conventional sociology of kin and caste," *Journal of Peasant Studies* 7, No.1 (1979).

13. See R. Rai, *Akal Kashta Niwarak* (in Hindi), report on famine-scarcity eradication to the Counsellor of Jodhpur State (Bali [Marwar]: Shri Ragunath Ayurvedik Pharmacy, 1942); and Singh, cited in note 12.

14. Agriculture in the arid zone is discussed in N.S. Jodha, "Society oriented pattern of arid agriculture," *Indian Journal of Agricultural Economics* 21, No.4 (1966).

15. These investigations are analyzed in N.S. Jodha, "The operating mechanism of desertification and choice of interventions," in *Arid Zone Research and Development*, ed. H.S. Mann (Jodhpur: Scientific Publishers, 1980).

16. See Y. Hayami and M. Kikuchi, *Asian Village Economy at the Crossroads: An Economic Approach to Institutional Change* (Baltimore: The Johns Hopkins University Press, 1981).

17. See S.P. Malhotra, *Socio-Economic Structure of Population in Arid* Rajasthan (Jodhpur: CAZRI, 1977).

18. See Rai, cited in note 13.

19. Ester Boserup, *The Conditions of Agriculture Growth: The Economics of Agrarian Change Under Population Pressure* (Chicago: Aldine, 1966).

20. See A.B. Bose and N.S. Jodha, "The Jajmani system in a desert village," Man in India 45, no.2 (1965).

21. See Jodha, cited in note 15.

22. Goat and sheep raising is discussed in K.A. Ram, Mruthyunjaya, G.V.S.R. Krishna, and D. Goyal, "Growth of goats and sheep in Rajasthan desert: *Analysis and implications*," Agricultural Situation in India 38, No.10 (1984).

23. See N.S. Jodha, "Market forces and erosion of common property resources," paper presented at the International Workshop on Agricultural Markets in Semi-Arid Tropics, ICRISAT Center, Patancheru (A.P.), India, 24-28 October 1983; see also Jodha, cited in note 15.

24. Tractorization is discussed in H.S. Mann and J.C. Kalla, "Asset-liability imbalances in agricultural sector of the Indian arid zone," ICAR, *Desertification and its Control*, presented at the UN Conference on Desertification, Nairobi, Kenya, 1977.

25. See Jodha, cited in note 9.

26. See N.S. Jodha, "The role of administration in desertification: Land tenure as a factor in the historical ecology of western Rajasthan," in Spooner and Mann, cited in note 4.

# II.3

# THE PRIVATIZATION OF THE COMMONS: LAND TENURE AND SOCIAL FORESTRY DEVELOPMENT IN AZAD KASHMIR

**Michael M. Cernea**

In the everyday jargon of development practitioners the term "social" is almost never used to describe sectoral agricultural programs. The one conspicuous exception is "social forestry development." Who introduced the term "social"? And *why* this unexpected exception? In other words, what is *social* in forestry?

My attempts to trace this term to its origins and to discover its first user have not been successful. But a large, if imprecise, consensus has developed as to its meaning. The many references to social forestry programs explicitly recognize that these projects are designed to trigger cultural change in the behavior of large numbers of people with respect to the planting and protection of trees. In other words, these programs are deliberately directed (or are assumed to be directed) not merely toward the ultimate end of growing more trees, but also toward influencing a crucial intervening variable: people's behavior toward trees.

Successful social forestry development, however, cannot result from behavioral change and individual initiatives alone. Social and behavioral aspects should be understood in a broader sense, including collective action, institutional development, and the establishment of enduring social structures that will activate and organize the behavior of individual actors. In this chapter I address institutional and sociostructural issues in social forestry development. I argue that alternative forestry development strategies must be based on specifically tailored institutional and sociostructural arrangements and on alternative units of social organization. A clear sociological understanding of what type of social organization can act to sustain specific sylvicultural strategies is mandatory. Such social structures or units may already exist and merely need to be strengthened and mobilized, or they may have to be established and organized.

Examining these variables in their practical embodiments rather than exclusively in conceptual terms, the first part of this chapter analyzes the anatomy of a real case — its objectives and its defects, particularly in relation to land institutional arrangements and the potential for community action. The second part resumes the conceptual discussion of some structural and institutional variables in forestry strategies. In particular, it analyzes collective versus individual innovation and describes various units of social organization capable of being social actors in forestry management and development programs.

## A SOCIAL INNOVATION AND ITS PREMISES

Although commercial and industrial forestry projects are not a recent invention, social forestry projects are. In the conventional type of forestry development, large corporations or government agencies hire workers to establish or expand plantations on large tracts of land that businesses and agencies control; the wood is harvested for use in industry or construction. The new approach, social forestry, is to induce a large number of small farmers systematically to plant fuelwood tree on their own lands.

The social innovation of these programs appears formidable indeed in the light of the long history of the traditional, patterned behavior it is supposed to change. Farmers across meridians have generally counted on natural regeneration of trees to meet their firewood and construction needs, without systematically planting trees for fuelwood. The major exception was fruit trees, which have long been planted as part of various production strategies.

That large-scale behavioral and cultural change is needed to intensify reforestation has gradually come to be recognized. Several factors underscore the urgency of the problem. The world's general energy crisis has suddenly turned the spotlight on the old fact that the majority of humankind still uses firewood as the main cheap source of everyday energy. Fuelwood shortages of almost crisis proportions have already struck many countries or extended regions of them, particularly in Asia and Africa. And there is a growing awareness that the current use of forest resources and people's behavior towards fuelwood trees, without new planting, could lead ultimately to more massive deforestation and possibly a worldwide fuelwood scarcity, with dramatic human and environmental consequences in the not too distant future.

One of the responses to that increasingly ominous threat was the advent of what are called social forestry programs and policies. Such programs were proposed in the Forestry Policy Paper issued by the World Bank in 1978, as well as in several recent statements and policies by other development agencies in different countries. The social forestry projects already launched are in essence financially induced programs for the massive planting of fuelwood trees.

The *social* innovations fostered through such policies are two-pronged. They attempt both to change the pattern of management of existing forestry resources, by involving large groups of people in conservation and management activities, and to stimulate the wide-spread adoption of a "new" productive activity: the systematic planting of trees for fuel, as opposed to the age-sanctioned gathering of naturally grown firewood.

Several social conditions are necessary if these innovations are to succeed. This chapter discusses a few of the substantive social prerequisites for every social forestry program, whether they are explicitly identified or ignored. Financial investments alone cannot make the program a success. These prerequisites often go beyond the dynamics of individual adoption of innovations regarding tree-growing to the more complex processes of collective adoption. Although adoption of innovations by individuals has been the subject of an entire stream of sociological research spearheaded by Rogers and others,[1] the collective adoption of innovation, as correctly pointed out by West, has received far less attention.[2] Yet processes such as reforestation, environmental protection, watershed rehabilitation, and in general the group management of natural resources require sociologists to be more concerned with the dynamics of collective behavior and with the prerequisites for the systematic diffusion of collective innovations.

Central among these social prerequisites is the existence of a unit of social organization or a structure capable of sustaining an innovation. Financial inducements alone, however important, are not sufficient and their impact is not automatic. Other social factors whose functions must be recognized include purposeful patterns of social organization for conserving natural resources or for producing new resources, existing land tenure systems that are either conducive to or restrictive of the given innovation, ownership rights to and distributive arrangements for the newly developed resources, authority mechanisms for collective decision-making and for mobilizing group (or even individual) action, social perceptions and attitudes, political power that affects the distribution of generated benefits, and the influence of external change agents.

It is often not properly realized in the planning of financially induced social forestry programs that consideration of these factors has to be woven into the very fabric of such programs. The penalty for ignoring them is failure. This is not to say that the recipe of *how* to incorporate them is readily available. It has yet to be produced. Both practitioners and action-oriented social researchers have to cooperate, search, test, predict, verify, monitor, learn, redesign, and resets. But this does not mean that there is no knowledge whatsoever about these factors of processes and that everything is still to be discovered. Much of existing sociological know-how can be mobilized and used as stepping stones to action, to testing, and to new knowledge. Therefore, there is no reason for sociologically illiterate social forestry programs.

## THE CASE OF A SOCIAL FORESTRY PROGRAM

To illustrate some of these issues, this chapter will first describe a specific project in which good social intentions proved to be no substitute for the missing social knowledge — a case which demonstrates that sociological factors are salient and work tenaciously under the thin layer of the "new" reality temporarily constructed with the financial inducements of the programs. Such factors were, in this case, the existing land tenure system, the usufruct system, the local power and authority system, and the absence of social structures for collective action.

The specific case is the pilot forestry program under the Azad Kashmir Hill Farming Technical Development Project in Pakistan, co-financed by the World Bank between 1978 and 1983. The lack of a sociological analysis when this project was appraised paved the way for false assumptions about land tenure. The strategy predicated on these assumptions backfired. The sociological analysis at project midpoint revealed the array of unanticipated consequences that had built up during the implementation process. By contrasting the complexity of the local social context with the uninformed and simplistic approach of the project, the following summary of that analysis suggests why seeing the people behind the trees should be the first commandment in social forestry.[3]

The Hill Farming Technical Development Project was started in 1978 in Azad Kashmir, Pakistan, with assistance from the World Bank, as a pilot exercise to test several new approaches with a view to replicating the successful ones in a subsequent, large-scale project. The forestry component financed fuelwood plantations, testing of new tree species under local conditions, and the establishment of nurseries for supplying seedlings. This component was included in view of the alarming prospects of rapid deforestation, a fuelwood crisis, and environmental deterioration. Indeed, both the demographically and culturally driven fuelwood shortage in Azad Kashmir and the answer devised through the project were rather typical for circumstances in many other places. They warrant a brief description.

Increasing demand for fuelwood and timber has caused large-scale deforestation in Azad Kashmir over the past twenty-five years. In 1972 about 1.5 million residents, or 300,000 families, relied entirely on fuelwood for cooking and heating. At the current high rate of growth (3 percent annually) the population will almost double by the year 2000, and pressure on government forests is increasing as people cut wood both for fuel and to clear land for farming (through illegal encroachments). Under customary rules, area inhabitants are entitled to remove deadwood, branches, and noncommercial species from reserved forests without payment, primarily for personal consumption. In practice, however, this customary right is liberally interpreted and abused. Within a radius of several miles from habitations virtually all trees are debranched beyond the limits set by sylvicultural recommendations. In many locations only the top 10 to 20 percent of the crown of trees remains. Outright topping has also occurred and prematurely killed the trees. In the Chir pine areas, long thin vertical slices of the bole of the tree are removed at stump level for home lighting. Roadside trees are similarly molested. Forest resources are also devastated by local livestock that graze without adequate controls. The situation is aggravated by the transhumant livestock of semi-nomadic populations who enter from Punjab and the North-West Frontier Province to use the Azad Kashmir alpine rangeland during summer.

The result is that the Forest Department needed the cooperation and support of the area population to stop and reverse deforestation, but instead it was in open conflict with a high proportion of the local inhabitants. At the time of the project appraisal more than 50,000 cases of forest offenses were pending in the courts. This amounted to about one family in six being involved in a reported forest offense, and many farmers were therefore reluctant to participate in reforestation schemes and were suspicious of the Forest Department.

Under the circumstances, far-reaching changes were required, both to improve the management of existing forests and to reforest depleted areas, if the need for fuelwood was to be met. In preparing the forestry component the technicians estimated the current average yearly consumption of firewood at 2 to 4 tons per family, amounting to some 800,000 tons in total. The scale of reforestation needed to produce this supply was estimated at 330,000 to 400,000 fully planted and well-managed acres. At the current cost of establishing fuelwood plantations (about 2,000 rupees [Rp] an acre), such a program would incur expenditures far beyond the available government resources. The government therefore needed to examine the extent to which the private users of fuelwood should contribute to these costs.

When the pilot project was prepared, it was thought that social support for the program (contributions from private users) could be blended with public support (government financing). Accordingly, the strategy was designed to experiment with both the technical and the social aspects of developing forestry and to involve local people in planting and maintaining the reforested areas. Community acceptance of the obligations of re-planting and protecting the new tree blocks was regarded as crucial for the project's success. The government was to finance the establishment of four nurseries at Patika, Kotli, Hajira, and Bagh, to produce seedlings for sale at a low price to the area farmers. Initially the government was also prepared to finance the costs of planting trees on community-owned lands in order to experiment with a model that could be replicated by farmers themselves and to provide benefits primarily to the small farmers, who make up the majority of these communities.

## LAND TENURE AND THE ANATOMY OF A PROJECT'S FAILURE

The project design was based on a set of sociological assumptions about the tenure of the land to be reforested, about community processes and about farmers' willingness to participate. In hindsight these assumptions appear rather naive and surprisingly uninformed. A sociological assessment of the area's land tenure system was not made during the project's preparation.

In the absence of a sociological field analysis, the appraisal report relied on explanations given by local officials and identified *shamilat* land as "land generally left uncultivated, owned jointly by a number of families." It was considered to be community land, for which villages had decision-making authority as well as rights to share in its use. The appraisal report assessed the shamilat area as a major resource of approximately 325,000 acres. This was equivalent to more than half the total cultivated farm area in Azad Kashmir, which was about 500,000 acres.

It was planned to finance the planting of 3,000 acres of fuelwood mainly on shamilat land (only a small proportion was expected to be planted on government or private land). The basic assumption was that the community would be the social unit which would stand behind the program. It was expected that community consent would be necessary to make shamilat land available, and that the project would elicit direct community participation in planting and protecting the tree plantations and would eventually generate tangible benefits for the communities involved. The small farmers in Azad Kashmir, who had less access to firewood, were expected to be the primary beneficiaries of project-financed planting on communal land. An implicit assumption was that the community structures would mobilize community support for fuelwood planting, in the form of labor, payments for seedlings, or other contributions toward reforestation costs. The same social structures were assumed to be strong enough to enforce the temporary closing of reforested areas to protect the tree seedlings and prevent indiscriminate grazing.

The features of "social forestry" were obvious in the design of the project. The communities were to be the social units supporting the reforestation of community woodlots, and the farmers' use of nondurable areas was to be changed by converting some nondurable and grazing lands to fuelwood plantations. (Other project components were to compensate for the loss of grazing land by intensifying fodder production.) In sum, the project was setting objectives that required a modified productive behavior. The question was, would the target communities and individual farmers respond as expected?

The physical accomplishments of the forestry component were initially quite satisfactory. The reforestation target of the first project year was met: fuelwood trees were planted on 500 acres and the first nurseries were established successfully. During its first months the project identified 100 acres of community and private land, in addition to the 400 acres of government land. As reported by the project staff, the owners and users of the private and community land agreed to allocate the land for fuelwood plantation, although no formal contract was signed.

In the second year, the project had an increased planting target of 1,250 acres. Other landowners came forward and volunteered their nondurable lands for tree plantations, and the project staff tentatively identified for planting about 750 acres of community and private land and 5000 acres of government land. This was a much larger proportion of nongovernment land than had been optimistically assumed at appraisal. The farmers response seemed to suggest that significant tracts of private and community (shamilat) land could be incorporated into the fuelwood production circuit.

Given the experimental nature of this project, during the implementation process that started in 1978 more attention was paid to its sociocultural aspects than was usual in comparable projects. A social analysis of the implementation of the forestry component was undertaken by me in 1979 and 1980 to ascertain whether the land identified for fuelwood plantation was consistent with the initial social and technical assumptions, and whether the expected distributional benefits were likely to occur as planned.

It is noteworthy that the social analysis was not triggered by a crisis situation or a lack of progress, but was initiated to examine what seemed to be the successful advancement of the project. The analysis ascertained the socioeconomic status of the farmers reached by the reforestation component of the project; determined the tenurial status of the lands involved in the project in the first two years and estimated the likely beneficiaries; assessed the social procedures used in project implementation, particularly the communication patterns between the project staff and the farmers; and assessed the adequacy of the experimental community strategy of the pilot project for reforestation and promoting changes in the patterns of land use. Given the critical importance of the land tenure for reforestation, special attention was also paid to the social mechanism of community decision-making and the procedures for sharing the expected profits from the forestry investments.

The analysis of the tenure system in Azad Kashmir identified three basic categories of land potentially usable for reforestation:

> *Khalsa*, or Crown land, is government-owned and consists of demarcated and un-demarcated forests.[4]
>
> *Shamilat* land itself derives its name from the concept of "getting together" and belongs to the communities. These lands are used as grazing areas, forests, sites for village public buildings, village graveyards, and so on.
>
> *Malkiat* land is privately owned, and ownership rights are recorded in the revenue register and are validated by it.

As a rule of thumb, the demarcated forest areas are of higher density and better quality than the un-demarcated forests, which are often located between the demarcated forests and the cultivated lands. Two other categories of forest in Azad Kashmir are forests under the management and control of the Revenue Department and private forests.

The social assessment identified significant differences between the legal or formal status of the land and the de facto situation. Contrary to expectations, shamilat land appeared to be, for the most part, not truly community land. Significant changes over time in most of Azad Kashmir had caused a dual, divergent status to evolve. Although shamilat continues to be considered in principle community land, in real life it is operated and used as private land, and the usufruct benefits from this land now accrue to individuals, rather than to the whole community. The sociological analysis thus invalidated some basic assumptions made when the planting of *shamilat* was initially planned, and revealed that unanticipated consequences of the planting program were likely to distort the intended flow of benefits to various social groups.

How did this major change in the tenure system come about? It appears that *shamilat* land was indeed once set apart and allocated to villages for common use as pasture, graveyard, woodlot, or a source of drinking water for people and cattle. Subsequently, there was a long period of social and political change, still ongoing, that occurred in roughly three stages:

*Informal partitioning*. Village families whose land adjoined the *shamilat* areas began to divide the *shamilat* among themselves and numerous small and remote farms were left out of this informal partitioning.

*Progressive appropriation*. These village families began to take over the land and even to cultivate it.[5] Rights to *shamilat* became transferable through inheritance or sale of fractions of the privately owned areas, which carry with them rights to proportionate fractions of the *shamilat* plots. While this de facto appropriation advanced, *shamilat* kept its formal status as community land and was not entered in the revenue records as belonging to private families. As a result, the families concerned did not have to pay land taxes on "their" *shamilat* plots.

*Gradual privatization*. Since 1974, when the tax on land was abolished in Pakistan, the pressure has increased to have *shamilat* plots entered in revenue records in the names of the families who appropriated them and thus have them validated as privately owned lands. The interested families use various means to change the registration of their land, contrary to existing legal regulations.

The cycle of partitioning, appropriating, and privatizing community land had progressed at different speeds in various districts of Azad Kashmir. It is reported that the status of land registration and tenure, for instance, differs in Mirpur district from that in Poonch district. Some areas and communities still maintain pieces of *shamilat* as truly community possessions. In general, however, the historical cycle described above seems to be continuing. For instance, current regulations continue to permit, under certain circumstances, the transfer of areas of *khalsa* (Crown) land to villages so that it becomes community land. Sooner or later, yesterday's piece of *khalsa* land thus becomes, through transfer or through encroachment, today's *shamilat* land, which in turn is likely to become tomorrow's *malkiat* land.

This being the real system of land tenure in the area, it is understandable that the project staff was not able to find genuine community land for project-financed reforestation. On close inspection, I found that the planting reported on *shamilat* turned out to be on individually controlled land. The social analysis of project implementation revealed that the tracts of *shamilat* land that had been offered for planting — and assumed by the project staff to benefit the communities — had surreptitiously changed their tenurial status. The de facto owners hoped to get "their" *shamilat* lands planted at government expense, without making any repayment commitments. No community decision-making was involved, and no community woodlot was established. Wherever there were still some genuine communally used plots of land, the communities did not come forward to offer them in support of reforestation, but preferred to save them for other uses.

The community forestry component, based on inaccurate assumptions and lacking from the outset a social structure to sustain it, failed in the early stages of the project.

Further analysis of the farmers who offered their private (*malkiat*) land for project reforestation and of the farmers who were in control of the nominally *shamilat* plots revealed that the larger landholders tended to take advantage of the project. The wealthiest landowners, who have the resources to contribute the costs of establishing and protecting the stands, had not done so, nor did they intend to do so in the future.[6] In one of the forestation sites, for instance, the main part of the 100 acres planted in the first project year belonged to one influential family of six brothers, only one of whom was "almost" a full-time farmer, while the others were absentee landlords operating shops and small enterprises in Muzaffarabad. Another landowner, who offered about 125 acres of land for planting in the second project year, flatly refused to contribute a payment, arguing that the government of an Islamic country should provide for the citizens. A third large farmer, who wanted his 56 acres planted in the second project year, requested government-paid guards to protect the plantation and to restrict the access and customary rights of smaller farmers to collect grass, tree branches, and the like.

The smaller farmers hesitated to accept project planting on their lands. They were fearful of losing possession or control over their land to the government once it was planted by the Forest Department, or of being deprived of rights to collect fodder and graze their cattle. Most of the smaller farmers interviewed indicated that they might offer small plots for project planting, provided they could be convinced that the Forest Department would not alienate their lands and that they would be able to cut grass for their cattle.

In contrast, the larger landowners, being confident of their political power, did not regard tree planting by the Forest Department as a threat to their ownership of land and trees, and tended to manipulate available project opportunities and resources to their own benefit. This attempt was facilitated by the absence of a legal framework that defined the obligations, not merely the rights, of the large farmers whose land was being reforested through government contribution. The absence of a contract left a huge loophole that enabled the large landowners to avoid making contributions.[7]

## LESSONS FROM THE SOCIAL ANALYSIS

The findings of the sociological analysis led to immediate changes in the project and generated several lessons of broader validity. The project's management was asked to reconsider the areas identified for fuelwood planting and to limit immediately the planting on fictitious *shamilat* land. During the following year the project reexamined the 800 acres of allegedly community and private lands that had been identified initially for planting, and retained only 400 acres, of which only 25 acres was *shamilat* land. The intent was to prevent turning the pilot project into a full "giveaway" program, until a cost-sharing system could be designed. The funds that remained available were redirected in the short run to planting on khalsa land, so that the pilot area was increased from 400 to 850 acres. The project's selection of private (*malkiat*) plots for experimental planting with fast-growing species was more emphatically oriented towards the smaller farms.

More important than these short-run adjustments were other benefits of the sociological analysis. It prevented the extrapolation of the pilot project on a much larger scale, as initially intended. The practical failure proved more convincingly than intellectual arguments that the social analysis should have been carried out at the time of preparation and appraisal, when it could have steered the pilot project on a different path, consistent with the local social landscape. Though done relatively late, it was instrumental and consequential.

When the follow-up development project in Azad Kashmir was appraised in 1983, an attempt was made to avoid the earlier errors with regard to forestry. The new orientation was toward overcoming the social constraints to a systematic hill development program. Most hillsides are a mix of various social tenure systems, and each hillside is a separate ecosystem that must be treated as such. It is of little use to design production and conservation measures on one part of the hill when run-off from another part is not checked at the same time. Consequently, the new project was oriented toward integrated hill management plans, based on agreement between the individual owners in each catchment area, the communities where relevant, and the government, with some cost-sharing and benefit-sharing arrangements. Since strong sustaining structures within the farming communities were neither identified nor established in the available time, the hill development programs were to be implemented mainly by government departments in a rather paternalistic, top-down manner. At the same time, a different approach to forestry development received prominence in the follow-up project: "farm forestry" (discussed below).

Substantively, the sociological analysis discussed above brought three sets of social variables into the limelight: the complex land tenure system and the processes affecting it at deep structural levels; the community unit with its internal interactions, nonhomogeneous groups, and inability to act consensually; and the behavioral patterns of individual farmers. It hardly needs repeating that no social forestry project can be conceived and prepared without in-depth and timely treatment of at least these social variables.

## ALTERNATIVE UNITS OF SOCIAL ORGANIZATION

The three clusters of variables that were crucial to the failure of the Azad Kashmir project have in fact a more general relevance, since such variables are intrinsic to many forestry projects. Therefore I would argue that sociologists and foresters together should turn around such findings and translate them into methodologies for future action. Information about past social processes should be distilled into forward-looking strategies. This is the substance of social engineering at its best. The call of sociological analysis is not only to analyze and to explain, but also to assist in transforming the status quo. Speedy feedback from sociological analysis for the sake of short-run corrections, important as it is, should therefore be further enhanced by the formulation of sociologically substantiated operational strategies.

Perhaps the most important factor in designing the social strategy of forestry programs is the adequate identification of the *unit of social organization* likely to undertake the program and able to do so successfully. For a while, various forestry projects have lumped together under the broad umbrella of social or community forestry, various objectives and different approaches. This resulted (as in the Azad Kashmir project) in an unclear or mistaken identification of the social unit which could perform the intended activities.

Contributing to this insufficient clarity was the fact that the concept of community forestry was at a certain point loosely defined by some major agencies as "including *any* situation which intimately involves local people in a forestry situation" (emphasis added).[8] Contrary to this overly encompassing definition the operational challenge is to disentangle the broad term "people" and to identify precisely *who* and *how*: what social units of organization among the people can and will do afforestation, and which social units and definable groups can act as sustaining social structures for long-term production activities.

Such social units of organization can be either natural (existing) social groupings, such as the family household, or groups organized specifically to plant and protect trees. Examples of deliberately created groups (discussed below) are tree growers' associations or women's groups. Creating such social units — organizing them — is, however, a task that requires both correct social understanding of what is to be done and appropriate methods for social organization. The need to establish social units introduces a clear sociological dimension in forestry development projects and in the work of forestry departments.

Establishing a functional social group means, of course, much more than simply lumping together a set of individuals into an artificial entity labeled "group." It implies a process of selection and self-selection of the members, a willingness to associate and participate, a perception of both self-advantage and co-responsibility, and the establishment of an enduring social structure with well-defined functions. This will in turn help mold patterned behavior among members and is the essence of grass-root, purposeful institution building. Forming enduring units of social organization is particularly important in the case of tree growing, given the long production cycle, which requires structured support over an extended period. Such small-scale organizations enhance the capacity of their members; they maximize the cumulative impact of the contributions of individuals and enable them to perform activities and achieve objectives that otherwise might not be attained.

The social arrangements that need to be designed and established for social forestry will vary with the technologies envisaged for reforestation in different ecological areas. The technical and physical characteristics of a forestry program and the sociostructural characteristics of the unit that is its social actor should be compatible.

When forestry programs are designed, it is essential to realize that there are a number of different potential "social actors," but that they are not equally fit for different technical (sylvicultural) approaches to forestry. The appropriateness of various tree-planting technologies to one or another local situation is not neutral to social structure. Such technologies refer to species selection, nursery development, planting technology and configurations, plantation managing, protection, marketing, and so on. For instance, to determine which of three basic types of tree arrangements — block planting, linear planting, or mixed associations of trees and crops — is most adequate in a particular case would require identification of the socioeconomic characteristics of the farmers themselves and assessment of the local land tenure systems and land availability. The proper fit between the technical elements of afforestation and the social units around which an afforestation strategy can be built is at the core of the cooperation between forestry experts, planners, and sociologists.

The range of structurally different social actors in forestry development projects is quite broad: communities, villages, village governing bodies, farm families, groups of farmers, cooperatives, schools, private companies, and public institutions. Some of these social actors are examined below in the light of their sociological characteristics relevant to forestry work.

## *Community Woodlots*

Until recently, the community woodlot has been widely accepted as the dominant model in social forestry. Many experts considered that massive fuelwood planting could best be induced if large areas of communal lands were used and large numbers of people became interested in planting and protection. It therefore seemed natural to introduce this innovation through the community as a social grouping. Planting for social forestry was implicitly conceived, and treated operationally, as a collective innovation. Much emphasis was put on establishing woodlots on communally owned land. The *apparently* plausible social assumptions were that communities would influence their members to plant, would mobilize labor and promote self-help, and would collectively protect the young plantations on "their" land. It was also assumed that they could ensure the wide distribution of benefits among the small farmers who make up the majority of the community. Successful village woodlots in countries such as China and Korea, which had been supported authoritatively by the government, lent credibility to this approach and were assumed to be valid models for other social contexts.

When replicated in other countries, however, the community woodlot fared much worse than expected. Azad Kashmir is but one example, but results in Gujarat and other Indian states, in Niger and other African countries, and elsewhere were similarly disappointing. The review of actual experiences, some of them in World Bank-assisted projects, revealed that, in most of these failures, the village community was not effective as a social unit, for several reasons:

(1) Communities are generally large, not homogeneous, often split and stratified, and thus not able to sustain long-term projects which require efforts today for uncertain and delayed benefits in the future.
(2) The interests of community members often differ to such an extent that unified action is impossible. The "commons" syndrome[9] is particularly intractable since it runs contrary to the need for community members to cooperate in establishing woodlots, in abstaining from premature cuttings, and in protecting against animals. What is advantageous for one subgroup is not necessarily advantageous for another or for individuals. Local community leaders often appear reluctant, or not strong enough, to enforce restrictions to protect the trees.
(3) When available community land is limited and block sites are small, costs are high.
(4) The tenure status of communal lands is often uncertain; it is similarly unclear what social body has jurisdiction over the allocation of communal lands.[10]
(5) The elaborate distributional arrangements to ensure that produce from village woodlots is given to those needing it most have not worked out in practice. Usufruct is often blurred and

clear rules for distribution are absent. The long production cycle for trees weakens the confidence of those planting today that they will get wood eight years down the road, and it engenders the suspicion that the communal authorities will appropriate the wood in any case.

(6) Last but not least, communities are not necessarily organized as joint producers in any other respects. Externally designed programs seldom bother to establish grass-roots organizations and institutional structures within communities to achieve the goals of these programs. The close interdependence of members required by community schemes cannot be fostered by decree.

Because of such factors, poor results were obtained in many places. In the "bois de village" (village forests) in West Africa the community system was found "ill-suited ... to serve as a vehicle for reforestation,"[11] and in Asian countries its adequacy was questioned as well.[12] Often the forestry department had to take over the village woodlots to maintain the plantation.

## *Family Forestry*

The growing perception of the ineffectiveness of the community centered approach led to a substantial shift in thinking and strategies among foresters and planners. They began to focus on the *individual* farmer and family farm unit, as opposed to the community unit, in social forestry programs. This approach is being given various names — farm forestry, family woodlots, or agro-forestry — but the common denominator behind the semantic variability is that the family farm/household is the social nucleus around which reforestation is planned and financed. The technological package is different from the one proposed for community woodlots and is designed to suit the opportunities available to the individual small farmer.

This is not to say, of course, that there is no longer concern with village plantings or that there was previously no interest in supporting tree planting on individual farms. What I want to underscore is a shift in emphasis, a re-allocation of priorities, a refinement of social forestry strategies, and a change in the sociological underpinnings of certain forestry programs. This new type of program implies a demand for sociologists to refine the social strategy.

Recent World Bank-assisted forestry projects — in Karnataka, Kerala, Haryana, and other Indian states, as well as in Nepal, Mali, Haiti, and elsewhere — provide strong support and incentives for tree planting on individual farms. Farm forestry is now a substantial part of the follow-up project in Azad Kashmir, for instance, and about 12 million seedlings will be distributed to farmers. In the Jammu and Kashmir (India) social forestry project, village woodlots will represent only 11.3 percent of the total planting program, while farm forestry will represent about 43 percent, supported by a distribution of about 47 million seedlings without cost to individual farmers.

Sociologically, the significance of the family forestry strategy is manifold. It replaces joint (community) responsibility for planting with individual (family) responsibility. It replaces joint ownership of trees with individual ownership. It also vests the management authority over the tree plantation in a real person rather than in a diffuse, amorphous entity. The simplification of the distributional implications is obvious and enormous. For the farmer, the correlation between his inputs (labor or cash) and the output becomes direct, understandable, proportionate, and less risky.

Technically, trees can be grown on individual land not just as small blocks (family woodlots) but also along linear landscape features such as farm boundaries, internal field borders, and watercourses. From a socioeconomic viewpoint, tree planting technologies that maximize the use of interstitial locations and other marginal lands are particularly suitable for individual small farmers because they do not compete with existing land uses. Even small farmers who cannot afford to set aside an arable plot for a tree block can use their hedgerows for planting. Thus, opportunities for expanding tree planting are indeed enormous. Foresters have concluded that, since farmers secure most of their fuelwood by lopping branches, trees planted along homestead boundaries can produce several times more volume per tree than those felled from plantations. This has obvious implications for mitigating fuelwood shortages, since it is easier to persuade a farm family to plant on farm boundaries than to persuade communities to provide scarce land for block plantations. Current projections of increases in fuelwood planting until the year 2000 therefore expect family forestry to contribute the central share with community woodlots and state forests accounting for the rest.[13]

The silvicultural technology recommended for family forestry programs differs, in some significant aspects, from the one recommended for tree-block planting. These differences are linked to the sociological underpinnings of farm forestry. Under this approach, tree planting is incorporated into the farmer's own farming system, rather than remaining parallel to it on a remote communal lot. Technologically, this integration may entail the use of multipurpose species of trees, since these will satisfy farmers' needs not only for fuelwood but also for shade, fodder, construction poles, and so on. Species suitable for animal fodder, with fuelwood as a subsidiary rather than primary benefit, often integrate more organically into their overall farming systems than species such as eucalyptus that have been promoted widely by many programs. If appropriate species are selected, trees can become a cash crop, not merely a dual-purpose product for home consumption. Forestry can be complementary to, not competitive with, agriculture. In favorable ecological circumstances, with reasonable rainfall, an average rural family needs comparatively few mature trees (according to some estimates, roughly a hundred) to cover its cooking and heating needs, and many species, if correctly spaced, can help increase agricultural crop yields; it therefore appears that land availability need not be a constraint to increased afforestation, provided that family forestry indeed becomes widespread.

Since family forestry is essentially adopted through individual decision-making, the spread process is free from the difficulties such as factionalism that impede the collective adoption of community forestry. Adopting family forestry does, however, imply a change in behavior inasmuch as farmers did not previously plant fuelwood systematically. In India, for instance, it was estimated that in 1984 only a small fraction (no more than 10 percent) of all farmers planted fuelwood trees. This very low figure suggests the gigantic dimensions of the changes that are necessary. Recent studies in Haiti, India, Malawi, Yemen, Zimbabwe, and other countries however, indicate some increase in farmers' interest in planting multipurpose trees — for poles, fodder, fuelwood, and as a cash crop.

Explaining the spread mechanisms of this innovation, sociologists suggest to forestry workers that such behavioral change has to be actively elicited, motivated, and supported as part of the *social* strategy for reforestation. External factors may play a potent role in facilitating farmers' decisions to plant and protect trees. Adequate social strategies must incorporate extension efforts focused on forestry, based on communicating information to farmers and influencing their perception of impending threats and existing opportunities; incentives and inputs such as low-cost or free seedlings, fertilizers, and seeds; and sometimes water supply and credits. Several successful forestry programs (in West Bengal, Haryana, and Jammu and Kashmir) use special change agents (extension agents called "motivators" or social forestry workers) to persuade farmers to plant trees and assist them in doing so.

Because of the long time lag between planting and harvesting trees and because small farmers cannot afford to wait several years for income, special incentives will be needed in certain situations to induce change in behavior. Economic incentives, though sometimes necessary, are difficult to provide when government funds are scarce or there are no cash markets for forest products. Alternative incentives, perceivable to the farmer, should therefore be sought. The appropriate use and combination of incentives are an important aspect of social engineering, and sociologists can contribute a great deal to their design.

Imaginative incentive systems can be developed with sociological knowledge of the local culture and value systems. Farm forestry can be linked to various other activities or events which stimulate the farmers' interest. In projects to regularize land tenure, for instance, large numbers of farmers who have only customary rights to land get a formal legal title to it. Since titles are very important to farmers, granting them can be used as an incentive for farm forestry; farmers can be asked to plant trees along the boundaries of their demarcated plots as part of the title receiving ceremony, and seedlings can be supplied to facilitate the process. Farm forestry can also be linked to irrigation and settlement projects and to the construction of infrastructure. Tree planting can be linked to many events in the farm family's life that are imbued with positive values and that help the successful adoption of the new behavior — the deliberate cultivation of trees for fuelwood.

As an enduring social unit able to sustain forestry development programs, the farm family is thus an excellent social resource. Tapping its potential requires a deftly tailored integration of technical, sociological, and economic elements, as well as operational cooperation between foresters and sociologists in designing and implementing this strategy.

## *Small Groups*

The often spectacular success of family-centered forestry may obscure the fact that *group*-centered approaches have development potential which is sometimes overlooked because of the ineffectiveness of the community approach. Even the community-centered strategy should not be dismissed altogether, however, because in certain socio-political and institutional contexts it can produce results. It would be throwing out the baby with the bath water if the de-emphasis of community woodlots were interpreted as renouncing all group-centered approaches.

Sociologists are best equipped to point out to planners and foresters that communities are just *one type* of group and that the community forestry approach is only one of many possible group-centered strategies. Foresters, in turn, must ask the sociologist: Are there social formations in between the entire community and the individual farmer, which are capable of acting as supporting structures for the development of forestry or other natural resources? Is it possible to avoid the weaknesses of the community approach, yet preserve the advantages and social synergy of group-powered efforts in forestry?

The sociologist's answer to this question has to be affirmative. Sociologically, alternative types of groups can definitely be organized, and some have already been formed as a result of local social invention under favorable circumstances. The problem is to have a group that is free from the inner conflicts of large communities, yet able to generate th synergy that makes groups more effective than the sum of their members.

The limitations of communities as social units are traceable to their large size and internal stratification. Other groups of a more manageable size would prove fully functional, and their smallness would not create problems of system maintenance that are more complex than those the group is originally called on to solve. Small groups are likely to be less diverse and stratified, more homogeneous. A common interest, pursued more effectively by joint action than by individuals, links the members together. A simple rule for the distribution of benefits (for example, equal shares for all) would eliminate actual disadvantages or misperceptions of advantages. A small group can also enforce rules about contributions through peer pressure, so as to eliminate free riders. Small groups often manage other natural resources (as in the case of a water users' association formed around a small branch of the irrigation system) and could operate a woodlot without the conflicts that surround community woodlots.

One successful example is a group farm forestry scheme developed in West Bengal. A group of landless or marginal farmers is given a block of marginal public land for tree planting. The members are not granted title to the land, but have usufruct of the land and ownership of the trees they are expected to plant and protect. Under this system there is tight group control over the temptation to change land use or mortgage the land. The area allotted and the number of trees to be planted guarantee enough wood from lops, tops, dead trees, and branches to meet a family's domestic requirement. The stem volume is then available for sale, and the total output ensures participant interest. The protection of land parcels can be organized jointly by the group. The group strategy thus not only maximizes land use for forestry but also encourages and facilitates consensual action for tasks that would be performed less effectively if carried out individually.

The target group of this West Bengal scheme is highly dependent on the income generated by their labor and cannot be expected to work without remuneration. Incentive payments have therefore been made to help meet consumption requirements of the families during the early stages of the plantation. Incentives are also given for each surviving tree to encourage maximum survival rates.

This type of group farm forestry is feasible only if land is available for planting close to the beneficiaries' residence. Tailoring this approach to particular sites and social strata also increases the role of land-use surveys and area population survey data as baselines for targeting. The operational principle is to create a clear link between a well-defined small group and a well-defined piece of land that is converted into a woodlot. In addition, there needs to be a clear correlation between contributions and returns, and authority and benefits must be restricted to the members of the group, not left open to the community at large.

The potential for such small groups is substantial, but a socio-organizational effort is required to establish and validate them. The advantage is that they will then supply the social structure necessary to put to productive use certain natural resources that would otherwise remain underutilized or completely neglected. Several states in India envisage a considerable expansion of group farm forestry on public lands. It has been estimated that up to 2,500 seedlings, given free to each participant, would enable the family to gather its domestic fuelwood from lops, tops, and fallen wood and to sell the main stem volume for cash income. This innovation is a socially significant instance of partial "privatization" of the usufruct (not ownership) of public (waste) lands, under which landless people are enabled and encouraged to raise trees as a cash crop. Where surplus labor is available and private land is scarce, this option offers the additional possibility of generating some effects that will alleviate poverty.

## *Associations*

Even when tree planting is done by individual farmers, some form of group or association may be economically and socially beneficial. In several Indian states, where family farm forestry is being implemented faster and more successfully than anticipated, the forestry departments help establish tree growers' associations or simple organizations to assist farmers in the marketing of the wood produced from family forestry.

One structure that could support reforestation with the direct involvement of farmers is the forestry cooperative. With a clearly defined and not too large membership, cooperatives might be a more coherent and effective organization than the village community as a whole. In the North-West Frontier Province of Pakistan a pilot program to revive forestry cooperatives in Guzara forest envisages the establishment of some fifteen cooperatives, each with a minimum of 500 acres of forest land. Each cooperative has responsibility for managing the forests of its members in accordance with a plan approved by the Forest Department. The cooperatives receive technical assistance in preparing the management plan and the services of field foresters, both paid for by the provincial government. No other subsidies are given, and all other forestry costs (re-planting felled areas, maintenance, extraction and so on) are borne by the cooperatives. For this purpose, cooperatives are authorized to retain at least 40 percent of the revenue from the sale of trees, and receive credit if needed. A sociological study found that farmers strongly value the contribution cooperatives can make toward protecting their ownership rights to Guzara forests, but see government interference and the intrusion of party politics as a mortal threat to these cooperatives.[14]

## *Age Groups*

Many traditional societies, particularly in Africa, entrust to subgroups certain maintenance functions in the society. Some of these groups are defined by age and gender and are accountable to appointed group leaders as well as to the overall authority structure. Similar groups could be used for certain activities in forestry development.

One of the notable successes in recent years has been the involvement of school age youths in small social forestry projects (in Kenya, Malawi, Gujarat, and Haiti), particularly in establishing tree nurseries. School-children are a homogeneous age group, concentrated, organized by virtue of their main activity — going to school — and with a built-in leadership system. Although the nature of this age group limits its use for activities of long duration, it is perfectly suitable for short-term, technical processes in forestry, such as the establishment of nurseries and the production of seedlings. Institutional arrangements in the form of a "partnership between schools, communities, and government agencies"[15] can effectively formalize and increase support for social forestry.

The example of Gujarat is impressive: at the outset of a social forestry program in 1980 there were less than twenty schools with tree nurseries. The Forest Department decided to encourage schools and private farmers to raise seedlings rather than to expand its own state nurseries. The program proved to be a big success, and in three years about 600 schools opened nurseries in which schoolchildren, with guidance from foresters and teachers, produced several million seedlings a year. The only incentive provided is a guaranteed price for seedlings; when they are ready for transplanting, the state forest service buys them for distribution to local farmers. This economic incentive is backed up by technical advice from extension workers to help schools construct and operate small tree nurseries. In practice, many of the seedlings have been taken home by the school-children and planted around their family homesteads. The program has thus stimulated a genuine interest in the planting, ownership, and protection of trees.[16]

## *Women's Groups*

Experience with women's groups in forestry seems much more limited. Since women are responsible in many cultures for collecting fuelwood, they would appear to be the ones most directly interested in producing it. Women often possess an exceptionally good knowledge of the qualities of various tree species.[17] Evidence from a number of social forestry programs points out the contribution women could make to them.[18]

Although women have been organized for different productive, household-related activities in various countries, little has been done to involve them in taking group responsibility for the cultivation of woodlots. Even in a country such as Kenya, where women's groups are widespread and effective, a sociological field study reports that out of 100 women's groups active in one district (Mbere), none was directly involved with tree planting.[19] In other districts, however, womens' groups have recently started planting some woodlots for their own use.[20]

Women's groups could probably perform a role more or less similar to that of group farm forestry, described above, if adjustments were made for their other productive and household roles. Given the inelasticity of poor rural women's time, purposefully organizing group-based fuelwood production activities may maximize output without creating additional time constraints on the women.[21] In many places women and children are compelled to make enormous efforts to collect wood for cooking and heating, often travelling long distances. In certain areas of Nepal, for instance, the time a women spends collecting fuel is estimated to be between twenty and forty days a year. It may therefore save both time and labor to produce, rather than collect, the fuelwood.

A small group of women, offering mutual help and cooperation, is likely to be a more effective social device than if each woman spends the same amount of time and labor on individual farm forestry. This is certainly an area for action-oriented research and sociological experimentation, which will enable sociologists to make useful contributions of a social-engineering nature to the current efforts of foresters.

## Watershed Forestry

Foresters, planners, environmentalists, and policy-makers alike are increasingly concerned with the rehabilitation of watersheds. A legitimate question which developmental sociologists would therefore have to answer is: What social unit can sustain watershed rehabilitation and management?

Although a watershed is a physical unit, not a social one, it is inhabited by people; its resources are used in people's productive activities and often deteriorated and degraded by them. This is why land use planning or an erosion control program cannot be effective and cannot be sustained unless it is designed to incorporate watershed inhabitants into rehabilitation work.

The need for a sociological dimension in such programs is being increasingly realized. A forward-looking strategy proposal for rehabilitating about 150 million hectares of degraded watersheds in developing countries strongly urges the recognition of this sociological dimension:

> Watershed projects deal with people. The key to securing people's participation in such programs will lie in designing broad strategies based on a better understanding of their perceived needs and priorities and in particular of local land tenure. ... This implies that enough time will have to be spent at the outset of project development on sociological studies in order to define the type of incentives needed to elicit farmers' cooperation.[22]

The challenges for sociology contained in such recognitions, and the call for specific answers and implementable social engineering, are pressing. Watersheds vary enormously both in physical size as well as in population density or settlement patterns, and the general absence of organized group structures compounds the complexity of the problems.

Indeed, the questions to be asked from a sociological angle are: If a watershed can be treated in physical planning as an ecological system, can the people who are making use of it be treated as a *social* system? Do they constitute a structurally coherent social unit? The answer to the last question is, in general, negative (with some exceptions). A single watershed may contain a broad diversity of tenurial arrangements, stratified social groups, and various farming systems and land use patterns. Moreover, rehabilitation of deforested watersheds demands much more than watershed forestry and massive planting of trees. It involves flood control and soil conservation; often bench terraces need to be built with massive excavation and refill work; farming systems need to be adjusted to the ecological characteristics; and there may be changes in the land rights systems, in the rules of land transmittal, in settlement patterns and the number of inhabitants. The work required is therefore usually beyond the scope of what individual farmers can do on their own. Again, *group* action is required, as well as support from technical agencies. Coordinated social action for the group management of watersheds is probably one of the most complex types of collective adoption of innovation, particularly in the absence of structured groups.

The operational sociologist is faced here with a task probably more difficult than any of those previously discussed: to organize structures for social action and to engineer the formation of a group out of discrete and not necessarily organically interactive farmers. Watersheds and micro-watersheds may be the physical subdivisions in which farmers' activities can be aggregated into coherent group efforts. The social groups should participate in the design of a land use plan for the watershed and gain the strength to sustain it through convergent organized behavior based on commonly perceived objectives and jointly enforced rules. The sociologist is therefore called upon not only to design a watershed strategy, but to implement it and organize consensual social action, hand in hand with the land use planner, the forestry agent, and others in the field.

The textbooks for training such sociologists have not yet been written. They must be, and the sooner the better. But the actual sociological practice — albeit by trial and error, but with commitment and creativity — of such applied, operational sociology should certainly not wait for the textbooks to be written.

The alternative types of social units examined above are in no way an exhaustive list. The same line of analysis can be continued to bring others into the limelight. Enterprises established for the industrial exploitation of forestry plantations, for example, are also units of social organization, but with a distinctive structure and functions. In a broader sense, some nongovernmental organizations can also be suitable units, able to mobilize and sustain afforestation programs under well-defined circumstances.

The point is that such alternative social forms can be conceived and actually organized in real life. They are, in William Foote Whyte's terms, "social inventions,"23 or purposeful social arrangements for the performance of definite productive and distributional functions. A continuous learning process should accompany the process of organizing such units and improving their structure and operation. There is no single "best" social strategy available as a universal key to all development approaches in forestry; such strategies span a broad spectrum, and alternatives are available or can be devised. Sociological perceptiveness and knowledge are therefore instrumental and indispensable for conceiving, designing, and implementing any effective approach to forestry development.

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# NOTES

1. See Everett Rogers and F. Shoemaker, *Communication of Innovations: A Cross-Cultural Approach* (New York: Free Press, 1971); see also E. Rogers, Diffusion of Innovations, 3rd ed. (New York: Free Press, 1983).

2. Patrick C. West, "Collective Adoptions of Natural Resource Practices in Developing Nations," *Rural Sociology*, vol.48, no.1 (1983); and Patrick C. West and S. Light, "Community Level Change Strategies for the Management of Fragile Environments," in K. Shapiro, ed., *Science and Technology for Managing Fragile Environments in Development Nations* (Ann Arbor: University of Michigan Press, 1978).

3. A more detailed description of this sociological analysis was given in Michael M. Cernea, *Land Tenure and the Social Implications of Forestry Development Programs,* World Bank Staff Working Paper no. 452 (Washington D.C., 1981).

4. The official definitions in the 1930 Jammu and Kashmir Forest Regulation Act, no. 2, are: "*Demarcated Forest* means forest land or waste land under the control of the Forest Department, of which boundaries have already been demarcated by means of pillars of stone or masonry or by any other conspicuous mark, or which may hereafter be constituted as a demarcated forest; *Un-demarcated Forest* means and includes all forest land and waste land (other than demarcated forest and such waste land as is under the management and control of the Revenue Department), which is the property of the Government and is not appropriated for any specific purpose."

5. When a co-sharer of *shamilat* encroaches upon it and includes it in his cultivated area, he can be legally ejected at the request of another co-sharer (Land Revenue Act, sec. 150-A). However, such grievances, and particularly their enforcement, have been rather infrequent.

6. The wealthier farmers benefitted most from the government's financing of all the cost of the fuelwood planting, which included seedlings and the establishment of nurseries, labor for planting and filling in, transport of plants, and protection (wages for guards) for several years. The cost for planting was estimated to be Rs. 1.300 per acre, which excludes the

cost of annual maintenance and protection between planting and harvesting estimated at an additional Rs. 600-700 per acre per tree crop rotation.

7. An interesting example of such legislation is the 1936 Hazara Forestry Act, in the North West Frontier Province of Pakistan, which protects the ownership rights of the farmer while vesting the right to manage their forests in the Forest Department. It also institutionalizes a mechanism of cost recovery, whereby government costs for forestry management and commercial exploitation are covered by a fraction of the proceeds from sold timber.

8. See Y.S. Rao, "Community Forestry: Requisites and Constraints," in *Community Forestry: Some Aspects* (Bangkok: United Nations Development Programme, East West Center, and RAPA/Food and Agricultural Organization, 1984).

9. See Garrett Hardin, "The Tragedy of the Commons," *Science*, vol. 162 (December 1968).

10. Michael Horowitz, analyzing rural afforestation alternatives in Zimbabwe, pointed out that "the important issue where communal lands are involved is correctly identifying the locus of authority over land use allocation." See Michael M. Horowitz, *Zimbabwe Rural Afforestation Project, Social Analysis Working Paper* (Binghamton, N.Y.: Institute for Development Anthropology, 1982), p.51.

11. See J. T. Thomson, *Bois de Villages (Niger): Report of an Investigation Concerning Socio-Cultural and Political Economic Aspects of the First Phase of the Project and Design Recommendations for a Possible Second Phase* (Montreal: Canadian International Development Agency, February, 1980).

12. See Rao, Community Forestry: Some Aspects; Raymond Noronha, "Village Woodlots: Are They a Solution?" paper prepared for the Panel on the Introduction and Diffusion of Renewable Energy Technologies (Washington, D.C.: National Aeronautical and Space Administration, November 1980).

13. Outlining such a global projection, John Spears and Edward Ayensu wrote: "In order to guarantee a supply of fuelwood equivalent to the need of the 1 billion people who are already experiencing fuelwood scarcity ...

current fuelwood planting rates would have to be increased at least five-fold between now and the year 2000, implying average annual planting of about 5 billion trees during that period. At least 75 percent of this will need to be individual tree or woodlot planting on farmlands and waste-lands outside government forest reserves and about 25 percent sited close to urban townships, part of which would provide raw material for wood burning processing plants.... The main thrust of this program should be directed towards encouraging the spontaneous interest of farmers and local communities in multipurpose tree planting. The role of government agencies should be to ensure the availability of necessary inputs." (John Spears and Edward Ayensu, "Resource Development and the New Century: Sectoral Paper on Forestry," World Resource Institute, Washington, D.C., 1984).

14. Mohammad A. Rauf, *Sociological Perspectives of Forestry Development in Pakistan*, Report of Guzara Forest Owners Task Force (Islamabad; processed), pp. 101-04.

15. Kamla Chowdhry, "Schools as Partners in Social Forestry," Ford Foundation Discussion Paper Series (Delhi, August 1983).

16. See John Spears, "Appropriate Technology in Social Forestry," paper presented to the Inter-regional Workshop on Appropriate Technology, Kathmandu, Nepal, November, 1983.

17. See Marilyn W. Hoskins, "Women in Forestry for Community Development" (Washington, D.C.: U.S. Agency for International Development, 1979).

18. Gloria Scott, "Forestry Projects and Women," draft paper, World Bank, Projects Policy Department, 1980.

19. David W. Brokensha, B.W. Riley and A.P. Cartro, *Fuelwood Use in Rural Kenya: Impacts of Deforestation* (Binghamton, N.Y.: Institute for Development Anthropology, 1983), p.9.

20. Dianne Rocheleau, personal communication.

21. An interesting analysis of the issues of human energy and women's work including the implications for women's gathering, using, and producing firewood, is contained in Irene Tinker, *The Real Rural Energy*

*Crisis: Women's Time* (Washington, D.C.: EPOC, 1984; processed); see also Irene Tinker, *Women, Energy and Development* (Vienna: Centre for Social Development and Humanitarian Affairs, 1982).

22. Spears and Ayensu, "Resource Development and the New Century."

23. William F. Whyte, "Social Inventions for Solving Human Problems," *American Sociological Review*, vol. 47 (1982).

# II.4

# THE ROLE OF INSTITUTIONS IN THE MANAGEMENT OF COMMONLY-OWNED RANGELANDS IN BALUCHISTAN


**Nek M. Buzdar**


## INTRODUCTION

Baluchistan is the westernmost province of Pakistan, bordering Iran and Afghanistan to the west and north and the Arabian sea to the south. The province, with an area of 134,000 square miles, mainly consists of barren mountains, arid valleys and sandy deserts. A large percentage of the five million inhabitants of Baluchistan are nomadic pastoralists, raising camels, cows and especially sheep and goats. The mean annual rainfall in Baluchistan ranges from two inches in the west to about sixteen inches in the northeast. Some areas do not get any rain for periods ranging up to two years, and in some cases the entire year's rainfall comes in a single downpour. Low rainfall and sparse vegetation compel the inhabitants to lead a nomadic pastoral life to make the best possible use of the meager resources. For centuries the Baluch people have struggled against the forces of nature and developed a way of life peculiar to them. As among other nomadic groups, some Baluch nomads move throughout the year and throughout their lives, while others have limited movement and possess ownership rights over common rangelands.

These semi-nomadic tribes have, for centuries, managed their resources on more or less sustained levels and lead a subsistence-level but contented and proud life. As seems to be the case among nomads throughout the world, the Baluch today are faced with economic, political and social realities which endanger not only their way of life but also the resources on which they have depended for a living. In simple words, the problem is a too high man/land ratio, too many demands on too few resources, and too little being done to alleviate the problem. But Baluch nomads seem to be particularly hard-pressed, because their mobility to other areas of Pakistan is constrained by cultural and linguistic barriers, and by lack of education, skills and preparedness for jobs other than animal raising. Under these circumstances, ever increasing population and consumption demands must result in more and more pressure on land and in more resource destruction and depletion.

The author, for his doctoral dissertation, studied the problem at the local level in a selected area of Baluchistan. The main objectives of the study were to evaluate local rangeland resources and their uses and study the role of institutions in the management of resources. This paper, based on the above study, focuses on the importance of property rights and tenure-related institutions in determining or influencing stocking rates and productivity levels. The study of the institutional aspects of the problem seems extremely important because of the common property nature of the resources, and because it was through institutional mechanisms that these resources were traditionally managed. The study was carried out with the hypothesis that certain institutions are more conducive to conservative resource use than others.

It is not uncommon for intellectuals and government officials to ignore institutional aspects of development, based on the assumption that since common property rights systems exist among isolated "unimportant" tribal groups, they are not worth understanding. It is shocking to note that common property rangelands are not even recognized by the government to be the common property of the concerned tribe. The government position with regards to these lands is that they are government/public property. Even more shocking is the fact that if a tribal chief or head, illegally and against the established tribal laws, appropriates a portion of the common land for crop raising, the local "Patwari" will have no problem registering his ownership of this piece of land. It has been proved that in order to avail economics of scale in grazing, common property rights over rangelands are economically more efficient than private property rights (Dahlman, 1980). But government policies have always favored abolishing common property rights in favor of private property rights.

Various studies in Baluchistan (Bhatti 1970; Babar 1973; Buzdar 1982) have shown that, in general, the optimum levels of animal raising in most rangelands have already been passed. In almost all rangelands, animal numbers far exceed the carrying capacity. We are, in fact, at a point on the productivity curve where any increases in the stocking rates will inevitably lead to more depletion and vice versa. The first part of this paper discusses the traditional informal institutions of the semi-nomadic

Baluch with this fact in mind. No institutions concerning regulation of resource use would be necessary, if the resource concerned were not scarce. In this first section only those theoretical aspects of institutions will be discussed which have a direct or indirect bearing on rangeland productivity. As will also be discussed, these institutions impose annual closing periods and discourage the building of larger flocks and the overuse of fuelwood and building material obtained from the ranges.

In the second part of the paper, the relationship between stocking rate and productivity is discussed. Each of twenty rangelands was studied for six months in 1978 and for six months in 1980. The physical productivity of each of the rangelands was estimated repeatedly and then averaged over the entire period. Stocking rates and economic productivity-related data were collected through interviews with animal raisers. The physical/forage productivity was estimated through a technique called the "Ocular Method". Each rangeland was surveyed and estimates regarding the following were repeatedly made: (1) total range area in acres, (2) percentage of surface covered by vegetation, (3) percentage density of vegetation, and (4) vegetation palatability percentage. The product of items 2, 3 and 4 constitutes what is called the "use factor", which when multiplied by the total range acreage (No. 1 above) gives the total forage acreage of the rangeland. 'Forage acreage' is an imaginary acreage completely covered by vegetation and completely palatable. To find the carrying/grazing capacity of a rangeland, the total forage acreage must be divided by the forage acreage required per animal. (A forage acreage of 0.257 per animal per month is considered reasonable, so calculations were made on that basis.) Some very simple statistical analysis is then performed to see if any relationship exist between stocking rates and productivity.

In the third part of the paper, data on productivity from two institutionally different areas are compared to see if significant differences exist. It is assumed that differences in productivity between the two areas mean that a possible association exists between institutions and productivity. In the final part of the paper, conclusions are drawn and some policy recommendations are discussed.

## INSTITUTIONS OF COMMON PROPERTY RIGHTS

In this first part of the theoretical/institutional analysis, only the traditional institutional characteristics are discussed, although the subsequent analysis in the second and third parts deals with both traditional and non-traditional institutional areas. Put simply, the traditional areas are those where practices like those described below are followed and where the traditional structures are strong enough to punish or ostracize non-compliers. The non-traditional areas are those where, although common property rights exist, the mechanisms that enforce resource use have either completely disintegrated or become weak and ineffective.

## *The Institution of Range Closure*

Each tribe leaves the rangeland each year for a specified period of time, which is decided each year by the tribal leadership. Normally this closing period is in the summer and during the rainy season. All the tribesmen must leave at the same time and must return to the rangeland at the same time. The objective is to provide a rest period to the range and to allow grass and other vegetation to grow to the point that later grazing will not destroy their root and regenerative systems. The duration of closing periods differs from tribe to tribe depending on the vegetation density and palatability within the range, as well as those of the nearby open access lands to which the tribesmen go after closing their own ranges. Density and palatability in turn depend upon the rainfall and other factors. But generally the closing periods vary from 1-4 months during the summer. In the non-traditional tribal areas, closing periods vary from zero to a few weeks in the year. The closing periods must be observed, and sanctions as well as forceful eviction are used to ensure compliance, if necessary. The observance of closing periods plays an important role in limiting the average number of animals grazed in the range over the year. This also results in long-term conservation of resources. In the short run, the closing periods result in saving feed for the animals during the harsh winter months. As the closing periods end, generally in October or November, enough grass and other vegetation has grown for hay-making and for grazing the animals during the winter months ahead.

## *The Family System*

Certain aspects of the joint family system also effect resource utilization and conservation, through their impact on stocking rates. A man must acquire brides for all his sons, using a portion of his livestock for each bridal payment. Bridal payments are generally high: during the years 1978-80 such payments consisted of, on average, 60-70 sheep or goats, 6-7 camels or 10-12 cows. Most families must work for a number of years to amass a bridal payment, and many are left with no animals after making such payments. It is important to note that flock size in Baluchistan has an upper and a lower limit. Below about 50 sheep or goats, it is uneconomical to raise a flock of one's own. It is better to get employment with some other animal raiser as a shepherd rather than continue with a flock size that does not provide subsistence. Similarly, above 200-250 animals the flock becomes an inefficient and costly unit of operation. Even when the ranges are not overgrazed, managing a large flock requires excessive labor and other resources for taking care of the sick and disabled animals, distinguishing one's animals from those of others, and protecting them from thieves and wolves. Under arid conditions the ability to move fast is essential to take advantage of the sparse vegetation, and large numbers do not allow such mobility. Therefore, besides the indirect costs and obligations mentioned above, the direct costs also increase rapidly if the flock size is above 200-250 animals. Taking all these considerations into account, the average joint family owns just one flock of sheep or goats with a maximum number of 200-250 animals.

Until such time as the sons can establish independent households, the joint family has not only one flock, but also one house and one hearth. This is important because all energy resources come from the range, and human and animal uses are often competitive. The joint family also has just one set of household utensils and equipment. Fixed capital like camels and donkeys as well as minimal non-productive capital necessary for a semi-nomadic type of life such as summer tents, containers, and storage bags, all are shared by the members of the joint household. This is by no means unimportant as these goods absorb a large portion of a semi-nomadic family's total income. The joint family system that exists in the tribal areas of Baluchistan is more conducive to the conservation of rangeland resources than the nuclear family system. Many families in the non-traditional areas have become nuclear.

## *The Tribal/Political Institutions*

The tribal system constitutes a whole system of law and order, administration, and other functions regulating the economic, social and political activities of the community. The members of the tribe share interests in community self defence, in collective grazing rights, in facilitation and coordination of movements within tribal lands, and in regulation of resource utilization. Most important for the purposes of this article is the role that the chief or sub-chief plays in regulating resource use and levying sanctions for violations of these regulations.

Chiefs and sub-chiefs are equal to all other tribesmen with respect to rights to use the resources in their respective rangelands. They themselves must abide by and ensure that all tribal laws and regulations are followed by everyone in the group. They consult with other members of the sub-tribe or section and decide on such day-to-day and season-to-season matters as the maximum number of trees a tribesman is allowed to cut for building a house, what particular time or season of the year a resource should be used and in what approximate proportion by each person. They decide on matters like what group of families will camp in what part of the range or sub-tribal territory, which family or individual will guard the range when the tribe has closed it, and what time to close the range and what time to reopen it. In case of drought and even during normal years, the "council of elders" decides which open lands to go to, where and how long to stay, and scores of other such matters. These and many other institutional and customary requirements — such as extracting tribal contributions, guarding sacred trees and other resources, and staging compulsory tribal and religious feasts — all are guided and regulated by the tribal or sub-tribal chief or the elder at the local level.

Punitive action against individual defaulters range from forced eviction during closed periods, to fines for overuse of resources, to social sanctions for not observing religious and tribal obligations during festivals and wars and for not serving food to strangers. Social sanctions involve not being invited to social and political gatherings, and not being helped in collective jobs which a man cannot do by himself (such as shearing sheep and building houses). These also involve sanctions such as no bridal exchanges, and no help and protection in case the individual has any problem with members of other tribes. These sanctions are serious ones, given the lack of government law and order to protect life and property in most tribal areas. Since a man living in the tribal areas needs the cooperation of others in these matters for his own survival, he makes every effort to cooperate with others and follow the tribal laws, and the chief helps to ensure that this is done by everybody.

## *Religious Institutions*

All of the people in the tribal areas are Muslims by faith. However, they have interpreted and adjusted certain aspects of their religion and religious laws to conserve resources. It appears, that is, that the environment and the resource base in the tribal areas necessitate incorporation of beliefs not found among most settled Islamic communities. The religious practices and beliefs that have either a direct effects on the conservation of resources, or an indirect effect by limiting or otherwise by controlling animal numbers, are as follows:

(i) Rains will not fall unless the tribe makes animal sacrifices from time to time.
(ii) Human and animal diseases are caused by bad spirits, *jin*, and those spirits will only go away if animal sacrifices are offered by the family.
(iii) Besides the yearly compulsory donation of a portion of one's animals *(zakat)*, which is required of every Muslim by Islamic laws, animals also must be donated to the religious elders whose help is sought whenever any family member or animal gets sick.
(iv) It is also considered a religious duty to sacrifice animals on the birth of children, particularly sons, as well as on the death of any family member and then annually at the death anniversaries of grandparents, parents, brothers, sisters and sometimes other close relatives.
(v) Certain trees or sometimes whole tracts of rangeland are considered sacred. Trees and vegetation in these areas cannot be cut or otherwise used. Also, in some cases it is known to the whole tribe that bad spirits, *jin*, reside in certain trees. Therefore, these areas and trees should not be touched and animals should not be grazed there.
(vi) Trees and other plants are considered living beings just like human beings, so taking their lives is deemed nearly as bad as taking human life. This particularly applies when the trees are young and during the rainy season when the trees are green and growing.
(vii) Lastly, if a man has animal wealth beyond a certain level, he must perform a pilgrimage to the holy places in Saudi Arabia. Along with *zakat* mentioned before, pilgrimage is one of the five basic requirements of Islam. This costly trip required of the rich always involves disposing of a large portion of the animal wealth of the tribesmen involved.

## *Economic Institutions*

The economy is basically subsistence-oriented, and animal raising is not commercial in scale. This itself, accompanied by the general isolation, lack of outside contacts, and limited consumption needs, has a conservative influence on the use of the rangelands. The ecology of Baluchistan, and the nomadic way of life of its people, necessitate the raising of small animals, mainly sheep and goats. Normally only male and old and disabled animals are sold and only to purchase the necessities of life like grain and clothing. Only when absolutely unavoidable are females are sold. The institutional and physical environment nevertheless discourages large accumulations of animal wealth.

A system of stock association called *nimsude* is prevalent in the traditional areas. Under this system animals are lent and borrowed on an annual basis. At the end of the year the owner receives back his principal (the original animals or their replacements) and half of the newly born lambs and kids. Shepherds, when employed, are also generally paid in animals. In most areas a shepherd receives every 8th male and every 16th female kid or lamb born during the year of his shepherding. This system is relatively egalitarian, and a stock associate or a shepherd can collect a herd of his own in 4-5 years time, if natural conditions are favorable. In recent times, particularly in the non-traditional areas, a new rich trading class has emerged and they, along with the chief and his clan, make up an elite class. Such economic differentiation did not exist before.

# RELATIONSHIP OF STOCKING RATES TO PRODUCTIVITY

Now we will try to determine the relationship between stocking rates and productivity. The correlation coefficient "r" between stocking rates and productivity as expressed in the total acreage/forage acreage ratio (see Table 1) is 0.91. This shows a high correlation between the two variables. A 95 percent confidence interval for "p" is $0.55<p<0.89$. The null hypothesis that p equals 0, or that the simple correlation coefficient "r" is not significantly different from zero, may be rejected at the 5 percent significance level since the interval does not include zero. The test of significance of the sample correlation coefficient can also be performed as follows:

$$t = r/(1-r^2/n-2)^{1/2} = 9.30$$
$$t\ 0.025\ (18\ df) = 2.101$$

The "t" value shows that the sample correlation coefficient is significantly different from zero.

**Table 1. Animals Per Acre and Per Forage Acre**

| Range | Total acres | Forage acreage | Total area /FA ratio | Animals in the range | Animals per acre | Animals per F.A. |
|---|---|---|---|---|---|---|
| **I. Non-traditional areas.** | | | | | | |
| 1. | 14782 | 198.724 | 74.380 | 1422 | 0.0962 | 7.156 |
| 2. | 10367 | 284.664 | 36.418 | 1751 | 0.1689 | 6.151 |
| 3. | 16120 | 212.912 | 75.712 | 1575 | 0.0977 | 7.397 |
| 4. | 19258 | 135.139 | 142.500 | 3116 | 0.1618 | 23.057 |
| 5. | 25598 | 223.558 | 114.500 | 2949 | 0.1152 | 13.191 |
| 6. | 9675 | 190.564 | 50.770 | 776 | 0.0802 | 4.072 |
| 7. | 11325 | 100.353 | 112.850 | 1282 | 0.1132 | 12.774 |
| 8. | 4516 | 39.976 | 112.960 | 509 | 0.1127 | 12.733 |
| 9. | 5614 | 60.898 | 92.187 | 585 | 0.1042 | 9.606 |
| 10 | 24598 | 414.018 | 59.413 | 2204 | 0.0896 | 5.323 |
| Mean | 14185.3 | 186.081 | 87.169 | 1616.9 | 0.1397 | 10.146 |
| **II. Traditional areas** | | | | | | |
| 1. | 16462 | 401.309 | 41.020 | 861 | 0.0523 | 2.145 |
| 2. | 17138 | 248.479 | 68.970 | 1563 | 0.0912 | 6.290 |
| 3. | 12468 | 299.269 | 41.660 | 1187 | 0.0950 | 3.966 |
| 4. | 17774 | 1353.429 | 13.132 | 1493 | 0.0840 | 1.103 |
| 5. | 13757 | 136.103 | 101.070 | 1450 | 0.1054 | 10.654 |
| 6. | 9306 | 153.712 | 60.540 | 644 | 0.0692 | 4.190 |
| 7. | 15512 | 344.374 | 45.040 | 1165 | 0.0751 | 3.383 |
| 8. | 15404 | 284.968 | 54.050 | 1334 | 0.0866 | 4.681 |
| 9. | 22408 | 347.829 | 64.420 | 2019 | 0.0910 | 5.800 |
| 10. | 16163 | 203.543 | 79.410 | 1647 | 0.1019 | 8.092 |
| Mean | 15639.2 | 377.302 | 56.931 | 1336.3 | 0.0852 | 5.030 |

Stocking rates affect long-term as well as short-term productivity of the rangelands. Both stocking rates and the total area/forage acreage ratio are only six-month averages. Stocking rates as well as forage acreage and carrying capacity in any particular rangeland differ from day to day, month to month and year to year. For purposes of this study only monthly figures have been used, assuming that no significant changes take place within the month. The significant correlation between stocking rates and forage productivity indicates that in general, range productivity and stocking rates are negatively associated.

A similar analysis is performed to find evidence of general relationships between stocking rates and various indicators of economic productivity. It is assumed that annual birth/survival rates, death rates and gross returns from animals are indicators of range productivity. First, birth/survival rates and adult death rates will be analyzed as indicators of economic productivity. Table 2 shows percentage birth/survival rates and death rates in both the traditional and non-traditional tribal rangelands.

**Table 2. Mean Annual Birth/Survival and Death Rates (Average of five herders)**

| Range | Average animals | Breeding animals | Lamb/kid born and survived | Birth/ survival rates | Adult died | Death Rates |
|---|---|---|---|---|---|---|
| **I. Non-traditional areas.** | | | | | | |
| 1. | 121 | 106 | 69 | 65.09 | 6 | 0.05 |
| 2. | 145 | 118 | 73 | 61.86 | 10 | 0.07 |
| 3. | 128 | 110 | 72 | 65.45 | 5 | 0.04 |
| 4. | 114 | 104 | 57 | 54.80 | 4 | 0.03 |
| 5. | 143 | 122 | 76 | 62.29 | 8 | 0.06 |
| 6. | 97 | 89 | 58 | 65.17 | 3 | 0.03 |
| 7. | 152 | 136 | 95 | 69.85 | 8 | 0.05 |
| 8. | 88 | 82 | 48 | 58.54 | 2 | 0.02 |
| 9. | 81 | 75 | 50 | 66.67 | 2 | 0.02 |
| 10. | 133 | 114 | 71 | 62.28 | 8 | 0.06 |
| Mean | 120.2 | 105.6 | 66.9 | 63.20 | 5.6 | 0.04 |
| **II. Traditional areas.** | | | | | | |
| 1. | 132 | 122 | 113 | 92.62 | 4 | 0.03 |
| 2. | 115 | 102 | 69 | 67.65 | 12 | 0.10 |
| 3. | 129 | 114 | 102 | 89.47 | 2 | 0.02 |
| 4. | 156 | 140 | 128 | 91.43 | 4 | 0.03 |
| 5. | 140 | 127 | 72 | 56.69 | 8 | 0.06 |
| 6. | 109 | 98 | 87 | 88.77 | 3 | 0.03 |
| 7. | 117 | 106 | 91 | 85.84 | 4 | 0.03 |
| 8. | 118 | 100 | 82 | 82.00 | 3 | 0.03 |
| 9. | 105 | 97 | 72 | 74.22 | 8 | 0.08 |
| 10. | 146 | 132 | 83 | 62.88 | 8 | 0.05 |
| Mean | 126.7 | 113.8 | 89.9 | 79.16 | 5.6 | 0.05 |

Simple correlations were calculated to examine any relationship between the stocking rates (animals per forage acre) and the two economic productivity indicators. The correlation coefficients in each case are as follows:

(i) Stocking rates/birth survival rates: $r = -0.674$

(ii) Stocking rates/adult death rates: $r = 0.018$

A test of significance of the correlation coefficient in the case of stocking rates/birth survival rates shows a "t" value equal to -3.807, which is significant at the five percent level. The "t" value in the case of stocking rates/adult death rates, however, is insignificant (= 0.0764). This demonstrates that although death rates have no significant correlation with stocking rates, birth/survival rates are significantly correlated with the stocking rates, as expected. One would expect the birth/survival rates to be higher in ranges with relatively higher forage productivity and lower stocking rates. The insignificant correlation between stocking rates and death rates is perhaps due to the fact that death rates, more than any other productivity indicators, are affected by factors not related to malnutrition. Diseases and epidemics play an important role in this respect.

Next some of the other economic productivity indicators will be analyzed. Table 3 shows gross returns per acre, gross returns per animal and gross returns per rupee invested. The correlation coefficients in this case are as follows:

(i) Stocking rates/returns per acre: $r = 0.112$
(ii) Stocking rates/returns per animal: $r = -0.675$
(iii) Stocking rates/returns per rupee: $r = -0.648$

Very low correlations are evident between stocking rates and returns per acre. The correlation coefficient "r" is not significantly different from zero in this case, since a 95 percent confidence interval ($-0.3 < p < +0.45$) includes zero and the test of significance of "r" shows a "t" value equal to 0.478. The insignificant correlation between stocking rates and returns per acre may be due to the fact that increased stocking rates will increase returns per acre as long as the animals survive even at starvation levels. It is possible that relatively higher returns per unit area of less depleted rangelands are cancelled out by higher numbers per unit area in more depleted ranges.

The stocking rates and returns per animal show high levels of correlation and a test of significance of "r" shows a "t" value of -3.807, which is significant at the 5 percent level, so the hypothesis of no significant linear relationship may be rejected. In the case of the relationship between stocking rates and returns per rupee invested, the significance of "r" test shows a "t" value equal to -3.62 and so the null hypothesis that the coefficient of correlation is not significantly different from zero may be rejected. This demonstrates that higher stocking rates are related to lower returns per animal and to lower returns per rupee. This, along with the already established correlation between stocking rates and forage productivity, provides a basis for the assumption that, on average, higher stocking/use rates are associated with lower biological and economic productivity.

Table 3. Gross Returns Per Acre/Animal/Rupee (in Rs.)

| Tribe | Average flock numbers | Approx. range-portion grazed* | Initial invest-ment | Gross return total | Gross return /acre | Gross return /anim. | Gross return /Rupee |
|---|---|---|---|---|---|---|---|
| **I. Non-traditional areas.** | | | | | | | |
| 1. | 121 | 1258 | 29161 | 18333 | 14.57 | 151.50 | 0.63 |
| 2. | 145 | 858 | 33496 | 19629 | 22.87 | 135.37 | 0.59 |
| 3. | 128 | 1310 | 32149 | 15657 | 11.95 | 122.30 | 0.49 |
| 4. | 114 | 705 | 29054 | 11764 | 16.69 | 103.19 | 0.40 |
| 5. | 143 | 1241 | 32960 | 20036 | 16.15 | 140.10 | 0.61 |
| 6. | 97 | 1209 | 24219 | 15681 | 12.97 | 161.65 | 0.65 |
| 7. | 152 | 1343 | 37914 | 17234 | 12.83 | 113.38 | 0.45 |
| 8. | 88 | 781 | 21523 | 9883 | 12.65 | 112.30 | 0.46 |
| 9. | 81 | 777 | 23594 | 12576 | 16.19 | 155.26 | 0.53 |
| 10. | 133 | 1484 | 33982 | 17588 | 11.85 | 132.20 | 0.52 |
| Mean | 120.2 | 1096.6 | 29805.2 | 15838.1 | 14.87 | 132.73 | 0.53 |
| **II. Traditional areas.** | | | | | | | |
| 1. | 132 | 2524 | 17561 | 29127 | 11.54 | 220.60 | 1.66 |
| 2. | 115 | 1261 | 21166 | 13971 | 11.08 | 121.48 | 0.66 |
| 3. | 129 | 1355 | 20700 | 23598 | 17.42 | 182.93 | 1.14 |
| 4 | 156 | 1857 | 20144 | 30246 | 16.29 | 193.88 | 1.50 |
| 5. | 140 | 1328 | 25296 | 12593 | 9.48 | 89.95 | 0.50 |
| 6. | 109 | 1575 | 18300 | 18600 | 11.81 | 170.64 | 1.02 |
| 7. | 117 | 1558 | 16911 | 22415 | 14.39 | 191.58 | 1.33 |
| 8. | 118 | 1363 | 19348 | 18165 | 13.32 | 153.90 | 0.94 |
| 9. | 105 | 1165 | 17429 | 15639 | 13.42 | 148.90 | 0.89 |
| 10. | 146 | 1433 | 23938 | 16826 | 11.74 | 115.25 | 0.70 |
| Mean | 126.7 | 1541.9 | 20079.3 | 20118 | 13.05 | 158.91 | 1.03 |

* The approximate range portion grazed has been calculated by multiplying acres per animal in the entire range by the average flock size studied.

# PRODUCTIVITY IN TRADITIONAL VERSUS NON-TRADITIONAL INSTITUTIONAL AREAS

The extent of overstocking in different tribal rangelands in the traditional and non-traditional areas is shown in Table 4. The table shows that mean overstocking in the non-traditional tribal areas is over six animals per forage acre, while it is only slightly more than one animal in the traditional tribal areas. The figures also show that, in general, both

**Table 4. Estimated Overstocking in the Ranges**

| Tribe | Forage-acreage | FA requ-irement/ animal/month | Optimal no. of animals per FA* | Actual no. of animals per FA. | Over-stocking per FA. |
|---|---|---|---|---|---|
| **I. Non-traditional area ranges.** | | | | | |
| 1. | 198.724 | 0.257 | 3.89 | 7.156 | 3.266 |
| 2. | 284.664 | 0.257 | 3.89 | 6.151 | 2.261 |
| 3. | 212.912 | 0.257 | 3.89 | 7.397 | 3.507 |
| 4. | 135.139 | 0.257 | 3.89 | 23.057 | 19.167 |
| 5. | 223.558 | 0.257 | 3.89 | 13.191 | 9.301 |
| 6. | 190.564 | 0.257 | 3.89 | 4.072 | 0.182 |
| 7. | 100.353 | 0.257 | 3.89 | 12.774 | 8.885 |
| 8. | 39.976 | 0.257 | 3.89 | 12.733 | 8.843 |
| 9. | 60.898 | 0.257 | 3.89 | 9.606 | 5.716 |
| 10. | 414.018 | 0.257 | 3.89 | 5.323 | 1.433 |
| Mean | 186.081 | 0.257 | 3.89 | 10.146 | 6.256 |
| **II. Traditional area ranges.** | | | | | |
| 1. | 401.309 | 0.257 | 3.89 | 2.145 | 1.745 |
| 2. | 248.479 | 0.257 | 3.89 | 6.290 | 2.400 |
| 3. | 299.269 | 0.257 | 3.89 | 3.966 | 0.076 |
| 4. | 1353.429 | 0.257 | 3.89 | 1.103 | 2.787 |
| 5. | 136.103 | 0.257 | 3.89 | 10.654 | 6.764 |
| 6. | 153.712 | 0.257 | 3.89 | 4.190 | 0.300 |
| 7. | 344.374 | 0.257 | 3.89 | 3.383 | 0.507 |
| 8. | 284.968 | 0.257 | 3.89 | 4.681 | 0.791 |
| 9. | 347.829 | 0.257 | 3.89 | 5.800 | 1.915 |
| 10. | 203.543 | 0.257 | 3.89 | 8.092 | 4.202 |
| Mean | 377.302 | 0.257 | 3.89 | 5.031 | 1.141 |

*1/0.25/

traditional and non-traditional rangelands are overstocked. The overstocking estimates as well as the productivity indicators (which have already been shown to be significantly correlated), are shown in Table 5. These data for the traditional and non-traditional tribal areas can be

**Table 5. Overstocking and Productivity in Traditional and Non-traditional Tribal Areas of Baluchistan**

| Tribe | Over-stocking | Percent birth/ survival rate | Gross Returns per animal | Gross Returns per rupee |
|---|---|---|---|---|
| **I. Non-traditional tribal areas.** | | | | |
| 1. | 3.266 | 65.09 | 151.50 | 0.63 |
| 2. | 2.261 | 61.86 | 135.37 | 0.59 |
| 3. | 3.507 | 65.45 | 122.30 | 0.49 |
| 4. | 19.167 | 54.80 | 103.19 | 0.40 |
| 5. | 9.301 | 62.29 | 140.10 | 0.61 |
| 6. | 0.182 | 65.17 | 161.65 | 0.65 |
| 7. | 8.885 | 69.85 | 113.38 | 0.45 |
| 8. | 8.843 | 58.54 | 112.30 | 0.46 |
| 9. | 5.716 | 66.67 | 155.26 | 0.53 |
| 10. | 1.433 | 62.28 | 132.20 | 0.52 |
| Mean | 6.256 | 63.20 | 132.73 | 0.53 |
| **II. Traditional tribal areas.** | | | | |
| 1. | -1.75 | 92.62 | 220.60 | 1.66 |
| 2. | 2.40 | 67.65 | 121.48 | 0.66 |
| 3. | 0.08 | 89.47 | 182.93 | 1.14 |
| 4. | -2.79 | 91.43 | 193.88 | 1.50 |
| 5. | 6.76 | 56.69 | 89.95 | 0.50 |
| 6. | 0.30 | 88.77 | 170.64 | 1.02 |
| 7. | -0.51 | 85.84 | 191.58 | 1.33 |
| 8. | 0.79 | 82.00 | 153.90 | 0.94 |
| 9. | 1.92 | 74.22 | 148.90 | 0.89 |
| 10. | 4.20 | 62.88 | 115.25 | 0.70 |
| Mean | 1.14 | 79.15 | 158.91 | 1.03 |
| t value | 2.58 | 19.79 | 1.83 | 9.934 |

compared to see if the differences in the two areas are significant. A simple difference between means test is performed and the "t" values are reported.

The null hypothesis is that the means of overstocking, birth/survival rates, gross returns per animal and gross returns per rupee invested in traditional and non-traditional areas are not different (i.e. means of tribes A = means of tribes B). The "t" values in table 5 demonstrate that this hypothesis may be rejected in all cases. The difference between the means in birth/survival rates and returns per rupee invested are highly significant even at the 1 percent level of significance. The difference between the means in overstocking is significant at the 5 percent level and in gross returns per animal it is significant at the 10 percent level. From the results of the tests, we can conclude that the extent of overstocking is significantly higher in the non-traditional areas; and the birth/survival rates, gross returns per animal, and gross returns per rupee invested are significantly higher in the traditional areas. This demonstrates that there is less overstocking and higher productivity in areas where traditional institutions exist. This means, by implication, that traditional institutions have played an important role in maintaining the productivity of resources at levels consistent with survival. It also suggests that changes in institutions have played a role in the general decline in productivity of the ranges.

Two more aspects of institutions on which some data were collected, namely the closing period and the form of economy, also need to be analyzed. Annual closing periods and sheep/goat ratios, along with total area/forage acreage ratios in the tribal rangelands, are reported in Table 6.

As mentioned earlier, the closing period (and other means of limiting animal numbers on the ranges) is a very old institution, as old as the institution of common property rights itself. Closing periods are observed in the summer rainy months (normally May-September), and they have two objectives. The first is to allow the vegetation to grow to a stage where, when it is grazed, it will not be completely uprooted or destroyed, thereby leaving enough grass and other vegetation for the hard and dry winter months ahead resulting in and the least depletion in the long run. The second objective is to take advantage, to the maximum extent possible, of the vegetation that grows in the open field in the rainy season, and so conserve one one's own fodder resources. In the areas where closing periods were not observed or the duration was very short, this has been the case only for the last few decades. Animal raisers interviewed everywhere testified to their existence before.

The approximate length of the closing period in each of the twenty rangelands studied is given in Table 6. The table shows that the average closing period in the ten non-traditional areas is only about ten days, while the average is over three months in the traditional tribal areas. The observance of closing periods obviously effects the stocking rates and the general forage productivity of the ranges.

Rotations within the rangelands are observed in the traditional tribal areas and not observed in the non-traditional tribal areas (or observed only to a limited extent). Such rotations have the objective of balancing the grazing within the rangelands, by allowing a rest period for the vegetation to grow in one area while other areas are being grazed, and also by providing manure to every area of the rangeland. Such rotations have obvious positive effects on the conservation of the rangelands.

**Table 6. Total Area/Forage Acreage Ratio, Closing Period, and Sheep/Goat Ratio**

| Tribe | Total Acres/ Forage Acreage Ratio | Closing Period months/year | Sheep/Goat Ratio |
|---|---|---|---|
| **I.Non-traditional ranges.** | | | |
| 1. | 74.380 | 0 | 10 |
| 2. | 36.418 | 0 | 11 |
| 3. | 75.712 | 0.5 | 10 |
| 4. | 142.500 | 0 | 12 |
| 5. | 114.500 | 0 | 19 |
| 6. | 50.770 | 1.5 | 9 |
| 7. | 112.850 | 0 | 13 |
| 8. | 112.960 | 0 | 17 |
| 9. | 92.187 | 0.5 | 8 |
| 10. | 59.413 | 1.0 | 12 |
| Mean | 87.169 | 0.35 | 12.1 |
| **II. Traditional ranges.** | | | |
| 1. | 41.02 | 2.5 | 0.100 |
| 2. | 68.97 | 2.5 | 0.030 |
| 3. | 41.66 | 3.3 | 0.050 |
| 4. | 13.13 | 3.5 | 0.020 |
| 5. | 101.07 | 3.0 | 0.100 |
| 6. | 60.54 | 4.0 | 0.025 |
| 7. | 45.04 | 3.5 | 0.050 |
| 8. | 54.05 | 3.0 | 0.300 |
| 9. | 64.42 | 2.0 | 0.080 |
| 10. | 79.40 | 3.0 | 0.100 |
| Mean | 56.93 | 3.03 | 0.885 |

The sheep/goat ratio is a proxy for the subsistence versus market orientation of production as well as the relative prices of products (showing price affects). It is assumed that the sheep/goat ratio that exists today is the result of changes in the traditional economic system. In a subsistence economy, goats are hardy and require little feed and care, while fulfilling the important needs of nourishment and equipment-making. In contrast, sheep are less capable of fulfilling these subsistence needs. In a market economy, where production is mainly for the market and not for self-consumption, higher sale prices and profitability are the have been for the last few decades. During the year of study, a sheep sold for almost twice the price of a goat and wool prices were about five times higher than mohair prices.

From an environmental standpoint, however, sheep are intensive grazers and feed mostly on the grasses and smaller plants that hold the very thin layer of soil in the semi-arid conditions of Baluchistan. Under overstocked and arid conditions, the sheep will completely remove the vegetation cover and expose the soil to the eroding forces of wind and water. Also, by eating to the roots and destroying the palatable species of grass, in the long-term the species composition of the grass and other vegetation will changes, so that in the end only unpalatable species remain. Goats have different grazing habits and preferences. They nibble the leaves of thorny bushes and trees without damaging or hindering their growth and future productivity (and new leaves are produced after every rainfall). Since the vegetation in general is sparse and the rangelands are spread over large areas with only a few watering points, and since goats are faster and more mobile then sheep, a range with more goats than sheep will receive more balanced grazing. Otherwise, areas near the watering points and camping sites will tend to be overgrazed, while the areas farther away in the range will be undergrazed.

With these considerations in mind, the sheep/goat ratio is assumed to be an indicator of depletion versus conservation of rangeland resources, and of market profit motive versus subsistence motive. Economic theory indicates that as the prices of depleting products rise, they lead to depletion; and as the prices of conserving products rise, they lead to conservation. As explained above, sheep versus goats as well as camels versus cows, by the nature of their grazing preferences, are depleting versus conserving in the same way as agricultural crops like potatoes and cotton versus legumes. So it is expected that the higher the sheep/goat ratio, the lower the productivity of the rangelands. Table 6 shows that this ratio is significantly different in the two types of tribal areas. The average ratio for the ten tribal areas with non-traditional institutions is 12.1, compared to an average of just 0.885 in the areas with traditional institutions.

## CONCLUSIONS AND POLICY RECOMMENDATIONS:

Problems pertaining to resource use and productivity in different institutional environments, traditional and non-traditional, have been the main focus of this paper. Traditional tribes observe traditional closing periods and possess resource-regulating tribal, family and other institutions. The analysis showed that, in spite of the fact that raising a higher number of animals is in the self interest of tribesmen, in the traditional areas they limit their stocking rates following according to institutional regulations. Closing periods also help limit stocking rates. Because of these factors, significantly lower levels of overstocking per forage acre, and higher levels of animal birth/survival rates, higher gross returns per animal, and higher gross returns per rupee invested, were found to exist in the traditional areas when compared with the non-traditional areas.

Although the traditional institutions have performed efficiently up until now, there is no certainty that these institutions will remain viable under the environmental changes that will inevitably take place. The main problem is that many of the traditional tribal institutions are incompatible with the institutional systems of the nation state. But these incompatabilities are not insurmountable. The government can play a very important role in maintaining and strengthening an institutional environment that has proved its superiority over others, particularly with respect to animal raising. As mentioned earlier in the paper, even in situations where different property rights exist, it is in the interest of all concerned to establish common property rights over grazing lands. This is because economies of scale can only be achieved under a system of common property rights. But as we have seen, common property rights systems require a particular institutional environment to function properly. Without it distortions and misallocations of resources take place.

Governments typically intervene in traditional systems of land tenure in order to achieve the objectives of improved productivity, efficiency, and social equity. In the tribal areas of Baluchistan, the government intervened to abolish tribalism, basically with the same objective of benefitting the common tribesmen. But as the political functions of tribalism ceased, so did the resource-regulating functions. In the tribal areas that we have called *traditional*, tribal organization as a whole is stronger. The need is not to revive or strengthen the political tribal organization therefore, but rather the institutions that encourage improved resource use and productivity. Any cooperative or other form of farmer organization that utilized the concepts of traditional institutions could help to achieve these objectives.

The government could play an important role in encouraging the formation of cooperatives within the common rangelands that, consistent with the customs and traditions of the tribesmen, would regulate resource use according to the carrying capacity of the rangelands while providing minimum future security for individual tribesmen and their families. It may help to educate the tribesmen in such matters as the desirability of obtaining higher values for their labor, not through increased numbers of unhealthy animals but through smaller numbers of healthy animals. It is important to educate the tribesmen in the concept of long-term resource depletion, based on deterioration in rangeland conditions, and disappearance of desirable and valuable vegetation species. If cooperatives or some other organizations capable of performing the functions of the old tribal system could be established, these could also enforce something like the traditional rotational grazing. The institutional regulation of closing periods may no longer be possible as there are not many open lands available now and those that are available are not productive. But the government could help by providing some irrigation assistance through small dams, for example, because where animal feed can be grown and used for part of the year, the necessity of closing periods disappears.

Economic forces such as income, interest rates and taxes are also important tools to change the behavior of resource users. Credit, taxation and other such institutions were developed in these societies a long time ago and, in spite of changes in other aspects of people's lives, these have not changed yet. These institutions were originally designed to achieve certain economic and social objectives, such as equality in income distribution and conservation of resources. In a changed institutional environment, however, different economic institutions need to be developed. Under the existing condition of depleted rangelands and very low productivity, probably no taxes can be imposed or extracted from the tibesmen. But if the government is able to make some investment for improving the productivity of the rangelands and providing infrastructure for general development activities, then not only can taxes be imposed on the people but they can be used as tools to influence animal raisers' decisions (viz., by changing their incentives regarding resource use rates). On the local tribal level, the tribesmen, through the tribal organization if it still exists, or through some cooperative body so constituted, can be encouraged to impose some type of grazing tax on animal raisers. Such taxes could be highly progressive so that beyond a predetermined level (a level determined for the whole tribal area on the basis of the carrying capacity of the rangelands), the taxes would increase to prohibitive levels. For example a tax system could be devised where a tribesman raising more than 120 animals (e.g.) pays taxes equal to 15-20 percent of the value of all animals *above* this ceiling. Such value-based taxes would discourage overgrazing and at the same time encourage raising relatively more goats and less sheep.

Another recommendation for relieving the pressure on rangelands involves the development of small-scale industry. The government has already established some small-scale carpet and rug-making industries in several towns and cities in Baluchistan. These industries use the raw material of wool and mohair that is produced in animal-raising areas. But most of the people employed in these industries are people from the towns themselves, and this does not help the tribal people. If such industries were established in tribal areas, tribal people could be employed and this would help alleviate the pressure on rangelands. Otherwise, because there are no alternative employment opportunities at present, increased population means increased animals. Similarly, many tribesmen who can afford to save and invest, necessarily do so in animals at present, because of the lack of alternative investment opportunities. So establishment of industries to use the raw material coming from the tribal areas themselves would provide opportunities for alternative employment and alternative investment, and thus decrease pressure on rangelands. It is possible that establishment of small-scale industries would increase the demand for wool, which could result in increased sheep raising. But such possibilities are remote at this stage because the wool which is presently exported out of the tribal areas could easily meet the local industrial demand for some time to come.

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# II.5

# COMMON RESOURCE MANAGEMENT IN PAKISTAN: GARRETT HARDIN IN THE JUNGLAT

MICHAEL R. DOVE AND
ABDUL LATIF RAO

## INTRODUCTION

One of the most influential studies in the current debates over common resource management continues to be that of Garrett Hardin, published in 1968 under the title 'The Tragedy of the Commons'. The basic thesis of his article is that common control and ownership at resources ultimately and inevitably leads to over-exploitation, because the benefits to each individual of over-exploitation will always exceed the costs. This will occur, Hardin says, even though the individual's benefits are exceeded by the costs of his actions to society as a whole, and even though his benefits will eventually be exceeded by his own costs — assuming that all other members of the society follow his example — because each member of society must act selfishly and independently.

In this paper we will examine the applicability of Hardin's thesis to the management of common property resources in Pakistan. We will begin with a discussion of three case studies of the traditional management of such resources. We will suggest that they demonstrate a basic limitation in Hardin's thesis, namely its inapplicability to traditional as opposed to modernizing societies. We will then discuss the role of common property concepts in developmental planning in Pakistan today, focussing on two social forestry projects. We will suggest that some of the principal challenges faced in these projects involve the difficulty of creating new institutions, and the failure to correctly understand the functioning of traditional institutions. The solution, we will suggest, is to utilize extant, traditional but still powerful institutions, examples of which include both formal and folk religious beliefs.

# CASE STUDIES OF TRADITIONAL COMMON PROPERTY RESOURCES

The three case studies to be discussed include a detailed one from Baluchistan, and briefer ones from Rajasthan (India) and the Swat valley.

## *Baluchistan*

Buzdar (1982) has produced the most thorough extant analysis of common property management of rural resources in contemporary Pakistan (cf.Buzdar, chapter II.4 in this volume). The subject of his analysis is the system of tribal ownership and management of grazing lands in Baluchistan. He suggests that this system represents an adaptation to the local ecology and economy: common ownership enables the tribesmen to take their herds to any part of the tribal territory that has recently received some rain, and it provides economies of scale as well. Thus, this institution maximizes human exploitation of the local environment.

There are several tribal institutions that ensure that the environment is not over-exploited. One is a system of periodic enforced closure of all rangelands, in rotation, which gives them a period of recuperation after each period of use. The second is a system of tribal taxation and obligatory social expenditure, which reduces the size of individual herds as they approach critical limits, thus putting a lid on the overall livestock/land density. The third is the ritual proscription of the exploitation of particular trees or patches of forest. And the fourth is a subsistence-oriented focus on goats, whose browsing places relatively little pressure on the range grasses. Buzdar makes it clear that all of these institutions are backed by tribal sanctions, the cost of violating which exceeds the benefits of the violation.

The foregoing description, Buzdar states, holds only for the traditional parts of Baluchistan. In the areas where outside influences have more deeply penetrated, and the tribal culture has weakened, the picture is very different. In these modernizing areas, the enforced closures, tribal taxations, social expenditures, and ritual proscriptions have all weakened or disappeared entirely; and the subsistence focus on goats has shifted to a market-oriented focus on sheep, whose close-cropping is much harder on the range. As a result, he suggests, individual tribesmen have over-exploited the rangelands, which have deteriorated as a result. This relative deterioration, he suggests, is reflected in the fact that the returns per animal or per rupee invested, as well as the birth/survival rates of animals, are demonstrably lower in the modernizing parts of Baluchistan than in the parts where the tribal institutions are still strong.

## *Rajasthan*

In a more recent study in Rajasthan (see chapter II.2 in this volume), Jodha (1985) reached conclusions similar to those of Buzdar. Speaking also of an arid region inhabited by tribal herdsmen, he concludes, first, that the livestock themselves represent an adaptation — because of their mobility — to the perennial threat of severe but localized droughts. The mobility of the livestock is ensured, he then argues, by the tribal institution of common ownership of rangelands. Just as Buzdar said, this allows the tribesmen to take their herds to whatever part of the tribal territory has most recently received some rain.

Jodha then analyzes the impact on this social and physical environment of recent, government-instigated land reform, which involved breaking the tribal rangelands up into individual family-held sections. As a result of this reform, he suggests, the land is becoming concentrated in the hands of the wealthy few, being over-exploited, and consequently deteriorating in condition. As one consequence of these changes, he goes on to say, the average size of herds in Rajasthan is declining, eliminating some of the economies of scale that gave Rajasthan a comparative advantage in animal husbandry in the past.

## *Swat*

In his classic study of the tribal politics of the Swat Pathan, Barth (1959) offers a few observations on the local system of land tenure that are relevant to the current discussion. Specifically, he notes that (at the time of his study, at least) individual Pathan did not own land per se, rather they each owned a particular number of brakha 'shares' in the overall landed estate of their descent group. Under the terms of the traditional system, every 5-10 years the shares were rotated among the members of the descent group. (In the 1920's, however, the ruler of Swat state 'froze' the rotation as it happened to be at the time, and no further rotations have occurred since.)

This system of land tenure probably had a number of different functions. At the most superficial level, it minimized conflict within the descent group over use of the choicest land, since every descent group member eventually got to use every section of the group's land. At another level, the system helped to maintain the integrity of the descent group (as Barth himself argues [1959: 68]), by periodically severing — *during* the periodic rotation of land sections — all ties between the Pathan landlord and the numerically superior but politically inferior non-Pathan tenants who resided on and worked each section of land.

Of more relevance to the current discussion, the system of rotation may have helped to maintain an optimum population/land balance, by 'randomizing' the distribution of Pathan families — regardless of size or agricultural predilections — over the landscape. Over time this would have *equalized* their impact on the environment. (Not all of the consequences of this system were benign, however: for example, Barth [1959: 66] himself notes that it was not conducive — for obvious reasons — to the planting of perennial crops such as trees, which could not be planted and harvested within a single 5-10 years rotation.)

## *Analysis*

These case studies of systems of common property management show them functioning to promote balanced use of the environment and minimize destructive exploitation of it, and thus they seem to disprove Hardin's thesis. However, note that each one of these systems is supported by strong, traditional tribal sanctions (this is explicit in Buzdar's study, and implicit in the other two). In contrast, the setting in which Hardin's 'tragedy' takes place is one without sanctions. It is precisely the way people behave when they have to answer to no one but themselves that leads to the tragedy of which he speaks. This aspects of Hardin's analysis is actually proven to be *correct* by the data in the case studies presented above. Both Buzdar and Jodha present evidence showing that when the traditional institutions for common property management are removed, the people involved abandon their balanced use of their natural resources and begin to over-exploit and indeed destroy them. Hardin clearly believes that this is what will happen whenever society does not impose sanctions to keep it from happening. Hence, in the conclusion to his article, he urges the imposition by society of sanctions against everything from over-use of national parks to bearing too many children.

Where Hardin is in error, and where his work is truly at odds with the studies discussed above, is in assuming that the absence of such sanctions is the norm. As Buzdar (and to a lesser extent) Jodha and Barth show, strong sanctions are a prominent feature of traditional societies and a critical factor in their balanced use of common property resources. Hardin is right, therefore, in concluding that coercion is necessary to the proper management of such resources, but wrong in assuming that a lack of coercion characterized the typical commons situations.

We suggest that the commons is left unprotected by social coercion or sanctions only during the period of transition from traditional tribal or feudal society to nation state. During this transitional period, the power of the emerging state is usually sufficient to weaken or destroy the sanctions supporting traditional systems of resource conservation, but it is usually not sufficient to establish an efficient mechanism of enforcement for its own system: it takes the administration of a fairly advanced modern state to equal, much less surpass, the efficiency of administration of the average tribal or feudal society.

In the transition from traditional to modern societies, not only is the power to enforce systems of resource conservation temporarily lost, but the systems themselves may be lost (a topic that was not discussed by any of the authors cited earlier). Systems of resource use, such as that described by Buzdar for the Baluch herdsmen, are the products of literally millennia of cultural evolution — the products of the experience of hundreds of successive generations. The wisdom that comes to be embodied in such a system will not be equalled until the science of the emerging nation state is very advanced indeed (and it can even be plausibly argued that the science of resource management has not yet attained, in any nation on earth, the level that is represented by the traditional Baluch herdsmen).

## COMMON PROPERTY RESOURCES IN DEVELOPMENT PROJECTS

To illustrate the current view of common property resources in development circles in Pakistan, we will briefly discuss the World Bank's 'Azad Kashmir Hill Farming Technical Development Project', carried out between 1978 and 1983, and the 'Forestry Planning and Development Project' of the U.S. Agency for International Development (U.S.A.I.D.), begun in 1985.

### *The World Bank Project*

This project comprised several components, one of which was a forestry program designed to address problems of deforestation, environmental degradation, and fuelwood shortage in Azad Kashmir. According to Cernea's (1985) account (see chapter II.3 in this volume), the forestry operations focussed on village *shamlat* lands in the expectation that the benefits provided would thereby accrue largely to the village poor. In fact, he goes on to say, no sooner were the *shamlat* lands planted with trees, than the wealthier villagers began to claim that the land and consequently the newly planted trees belonged to them, not the village as a whole (much less to the village poor).

Based on his subsequent field study of the situation, Cernea concluded that the designers of the project had erred in their initial perception of the *shamlat* lands. Although they had been told by government officers that these lands were community lands, and although these lands did indeed belong to the village as a whole at some point in the past, Cernea argues that they had since come — through a gradual process, supported by changes in government regulations — to belong (on a *de facto* if not *de jure* basis) to individual villagers. On the basis of this mid-project evaluation, the focus of the World Bank's tree-planting efforts was shifted from *shamlat* lands to private lands held by single families.

## *The U.S.A.I.D. Project*

The problems encountered by this World Bank project have had apparent reverberations in other projects, including the U.S.A.I.D. Forestry Planning and Development project currently underway in Pakistan. One of the principal aims of this project is to encourage the rural population to plant trees for use as fuel and fodder. Under the project design, these efforts are exclusively targeted on the private holdings of individual farm families. Community lands are specifically excluded from these efforts (although 'extended family' lands are not), and one of the reasons explicitly cited for this is the difficulty experienced in the past in planting trees on *shamlat* lands elsewhere in Pakistan — in apparent reference to the World Bank's Azad Kashmir Project (A.I.D. 1983: 137). The experience with community lands in the World Bank project merits our attention therefore, because of the broader impact it has had on forestry-related projects throughout Pakistan (if not throughout Asia).

## *Analysis*

As Cernea has ably demonstrated, the World Bank project in Azad Kashmir experienced difficulties because it was based on a historically-dated perception at *shamlat* lands: it was based on a perception of them as being completely communally owned, whereas many had been privatized by the time of the project. These difficulties may have been further compounded by the project's own impact on this privatization process. It is possible that some *shamlat* lands were not completely privatized at the time that the project began, and that one of the consequences of project activities was to hasten their privatization. It is possible, that is, that the planting of trees on any remaining de facto *shamlat* lands helped to bring about, or accelerate, a change in their status, a change of which the wealthier and more influential farmers were able to take advantage (cf. Jodha 1986). The principle involved here — namely that planting a tree on a piece of land can change its tenurial status — is of course a well-known one, which has been used and abused by farmers and foresters alike all over the world. The difficulty in anticipating and providing for this principle when designing development project is due, we suggest, to two problems.

The first problem is the one that is posed in taking a communal pasture and replacing it with a communal forest, namely the problem of creating a new institution. This presents development planners with a challenge far tougher than most others that they face, and as some of the most perceptive observers of the field have said (e.g., Murray 1985; Noronha 1982), it is a challenge that is best avoided wherever possible. There are countless examples of institutions for the common management of resources that have evolved traditionally and that work beautifully; there are very few examples of institutions created by development planners for the same purpose that have not failed utterly (of which the notoriously unproductive 'communal farm' is just one of the better known examples [cf. Deshpande 1979]).

The second problem is that in creating the new institution, something crucial is left out: namely, the need for sanctions against behavior that maximizes the short-term good of the individual to the detriment of the long-term good of the group. This is left out in most such cases, simply because development planners do not realize that it was present in the pre-project situation. Prior to the World Bank project in Azad Kashmir, for example, the village poor would in fact have been able to make some use of the *shamlat* lands. A variety of traditional institutions would have served to prevent the wealthier and more influential villagers from using these lands completely for their own benefit. Under these circumstances, the wealthy would have welcomed the World Bank project, as a way of circumventing these traditional institutions, while attaching minimal blame to themselves.

The failure to see this aspect of traditional society — which of course is the same error that Hardin makes — is due to a peculiarly Western vision of 'primitive society'. According to this vision, traditional Third World societies are fundamentally 'communal' in their nature — a prospect that fills the Western development planner with both hope and foreboding; hope because this communal nature is supposed to predispose its bearers to self-sacrifice and group effort, and foreboding because this nature is a far cry from the self-centered individualism that the West itself embraces (Dove 1982). In fact, both hope and fear are based on a myth: traditional tribesmen or peasants are just as self-centered — and just as in need of benign coercion by society — as their Western counterparts, as we noted earlier.

## RECOMMENDATIONS

In all efforts to create new institutions for the management of common property resources in the developing world, therefore, the target population is likely to have no less need of sanctions against selfish management practices than any similar population in the developed world. Any attempt to create new institutions is always less likely to succeed than attempts to make use of extant traditional institutions. This was noted by Buzdar (1982:113-114), who recommended that new institutions for managing the Baluchistan rangelands be created, but that they be based on the traditional institutions of cooperation and constraint. The same point was noted by Gibbs (1983:12), in his recommendation that the models developed by the U.S.A.I.D. Forestry Planning and Development project be well adapted to the institutional realities of the villages involved. The problem with these recommendations is that traditional institutions are almost all local level ones; whereas social and political powers of sanction are increasingly being transferred to the national level of the state. The question is, in a nation state, can a local institution be given the power of coercion? The answer to this question is beyond the scope of this paper. Suffice it to say, for the moment, that there is still one source of local level sanctions that has not (in most cases) been appropriated by the central governments of the developing nation states: religion.

The threat of supernatural sanctions has helped to support traditional institutions for managing common natural resources all over the world. In 1957 for example, Bartlett noted that in many parts of the tropics the only remaining stands of healthy forest were those whose exploitation was proscribed by local ritual taboo or religious doctrine. One example of this phenomenon in Pakistan was noted earlier, in the ritual proscription of exploitation of certain patches of vegetation in the rangelands of

Baluchistan, which Buzdar interprets as having a conservation function. A second example from Pakistan is the widely observed proscription against exploiting the vegetation around graveyards and holy shrines. Indeed, the vegetation in such places is now studied by Pakistani foresters as the closest remaining approximation of the country's natural vegetation (Chaghtai et al. 1978, 1983, 1984).

In general, the topic of the relationship between Islam and Pakistan's natural environment merits close study. The special relevance of Islam in this regard is suggested by the fact that it originally evolved in an arid environment populated by nomadic and pastoral peoples, much like parts of Pakistan today. Hence the references in the Holy Koran (Ahmad 1984) to the fact that trees are highly valued (because of their scarcity) and are raised in walled gardens (because of the threat from livestock). This theological and cultural background is of obvious relevance to any development program of social forestry in contemporary Pakistan. Some attempts to involve the Islamic clergy in forestry programs have already been made, but nothing approaching a thorough analysis of the cultural and ecological implications of Islamic teachings for forestry has yet been attempted, much less employed in the planning and implementation of forestry projects. This is a rich field for further work (cf. Burch 1988).

# SUMMARY

We began this paper with an analysis of Hardin's thesis of 'the tragedy of the commons'. We suggested that he is right that human behavior has tragic implications when there is free access to a commons, but wrong in thinking that this is the norm in traditional contexts. In the normal traditional context, access is not free and the principle of the commons works effectively, as Buzdar, Jodha, and Barth show in their studies. It works in these contexts because of the existence of sanctions. These tend to weaken or disappear in the course of the integration of traditional societies into the developing modern state — and then the principle of the commons stops working, during the hiatus before truly effective modern systems and sanctions can be developed and imposed.

We then investigated the treatment of common property concepts in two forestry development projects in Pakistan, one funded by the World Bank and the other by U.S.A.I.D. The former attempted to employ them, with dismaying results, so the latter shied away from them. We concluded that the problems of incorporating common property in development projects can be attributed not only to the difficulty of creating new institutions, but to the failure to realize that any new (or old) institution needs to be supported by sanctions. This failure in turn is associated with unfounded beliefs in the communal character of traditional society.

In conclusion, we recommended that development projects build upon extant social institutions wherever possible. One of the few remaining traditional institutions with any power of sanction, we noted, is religion; and we suggested that the teachings of Islam in particular should be studied and utilized in the planning and development of social forestry in Pakistan.

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# III. ENERGY FLOWS

# III.1

# ENERGY USE AND SOCIAL STRUCTURE IN A BANGLADESH VILLAGE

John Briscoe

Analyses of energy use in developing countries typically compare the aggregate availability of energy with the aggregate requirement for energy and implicitly assume that distribution takes place according to need.[1] For an important energy resource, food, such a method is obviously flawed: at the global level because widespread chronic malnutrition coexists with an adequate supply of food to feed the world population; at the village level because it is primarily inequalities in food consumption that explain why, during famines, landless villagers die at much greater rates than their landed neighbors.[2] Whether the context is global or local, the issue of distribution is crucially related to control of available resources and the structure of social organization that governs the distribution of these resources from owners to users.

This paper examines energy availability and patterns of energy use in the context of a single village in rural Bangladesh. From a quantification of the average daily flows of energy use by the study population in the village, the analysis proceeds to an examination of patterns of land ownership and of the relations governing transactions between members of different classes in land, labor, and crop residues. The data confirm the observation of the older villagers that the patron-client system of old, in which the richer peasants tried to underwrite the minimal needs of their poorer clients, is being replaced by a system in which transactions between families of the same class are the norm.

Since fuel for cooking food is by far the largest component of energy use in rural areas of the Indian subcontinent, data on specific fuels used by different classes in the village are analyzed in light of the social and economic organization. It is shown that families of different classes use different types and sources of fuel, and, in particular, it is the socially and economically most disadvantaged villagers who are forced to purchase this increasingly scarce resource from the market. The current social structure and current mechanisms governing resource distribution in the village are contrasted with historical patterns, and future patterns of energy use in the village are estimated. The final section assesses the likely effect of specific energy and rural development projects on different classes in the village.

## THE STUDY POPULATION

The study village, Ulipur, is situated in the deep-water flooding plain of the Meghna River, in the western part of Comilla District. The village consists of an amorphous cluster of dwellings near a canal a mile west of the Dhanu, a major distributory of the Meghna river. The land is only ten feet above mean sea level and becomes covered with a sheet of water when the rivers flood their banks in June. By the end of October the waters have receded, leaving the land covered with a soft, fertile, sand-clay silt.

The 2,300 people per square mile in this densely populated rural area live in *baris*, clusters of predominately bamboo-walled and straw-roofed houses surrounded by trees and bamboo groves. The *baris*, which are raised above the level of the monsoon water on earthen mounds, are scattered over the flat plain. There is no road in the village, and no path remains above the monsoon water. The nearest market, at Raipur Bazaar, the administrative centre for the 250,000 inhabitants of Raipur Thana, can be reached in an hour, by foot in the dry season and by country-boat when the land is under water.

The families of each *bari* are usually a patrilineal descent group, identified by a quasi-hereditary title that once indicated an occupation. The most important extra-familial social grouping is the *somaj* ("society"), which usually includes between 200 and 500 people. This informal multipurpose institution is referred to by the name of its most prominent member. The *somaj* is most easily identified at religious festivals, but it also functions as an economic unit, with exchanges in land, labor, and fuel taking place between members of the same *somaj*.

The study population consisted of 8 Hindu fishing families and 40 families of Muslim agriculturalists. These families represented a random sample of 50 percent of the inhabitants of both the Hindu community of Jelepara and the adjacent Ali Sardar *somaj*.

# DATA COLLECTION

At the start of the study, information was collected from each study family on family size and composition, income and employment, animals owned, land owned, and land use. Estimates were also obtained of the production and distribution of crops and residues from the fields farmed by the family during the preceding years.[3]

The study design called for data collection for one full year, but due to unforeseen circumstances data were collected for only eight and a half months. Once every two weeks, detailed information on productive activities and the production and distribution of food, fodder, fuel, and fertilizer was collected from each study family. Primarily on the basis of direct measurement, estimates were obtained of the amount, type, and source of food eaten by the family's cattle over the previous 24-hour period. Similarly, the amount of dung excreted was estimated, and the use to which this dung was put recorded. The type and duration of agricultural work done by family members, on their fields and for others, on the previous day was recorded, as was the work done by others on the family's fields. Similar information was collected for the work of animals. Detailed information was collected on the planting, fertilizing, and harvesting of crops over the previous two weeks on the fields farmed by the families. On the basis of direct measurement, estimates were made of the production of crop residues. The names of the families using these residues were recorded, as was the use to which the residues would be put. Similar information was obtained on fuels collected from sources not owned by the family. On each working day precise measurements were made of the fuels used by a different study family for cooking their food and for parboiling paddy. The types and quantities of fuel used by each study family were thus recorded on a quarterly basis.

# PATTERNS OF ENERGY USE

Figure 1 illustrates the average daily flows of energy for the 330 people and 18 cattle in the study population. The detailed calculations behind these estimates are presented elsewhere;[4] in this section the methods followed in computing the most important energy flows — those of fuel, cattle, and humans — are outlined.

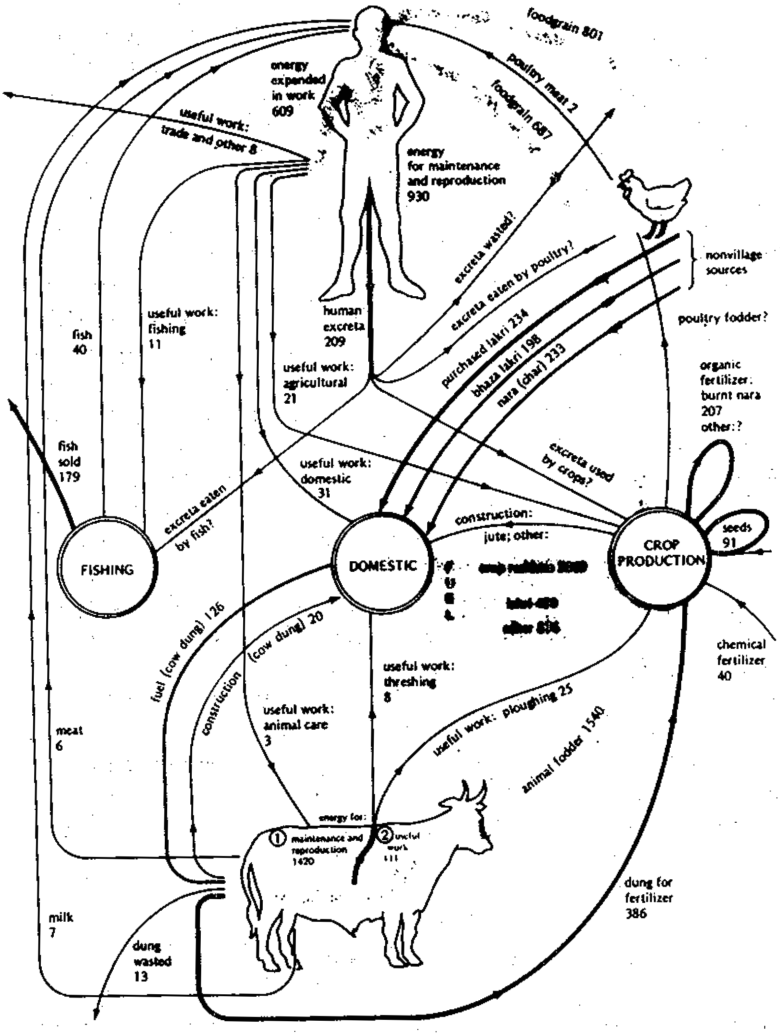


**Figure 1. Daily Per Capita Energy Flows in a Village in Bangladesh (in kcals)**

Notes: The study included 330 people, 48 cattle, and 43 acres of agricultural land. The term useful work refers to actual mechanical work output, which is on the order of 10 percent of total work. The denominator for each estimate is 1 person × 330.

## *Fuel*

The quality of each type of fuel used for parboling paddy and cooking food over the eight-and-a-half-month study period is estimated from the cooking fuel measurements. For the period during which data were not collected (February to mid-May) knowledge of the crops planted was used in conjunction with interview information about nonagricultural sources of fuel (such as water hyacinth) to estimate the types and quantities of fuel used by different groups in the population. For most fuel types, the estimates of total use obtained on the basis of measurements of cooking fuel were checked against information obtained on the production and distribution of crop residues. The aggregate annual fuel use in Ulipur is summarized in Table 1.

## *Cattle*

The useful outputs from cattle — work, dung, milk, and meat — are available only because of the food provided for the maintenance and reproduction of the entire cattle population. The average gross energy intake for the 10 bullocks, 20 cows, and 18 immature cattle is estimated to be about 10,600 kilocalories per day. Of the total intake, 54 percent is consumed by the 10 bullocks and 10 working cows.

Data were collected fortnightly on the activities of all cattle. For the non-study months, hours of work were estimated by comparing the intensity with which the animals were said to work during that period with the intensity during periods for which data were available. For the whole year, the 10 bullocks and 10 working cows worked an average of four hours a day for 150 days, 25 percent of the time being spent threshing paddy and 75 percent ploughing. In this wet area, unlike many other parts of the Indian subcontinent, cattle are not used for transportation.

The amount of energy expended in performing this work was estimated, following Revelle, by assuming that "a fully-employed bullock, like a human manual worker, utilizes about 43 percent of the energy it consumes in work."[5] Like other "machines", cattle are not perfectly efficient: the output of useful work is less than the energy expended in doing this work. Assuming, following Desai,[6] that the ratio of work to total energy consumed as work or heat is, as for human beings, about 25 percent, the useful work output is estimated at 28 percent of the net energy intake of all cattle, implying that the animals work at 0.43 horse-power.

**Table 1. Annual Use of Fuel in Ulipur**

| Fuel Type | Quantity of Fuel in $10^3$ Kcals/Person/Year | Percent |
|---|---|---|
| **Crop residues** | | |
| From village | | |
| *Amon nara* | 633 | 38.3 |
| *Amon kher* | 23 | 1.4 |
| *Aus kher* | 18 | 1.0 |
| *Boro kher* | 15 | 0.9 |
| Grain husks | 88 | 5.3 |
| Jute sticks | 32 | 1.9 |
| Sesamum plant | 48 | 2.9 |
| Mustard plant | 29 | 1.7 |
| Chili plant | 6 | 0.4 |
| Total crop residues from village | 891 | 54.0 |
| *Amon nara* from *char* outside village | 85 | 5.1 |
| **Animal residues** | | |
| Cow dung | 46 | 2.7 |
| **Firewood** (including twigs and branches) | | |
| From village trees | 167 | 10.8 |
| From river (*bhaza-lakri*) | 72 | 4.4 |
| Purchased from bazaar | 85 | 5.2 |
| Total firewood | 324 | 20.3 |
| **Other fuels** | | |
| *Doinshah* | 81 | 4.9 |
| Bamboo | 60 | 3.6 |
| Water hyacinth | 27 | 1.6 |
| Other crop residues and leaves | 136 | 7.6 |
| Total other fuels | 305 | 17.7 |
| Total, all sources | 1,615 | 100.0 |

NOTE: The fuel used by the 330 people in the study population is estimated to be $545 \times 10^6$ kcals per year.

The average dry-dung production is estimated to be 1.2 kilograms per animal per day. Seventy-one percent of the dung is used for fertilizer and 23 percent for fuel.

## *Humans*

In the absence of good data for the study population, the food consumption in Ulipur is assumed to be the national average of about 1,300 kilocalories per capita per day.[7] Muslim agriculturalists obtain 43 percent of their foodgrains from outside the village; Hindus obtain their foodgrains from the market.

Recent data on the use of time by men, women, and children in rural Bangladesh show that villagers are neither un- nor under-employed: they do a great deal of work, but generally with very low return.[8] Using these data in conjunction with Revelle's estimate that Indian villagers expend 43 percent of their energy intake in work, the energy inputs into animal care, trade, fishing, agricultural work, and household work are estimated. Assuming that the average ratio of work to the total energy consumed as work or heat is about 25 percent,[9] it is estimated that about 10 percent of the total food intake of the population is accounted for by useful work. The most important sectoral activities are household work, agricultural work, and fishing, which account for, respectively, 45 percent, 28 percent, and 15 percent of the total output of useful work.

## *A Frugal, Inefficient System*

Although the energy system in Ulipur is frugal, with virtually all products and by-products being used for some purpose, the use of energy is inefficient. In Ulipur, as in rural India, the energy input into foodgrain production accounts for over one-half of the energy output of the grain. This is slightly more than the energy input per unit of foodgrain output in energy-intensive U.S. agriculture. Furthermore, the amount of food that has to be consumed by a person or a bullock to produce a unit output of useful work is very high. The efficiency of cooking, too, is very low, with about 3 calories of fuel used for each calorie of foodgrain cooked. This is substantially higher than the estimated U.S. energy use for cooking and refrigeration combined.[10]

## *A Complex System*

Each crop in this village produces several products, each of which can be used for several purposes. Deep water *amon* paddy, for example, produces leaves, which are usually used for fodder but sometimes for fuel; grain, which is used for food; husk, which is usually used for fuel but sometimes for fodder; *kher* , the upper, tender straw, which is usually used for fodder but sometimes also used for fuel or as a compost; and *nara*, the lower, coarse straw, which is usually used for fuel but is also used for compost and occasionally for construction and animal fodder.

Patterns of landownership and tenancy are an important determinant of which organic materials are produced in the village. Decisions on cropping patterns are made by those who cultivate the land, not only on the basis of soil conditions and the prices of inputs and outputs, but also on the basis of the cultivator's need for primary and secondary products and possibly the needs of other people toward whom he feels responsibility.

So far energy use in Ulipur has been discussed as though the village were a homogeneous unit. Access to different types and sources of energy, however, is far from evenly distributed in the village: it varies with class and is largely governed by the social structure.[11] In the next section this social structure is described, with particular reference to the changing relations of production. Empirical and qualitative analyses are introduced to document the pervasive nature of the changes in social organization that the village is undergoing. The discussion provides the context for an examination, in the subsequent section, of the differential use of the largest component of energy use in the village — fuel.

## CHANGING FORMS OF SOCIAL ORGANIZATION IN THE VILLAGE

Equilibrium in rural societies such as that of Bengal has depended historically on a balance of transfers of peasant surpluses to the rulers in return for the provision of minimal security for the cultivators.[12] From the time of the Permanent Settlement of 1793, these patron-client relationships stemmed directly from the possession of differential rights in land. Landowners tended to become patrons for their tenants, servants, and laborers, and for members of the artisan and service groups.[13] Through these relationships landlords reduced their management problems and were ensured of a supply of labor during planting and harvesting. Clients also added to a patron's power in the endemic village factionalism and were helpers on ritual occasions and in times of crisis. For a poor villager, a relationship with a patron was advantageous because the patron provided work and income; he allowed the villager to collect fuel from his land, trees, and cattle; he interceded on the villager's behalf in village disputes and in contacts with government officials; and he helped with the education and employment of the poor man's children.

Evidence that changes are taking place in the forms of social organization in rural Bangladesh is widespread.[14] Where high-yielding crop varieties have been introduced, migrant workers compete with local laborers, and the traditional share system of payment has been partially replaced by the introduction of cash contracts and daily wages. Throughout

Bangladesh, the market orientation of production units appears to be increasing. Concomitantly the gap between rich and poor has widened. According to the International Labour Office, in the decade since the mid-1960s, about 15 percent of households experienced rising incomes, while the percentage of landless to total households increased from 18 percent to 38 percent and the percentage of families consuming less than 80 percent of the required caloric intake rose from 5 percent to 41 percent.

Changes in the agricultural labor market have contributed to the tilting of the balance of reciprocity in the customary relationship against the poor. The demand for agricultural labor has increased more slowly than output, while the labor supply has increased rapidly both because population has grown more rapidly than output and because the number of people dependent on agricultural wage labor has increased drastically as the proportion of landless families has increased.

The interdependence between landowners and agricultural laborers has decreased as more government jobs have opened to Bengalis since Independence. In Ulipur, members of 43 percent of the study families have extra-village employment, the poor and landless working in factories, while the rich have desk jobs in the bureaucracy in Dacca. It is also the rich who have jobs in, and control of, the important local agencies such as the Raipur Thana Multipurpose Cooperative and the Ulipur Swarnivar ("Self-Reliance") Committee.

In Ulipur, as elsewhere,[15] the disappearance of slack resources such as fisheries and crop residues has forced poor peasants into the insecurities of cash economy. In the 1960s Ulipur Muslims seldom fished the rivers of the area. Fishing was considered exclusively a Hindu occupation, with the relationships built up during the sale of the catch forming the basis for the integration of the Hindus into village society. When the Hindus occupied this niche they, like the poor Muslims, were allowed to collect then-abundant crop residues from the fields of landed villagers. As productive employment has become more difficult to obtain, as real agricultural wages have declined, and as the poor have become more impoverished, many Muslims have come to disregard their previous aversion to fishing. They now compete with the Hindus, albeit at a lower level of cooperation and using less complex equipment, for the produce of the waterways. Consequently, the rich inland fisheries are being overfished, with yields declining markedly over the past few years.[16] Furthermore, the Muslims of Ulipur now seldom buy fish from the neighboring Hindu fishermen of Jelepara. Since the Hindus no longer fulfill any essential productive function in the Ulipur economy, and since they now find themselves in conflict with the Muslims over fishing grounds, the few rights that they previously had as members of Ulipur society have all but disappeared.

Similar forces are at work within the Muslim society of Ulipur, too. The poorer Muslims meet their fuel requirements without being forced into the market only because there are still some surplus fuels in the village. With rising man-land ratios and static residue yields per acre, the day when the Muslim poor can no longer collect sufficient fuel within the village is not far off.

## *An Empirical Analysis of Changing Relations of Production*

In a "traditional" society, the process of accommodation centers around the sharing of access to land and labor. In such a society it is expected that landowners preferentially lease or sharecrop out their land to those who are poorer than they, and that the richer farmers preferentially hire laborers who are poorer and who depend most heavily on agricultural labor. As the patron-client system breaks down, "the levelling mechanisms of a community shuffle fewer resources, with the internal process of village sharing finally involving only marginal resources and opportunities."[17] Under these circumstances owners prefer to rent to tenants who are solvent favor laborers from their own class when employment is scarce, and distribute fewer resources to poorer villagers.

Thus, the degree to which the traditional structure in Ulipur has been eroded can be determined by examining the classes of the families involved in transactions in land, labor, and crop residues and determining the relative importance of the traditional, "vertical" relationships, on the one hand, and the "horizontal" relationships between families of the same class, on the other.

Data on transactions in land, labor, and crop residues among Ulipur families are analyzed by comparing the classes of the giving and receiving families with the classes that would be expected under three social paradigms. The paradigms are: a "vertical" paradigm in which rich peasants preferentially allocate land, employment, and crop residues to those who are poorer and who are their clients; a "horizontal" paradigm in which families preferentially allocate land, employment, and crop residues to other families of the same class; and an intermediate, "class-neutral" paradigm in which there is no systematic class preference.

To illustrate, the data specify that 24 parcels of land were sharecropped in the village. Three hypothetical allocations of the 24 parcels are constructed to represent exchanges in land between different classes under the "vertical", "class-neutral", and "horizontal" paradigms. By comparing these allocations with the actual allocations that took place between classes, it can be determined whether the actual transactions are best characterized as "vertical," "class-neutral", or "horizontal".

Table 2 presents such comparisons for transactions in sharecropped land, mortgaged land, human labor, animal labor, *kher*, residues other than rice straw, and *nara.*[18]

**Table 2. Actual Number of Inter- and Intra-Class Transactions and Number of Transactions under Hypothetical Social Structures Compared**

| Resource | Paradigm of Social Structure | Richer | Same | Poorer | A Difference Statistic[a] |
|---|---|---|---|---|---|
| Sharecropped land | Vertical | 14 | 0 | 10 | 25.5 |
| | Class-neutral | 10 | 8 | 7 | 3.6 |
| | **Actual** | **8** | **12** | **4** | — |
| | Horizontal | 6 | 15 | 3 | 1.5 |
| Mortgaged land | Vertical | 2 | 0 | 16 | 5.7 |
| | Class-neutral | 1 | 3 | 14 | 0.5 |
| | **Actual** | **1** | **4** | **13** | — |
| | Horizontal | 0 | 6 | 12 | 2.1 |
| Human labor | Vertical | 141 | 0 | 24 | 54.1 |
| | Class-neutral | 115 | 31 | 19 | 3.4 |
| | **Actual** | **110** | **40** | **15** | — |
| | Horizontal | 73 | 92 | 0 | 95.0 |
| Animal labor | Vertical | 21 | 0 | 29 | 58.8 |
| | Class-neutral | 12 | 19 | 18 | 7.0 |
| | **Actual** | **10** | **27** | **13** | — |
| | Horizontal | 2 | 43 | 5 | 20.8 |
| *Kher* | Vertical | 15 | 0 | 13 | 36.8 |
| | Class-neutral | 13 | 8 | 7 | 6.4 |
| | **Actual** | **10** | **14** | **4** | — |
| | Horizontal | 6 | 22 | 0 | 10.2 |
| Residues other than rice straw | Vertical | 1 | 0 | 16 | 0 |
| | Class-neutral | 0 | 3 | 14 | 0.3 |
| | **Actual** | **0** | **3** | **14** | — |
| | Horizontal | 0 | 5 | 12 | 1.6 |
| *Nara* | Vertical | 6 | 0 | 26 | 4.7 |
| | **Actual** | **6** | **4** | **22** | — |
| | Class-neutral | 6 | 7 | 19 | 2.7 |
| | Horizontal | 0 | 22 | 10 | 93.5 |

This statistic is a modification of the standard chi-square statistic. It gives a normalized sum-of-squares measure of the difference between the actual and hypothesized transaction vectors. When the value is high it means the vectors are very different; when the value is low the vectors are similar.

For each of the transactions, there is a unique position for the "actual" vector that preserves the monotonic progression in the columns. For transactions in sharecropped land, mortgaged land, human labor, animal labor, *kher*, and miscellaneous crop residues, the mechanism underlying the observed transactions is more akin to that expected under a regime in which class cleavages are strong than under a traditional patron-client regime. In contrast to all of these commodities, the distribution of *nara* is still dominated by the patron-client type of relationship. It is most interesting that the distribution of one crop residue, *kher*, is similar to that expected under the "horizontal" paradigm, while the distribution of another, *nara*, is similar to that expected under the "vertical" paradigm. For the Muslims, the shortage in organic materials has been manifested first as a shortage of fodder and only subsequently as a fuel shortage. *Kher* is primarily used for fodder and nara primarily for fuel. On the few occasions on which these residues are sold, a kilogram of *kher* is sold for five times the price of a kilogram of *nara*. Therefore, the anachronistic distribution pattern of *nara* is not unexpected, since it is with respect to resources that have not become particularly scarce that the old forms of distribution may be expected to survive. The corollary is that as the supply of *nara*, too, becomes scarce, the distribution of this material will evolve rapidly toward the pattern seen for *kher* and other scarce commodities.

## A Qualitative Description of the Changes Taking Place

These changes in social structure mean fundamental changes in the everyday lives and fuel collection practices of the villagers of Ulipur. A feeling for these changes is conveyed by brief descriptions of Sulaiman Majumdar and Ali Sardar, the two most powerful men in Ulipur.

Sulaiman Majumdar is the oldest son of Fakhruddin Majumdar, the last Zamindar of Ulipur. Sulaiman is the biggest landowner in the village, with 10 acres of agricultural land. His status has declined and continues to decline relative to that of Ali Sardar, but Sulaiman is undoubtedly the most important village leader. Despite his interests outside of the village (he owns a "baby-taxi" in Raipur Bazaar and has a small construction business in a nearby town), the hereditary nature of his position in the village means that many of his relationships are those typical of a traditional "patron". He sharecrops out a substantial portion of his land; he has a house servant and a permanent laborer who have worked for his for many years and who are treated paternalistically as "part of the family"; he has contributed heavily to public works like the village school and the embanked path through the village; he has acquired religious stature by going on a pilgrimage to Mecca, building a mosque in Ulipur, and employing an Islamic priest; he is the final authority in the mediation of most village disputes; he is the perennial Ulipur candidate for election to the chair of the local extra-village political body; and it is to him that distinguished guests are taken when they visit Ulipur. In terms of energy distribution, too, Sulaiman behaves like a traditional patron by giving permission to many of the poor of his somaj to clear residues from his fields after the harvest has been reaped.

Ali Sardar represents a different type of village leader whose power does not emanate from hereditary status but from his ability to take advantage of the new opportunities that have accompanied the influx of foreign aid into Bangladesh. Ali is Chairman of the Raipur Multipurpose Cooperative, his brother Abu is Secretary of the Cooperative, and another brother, Asad, is Secretary of the Ulipur Swarnivar Committee. Because the basis of Ali's position is not the dispensation of patronage to the villagers, his relationships with the people of Ulipur are quite different from those of Sulaiman Majumdar. Ali gives no land to others to farm, but he leases 0.4 acres and sharecrops 0.6 acres for relatives who work in Dacca. He manages these lands and his own 3.1 acres himself; he employs no permanent laborers; he lends money for interest (usually at a rate of more than 10 percent per month); he makes no effort to appear to be a devout Muslim. Whereas a traditional landlord's pursuit of power may be veiled by a paternalistic concern for his clients, Ali is far more direct. During the study period, Ali wished to occupy a part of Jelepara so that he could establish a more spacious home and fruit orchard. First, by refusing to continue to lease to the Hindus trees necessary for fishing, Ali made it difficult for these fishermen to continue earning a livelihood in this area. He and his family subjected the Hindus to harassment. He expelled those Hindus whose land he wished to use and who were indebted to him. When the one Hindu in this part of Jelepara who was not indebted to Ali refused to sell his homestead plot, he was forced to do so when threatened with death by Ali's oldest son. Ali was unconcerned that the villagers, Muslim and Hindu alike, did not approve of his actions in this matter. In terms of energy distribution, too, Ali acts quite differently from Sulaiman Majumdar; it is not his habit to distribute scarce crop residues to poorer villagers.

The changes in Ulipur society that are reflected in the data in Table 2 and in the decline of the Majumdars and rise of the Sardars can be described, paraphrasing Marx, as the substitution of feudal, patriarchal exploitation by unqualified, direct exploitation.

# THE SOCIAL STRUCTURE AND THE USE OF FUEL

Different classes in the study village use approximately the same number of kilocalories to cook a kilogram of foodgrain. Because the richer villagers eat more food, they use more fuel, but in a relatively good year like the study year of 1977, the difference in overall fuel use is not great.[19] Because poor people have considerable difficulty obtaining fuels, particularly at certain times of the year, and because not even careful management can greatly increase the efficiency of the *chulahs* (mud fireplaces for cooking foods that are of a standard design throughout the village), the results of fuel crises are not that the poor use fuel more efficiently, but that they are forced to go to greater lengths, including stealing and buying fuel with money that would otherwise have been used for food, to acquire the fuel necessary for cooking. Thus, while the fuel needs of rich and poor are similar, the quality of fuel used and the costs, including the effort expended to obtain it, differ significantly.

## *Seasonal Factors in Fuel Availability*

Crop residues provide over 70 percent of the fuel used by the study population, and therefore the cropping pattern (see Figure 2) is the primary determinant of the seasonal variation in the fuel supply. Other fuels, such as *bhaza lakri* (the trees and branches recovered from the rivers and riverbanks after the monsoon) are available over longer periods of time, while still other fuels, such as cow dung and firewood from the village trees and the market, are available year round.

Because the technology available for preserving fuels is rudimentary, the patterns of fuel use often closely correspond to the patterns of fuel production. Fuel-drying is essentially limited to sun-drying in the courtyards, although occasionally villagers dry damp fuels by placing them alongside the *chulah*. It is difficult for those villagers (particularly the Hindus) who live in the most crowded conditions, and therefore have little space between their houses, to use fuels like water hyacinth that require protracted drying periods. All families have difficulty drying fuel during the monsoon, since women have to bring the fuel inside repeatedly when it rains and lay it out again when the sun shines. An associated

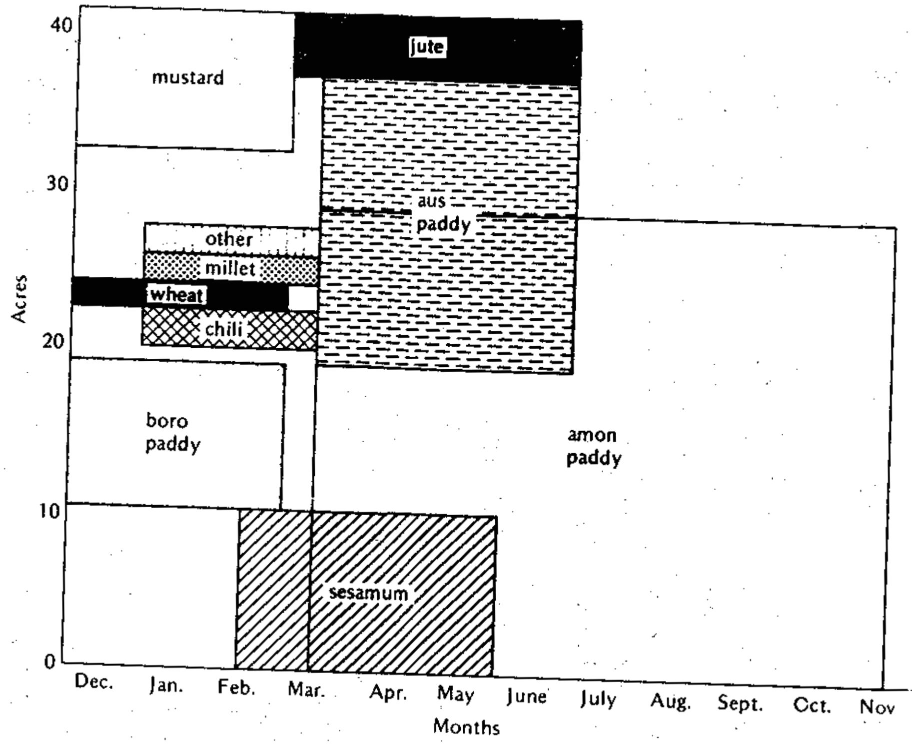


**Figure 2. Land Utilization in Ali Sarar Somaj**

determinant of the temporal use of different fuels is the suitability of the particular fuel for storage. For example, firewood and rice hulls are dense and do not rot, while nara is bulky and susceptible to rotting. Poor people are often constrained by the lack of storage space.

## *The Determinants of Class Differences in Fuel Use*

The ownership of assets that produce fuel is highly concentrated. As shown in Table 3, 16 percent of the families own 80 percent of the trees, 55 percent of the cropped land, and 46 percent of the cattle. In this society the *rights* to the products of the land lie exclusively with the owner of the land. Thus, in theory, the landowner commands all of the residues produced on his land. In practice, actual command of these resources depends on the owner or caretaker's ability to enforce his rights to the fuel from his land.

**Table 3. Ownership of Fuel-Producing Assets (per family)**

| | Hindu | Muslims | | | |
|---|---|---|---|---|---|
| | Fishermen | Landless | Medium | Poor | Rich |
| (Number of families) | (8) | (14) | (11) | (8) | (8) |
| Land (decimels[a]) | | | | | |
| Median | 0 | 8.5 | 66.0 | 126.5 | 242.0 |
| Mean | 0.7 | 9.5 | 65.2 | 135.1 | 295.8 |
| Trees | | | | | |
| Median | 0 | 6.0 | 8.0 | 16.0 | 182.0 |
| Mean | 2.0 | 11.1 | 12.2 | 17.5 | 209.0 |
| Cattle | | | | | |
| Median | 0 | 0 | 0 | 1.0 | 4.0 |
| Mean | 0 | 0.3 | 1.3 | 1.3 | 2.6 |

[a] One decimal = 1/100 acre.

The owners of the alluvial *charr* lands along the Dhanu river live far from their fields and would have to go to great lengths to prevent the removal of *nara* by others during the day. At night, protection of the nara would be virtually impossible. By contrast, since *kher* is carried to the *bari* with the harvested paddy, it would require desperation and audacity to steal it.

The importance the owner attaches to control of fuel also affects its distribution. A middle peasant who owns a distant plot of land lined with *madar* trees may be relatively unconcerned about pilfering of *nara* from this land; but if anyone were to chop down a tree of his or even break off a large branch, he would be most concerned because he planted the madar trees specifically so that his family could have more firewood. Because it is the landed people who assume responsibility for law and order in the village, the illegal chopping down of a tree would be considered a serious breach of village order. The vigor with which the offense would be prosecuted would depend on the social standing of both the owner of the tree and the pilferer. For the most marginal economic and social group in the village, the Hindu fishing people, the possibility of committing such a crime without being discovered would be slim because of their limited mobility within the village; and harsh punishment for such an infraction would be much more likely than it would be for any Muslim.

If a fuel is in short supply and can be easily protected, the owner of the fuel-producing asset controls its distribution, using much of it himself. Transactions in such fuels are likely to be predominantly between families of the same class. If a fuel is highly valued but difficult to protect, its use by different classes is likely to be more similar. Abundant fuels are likely to be the most equitably distributed among different classes; however, a difference in access between the landless Muslims and Hindus is to be expected because of the marginal position of the latter group.

Table 4 presents data on the types of fuels used by different classes in Ulipur.

***a) Sesamun shrub, hanza kuta, grain husks, ghoita, and jute sticks:*** These agricultural by-products are in short supply and are easily commanded by those who own the land and animals. They are used as fuel primarily by the landed classes, and mostly in the six-month period before the amon harvest when fuel is scarce for many villagers.

***b) Doinshah:*** This annual leguminosa with tall, slender stems grows during the monsoon on the small ridges that demarcate the agricultural plots. It is a valued fuel, in short supply, but difficult to protect. The uniform use of *doinshah* by all classes of Muslims is not due to voluntary distribution of the fuel from the rich Muslims to the poor, but results from the fact that it is easy to steal and can be used satisfactorily

**Table 4. Fuel Use by Different Classes During the Study Period**

| | Percent of Total Consumption | | | | |
|---|---|---|---|---|---|
| | | Muslims | | | |
| Fuel | Hindu Fishermen | Landless | Poor | Medium | Rich |
| Sesamum shrub | 0.3 | 0.0 | 1.5 | 10.3 | 10.2 |
| *Hanza kuta* | 1.2 | 3.2 | 10.7 | 8.6 | 16.6 |
| Grain husks | 2.7 | 4.1 | 6.9 | 12.7 | 17.3 |
| *Ghoita* | 0.0 | 1.3 | 5.3 | 3.2 | 4.7 |
| Jute sticks | 0.5 | 1.5 | 0.9 | 0.7 | 4.5 |
| *Doinshah* | 1.4 | 7.5 | 5.3 | 9.3 | 7.5 |
| *Nara* | 25.0 | 38.4 | 26.0 | 33.2 | 19.2 |
| *Lakri* | 46.9 | 26.8 | 31.1 | 9.0 | 10.8 |
| Bamboo | 16.6 | 3.1 | 1.2 | 4.8 | 1.5 |
| Water hyacinth | 0.0 | 4.8 | 1.7 | 1.8 | 1.8 |

over a fairly long period. Hindus use little of this fuel since they seldom go near the cropped lands and have few opportunities for pilfering it.

Despite the frequent pilfering of *doinshah*, farmers continue to grow the plant because, irrespective of who finally uses the stalks for fuel, *doinshah* fulfills other important functions. The stems provide a screen around the paddy field, preventing water hyacinth from entering and damaging the growing crop; the leaves are used for feeding cattle at a time when fodder is scarce; and the plant enriches the soil by fixing atmospheric nitrogen.

***c) Nara:*** In the past there has been a surplus of *nara* after the *amon* harvest in November. But although the fields of the rich and middle peasants still generate more *nara* than these families use themselves, for the village as a whole there is no longer a surplus.

Since the larger landholders have an excess of *nara*, and since guarding of the harvested fields at night would be an onerous task, unauthorized removal of *nara* by poorer people of the village is common. Indeed, some degree of pilfering is "socially acceptable". The larger farmers also often give poorer "clients" permission to clear a portion of the *nara* from their fields. As was shown in Table 2, nara is the only residue that is still distributed in the "traditional", vertical manner; and Table 4 confirms that the use of *nara* does not increase with size of landholding. In fact, richer farmers use less *nara* than the poor Muslims because after the *amon* harvest the rich families have large amounts of *hanza kuta*, comprised mostly of *kher* at this time, available in their *baris*.

The Hindus use *nara* least of all. Because of their marginal status, they are never allowed to take *nara* from the fields of Ulipur farmers during the day. At night, when many landless Muslims steal *nara* from nearby fields, the Hindus are usually busy fishing and have no time to collect *nara*. In addition, the penalty for being caught removing *nara* illegally is much heavier for a Hindu than for a landless Muslim.

The "safety valve" for the Hindus is the *char* land between the village and the Dhanu River. The owners of the *char* lands have ample *nara* closer to their homes and do not care if the Hindus or anyone else takes the *nara* from the *char*.

***d) Lakri:*** It seems surprising that, although the rich peasants own 80 percent of the 1,300 fruit and 800 firewood trees, it is the poor and landless Muslims who use the most *lakri*, or firewood. The anomaly is resolved when attention is paid to the types of *lakri* (which include twigs, branches, and logs) used by different classes and to the seasons during which most *lakri* is used.

Because the *nara* from the previous *amon* harvest is exhausted and the medium and rich peasants use all the residues from their dry-season crops, the six-month period between late summer (May) and the *amon* harvest (in November) is a time of acute fuel shortage for the poor and landless Muslims. The *lakri* twigs scrounged from beneath the trees of the rich and the small branches broken off the madar trees planted along the paths account for about half of the fuel used by the poor and landless Muslims during this period.

The medium and rich families seldom face any fuel problems and seldom resort to such inferior fuels. In pre- and early-monsoon months *lakri* accounts for only 5 percent of their fuel use. During the late monsoon months, before the *amon* harvest, firewood accounts for 28 percent of the fuel used by medium and rich farmers, but their primary fuels continue to be stores of crop residues.

The factors governing the high *lakri* use by the Hindus are quite different. When the monsoon waters start to recede in October, the Hindu fishermen recover trees and branches from the rivers and riverbanks. They continue to collect this *bhaza lakri* until mid-April. *Bhaza lakri* accounts for nearly 80 percent of the fuel used by the Hindus during November, falls to about 22 percent during the four months following the *amon* harvest, and rises again to about 50 percent during April and May. During the monsoon from mid-June through mid-September, when the

Hindus have exhausted their store of *bhaza lakri*, they are forced to buy firewood from the market at Raipur Bazaar. During June, July, and August, *lakri* accounts for 55 percent of their fuel use, and in September and October its share rises to nearly 80 percent of the fuel budget.

***e) Bamboo:*** All classes use this fuel during the pre- and early-monsoon months when other sources of fuel are scarce. Bamboo is particularly important for the Hindus, accounting for 36 percent of their fuel use during this period. The Hindus take most of this bamboo from groves along the river.

***f) Water hyacinth:*** Water hyacinth is available in abundance to all groups in Ulipur. Because the plant is 93 percent water, it has to be dried for long periods before it can be used as a fuel. The Hindus do not use water hyacinth because they have no open space for drying the plant.

The landless Muslims, like the Hindus, face actual fuel shortages, but they have more means for meeting their requirements. Poor Muslims frequently live in *baris* with some families who are better off than they, and since the courtyards are often used communally, space restrictions are less acute for the landless Muslims. Furthermore, in contrast to the Hindus, the landless Muslims are integrated into Ulipur society and so can use the village paths to dry water hyacinth.

As would be expected for an inferior fuel like water hyacinth, consumption of the fuel decreases with income: the landless Muslims use water hyacinth for 5 percent of their fuel needs, while the landed Muslim groups use it for less than 2 percent of their needs. When the latter use water hyacinth as a fuel, it is often a result of feeding water hyacinth to their cattle and using the part that the cattle do not eat as fuel, rather than deliberately collecting it for this purpose.

## ENERGY USE IN HISTORICAL PERSPECTIVE

### *From a Past of Fuel Abundance to a Present of Fuel Scarcity*

Assuming Ulipur to be typical of villages in the flooding plane of the Meghna River of Bengal in the nineteenth century, a picture of the use of energy in the village can be reconstructed from the remarkable statistical accounts of British administrator W.W. Hunter.[20] A hundred years ago, the 43 acres of land owned by the study population probably supported about 75 people. Fish were abundant, the farmers of this area grew more rice than they ate, and produced more jute, oil-seed, and pulses than the land produces today. The number of cattle was probably similar to the number found today, but fodder was plentiful: a quarter of the area was forested, and there were substantial pastures and fallow lands. With the abundance of firewood and crop residues, there was no competition between man and animal for those residues that could be used as fodder. The cattle certainly ate neither water hyacinth (which was only introduced in the early twentieth century) nor other similarly unsatisfactory fodders.

Agricultural relations were typical of the patron-client relationships prevailing through much of the subcontinent. Sharecropping was common and wages were paid in kind. This form of agricultural organization, coupled with the abundance of organic materials, meant that no group in the population experienced any difficulties in collecting *lakri* or crop residues for cooking their food. The acquisition of fuel in rural areas was such a trivial problem that, in his exhaustive description of life in Bengal in the 1870s, Hunter does not mention what fuels were used.

A hundred years later the situation is strikingly different. Patron-client relationships have been largely superceded by market relationships, and over half the population is effectively landless. The human population has increased by 350 percent, while the production of foodgrains and other organic materials has remained more or less static. The increased cropping intensity (from 140 percent to 200 percent) has been accompanied by reduced yields and has been at the expense of forests and pastures. While those who own sufficient land produce the food needed to feed their families, the poor are largely dependent on sources outside the village for the production of the food they eat. Over half of the foodgrains eaten by the study population are imported.

Since cooking technology has not changed, the requirements for fuel have risen about as rapidly as the number of people. Competition for the organic materials produced by the land has become intense; the number of village trials arising from disputes over the ownership of trees and crop residues is large and growing. The marginal social and economic groups are denied access to organic materials on which they previously depended for fuel and are forced to purchase fuel from the market. Given the inflexible requirement for cooking fuel, animals are fed less and are fed inferior fodders (such as water hyacinth), and the amount of organic materials returned to the land is reduced. The consequences are that the animals are unable to plough as well, and the fertility of the soil is reduced, meaning that crop yields continue to fall.

## *The Future: More Energy-Intensive Agriculture Bringing Wealth for Some and More Acute Poverty for Most*

In Ulipur, the 43 acres cultivated by the study families produce $530 \times 10^6$ kilocalories of energy annually. Since the incident solar energy is $6.3 \times 10^6$ kilocalories per acre per years,[21] 0.20 percent of the incident annual solar energy is captured. Surprisingly, this efficiency is similar to that of agriculture in the Punjab and twice the average efficiency for Bangladesh.[22] This does not imply that Ulipur agriculture is "as good as" agriculture in the Punjab, for while food accounts for only 16 percent of the gross energy product in Ulipur (and residues the remaining 84 percent), food accounts for 30 percent of the gross energy product in the Punjab. Since a calorie of rice fetches about ten times the price of a calorie of firewood, Punjabi agriculture is much more profitable. The surprisingly high efficiency of energy fixation in Ulipur agriculture is the result of the high cropping intensity of 200 percent and the large contribution (43 percent of the total fuel used) of rice straw from deep-water *amon* paddy.

Each calorie of food eaten by the people of Ulipur requires three calories of fuel and one calorie of fodder for cattle. The ratio of residues required to food required has been substantially lower than the ratio of residues produced to food produced in Ulipur because deep-water *amon* paddy produces about five kilograms of straw for each kilogram of grain. Consequently, although the area stopped being self-sufficient in food in the late 1940s, the era of fuel self-sufficiency persisted for another 15 or 20 years. Today the land farmed by the study population provides only 46 percent of the food eaten by the population, but 75 percent of the fuel used and 100 percent of the cattle fodder.

Agricultural practices in Ulipur will change dramatically in the near future, since the Water and Power Development Authority (WAPDA) is constructing a major embankment in the area. The project is designed to provide flood protection and to facilitate better drainage and irrigation practices so that cropping intensity may be increased and high-grain-yielding crops cultivated. As is implicit in the comparison between agriculture in Ulipur and the Punjab, the effect of increasing energy and useful work inputs in Ulipur agriculture is unlikely to be an immediate increase in the total fixation of solar energy. Rather, the effect of improved water control and increased use of fertilizers will be a pronounced shift from the production of residuals to the production of food. The greatest single factor in this shift will be the replacement of deep-water *amon* paddy by short-stem, high-grain-yielding varieties once the WAPDA embankment is completed. Despite this short-term anomaly, there is no doubt that medium- and long-term increase in the capture of solar energy can take place only when there are substantial increases in useful work in the form of the appropriate use of irrigation water, fertilizers, pesticides, and improved draft power. These same changes offer the possibility of alleviating the unalloyed human drudgery on which the present agricultural system is based.

For those who have significant landholdings and access to credit, fertilizer, and other inputs necessary for "modernized" agriculture, the future looks bright. They are presently producing more crop residues than they need for their own purposes. Since there is no incentive for these farmers to produce fuels for the poor, upon completion of the WAPDA embankment scheme they will switch to crop varieties that produce more grain but that will still yield sufficient residues for their own use.

The effects of the impending changes on poor and landless people will be quite different. Analysis of data from other areas of Bangladesh and India where similar changes have taken place leaves little doubt about how the poor will be affected. The number of landless people will continue to grow as landholdings continue to become more concentrated; migrant labor working for cash contracts is likely to displace much village labor; the real wages of agricultural laborers will fall; relations between families will become more strictly economic; and class cleavages will become more pronounced. As is happening to the Hindus of Ulipur now, many of the landless will be driven out of the village because they no longer serve any useful purpose to those who control the resources.

The landowners have responded to the scarcity of crop residues by ceasing to distribute residues to the poor and by prosecuting those who illegally remove residues from their fields. The replacement of deep-water *amon* (with a residue to grain ratio of 5:1) by high-yielding varieties (with a residue to grain ratio of 1:1) will drastically reduce the amount of rice straw that is generated. Furthermore, all of the rice straw will be carried to the *baris* of the owners when the crop is harvested, making it impossible for the poor to continue pilfering straw.

The poor and landless Muslim agriculturalists will be forced to buy fuel from the market. In 1978 the price of husked rice was about Tk 3 per kilogram (100 *takas* = US$0.67) and the price of firewood between Tk 10 and Tk 18 per *maund* (37 kilograms) in rural areas.[23] Each day the average villager eats 1,600 kilocalories of food and uses 4,800 kilocalories of fuel to cook this food. If all food and fuel is purchased, in a year this would amount to Tk 474 for rice and Tk 170 for fuel. These large expenditures on fuel are already the norm in the hills of Pakistan and Nepal, where villagers spend one-quarter of their incomes on fuel.[24]

Poor families in Bangladesh typically spend about 90 percent of their incomes on food. If they had to purchase the fuel that they presently collect for nothing, with their incomes unchanged they would have to reduce their caloric intakes to below 1,200 kilocalories daily. For the Hindus of Jelepara this process is already well advanced. For every Tk 100 spent on food they spent Tk 10 to buy firewood. This phenomenon, of fuel shortages leading to reductions in food intake, will become a reality for many more poor Ulipur families within a few years. The actual situation may be even more desperate than depicted above, since concomitantly agricultural wages will probably continue to decline and fuel prices will rise as the demand for commercial fuels increases.

## POLICY IMPLICATIONS

In short, modernizing agriculture in Bangladesh is both essential and, *given the present social and economic structure*, disastrous for the majority of the population. Many poor people in rural Bangladesh are already suffering as a result of energy scarcities. This analysis suggests that many more are going to suffer, and that many will die from deprivation consequent to a further reduction in available fuel. Where suffering is acute, reforms designed to reduce this suffering seem essential. All reforms are not equal, however: reforms may be promulgated as measures designed for the poor yet end up serving the rich and powerful; reforms may provide small material improvements, while leaving intact the political and economic structures responsible for the suffering; or reforms may expose structural inequities and prepare the ground for changing these structures. This study provides information for assessing the nature of reform implicit in different energy programs.

The standard method of assessing energy problems in rural areas of poor countries has been to compare the projected aggregate supply of energy with the projected aggregate demand for energy.[25] This method implicitly assumes some type of homogeneous, harmonious, and cooperative village social structure in which those who own the means of energy production share the energy produced with those who own no energy sources.

The consequences of this "apolitical" approach to energy planning are illustrated by the experience of the *gobar* (cow dung) gas plant program subsidized by the government of India. Although this is a national program in which over 50,000 plants have been installed, the plants have been widely adopted only in "progressive" areas of Gujarat, the Punjab, and Haryana. These are areas where traditional agricultural relationships have been transformed, primarily as a result of adoption of the new seed varieties. Evaluations in Gujarat[26] have revealed the following effects of the program:

(1) The average *gobar* gas plant owner is literate, has 26 acres of land, 10 head of cattle, and an annual income of US$1,000.
(2) Among those who installed gas plants, 40 percent had subsidiary occupations such as business or government service, while none of the non-plant owners of equivalent social status had any such subsidiary occupation. This suggests the rich who have severed their traditional ties are able to mobilize their resources for their own use more easily than the rich whose relationships are more traditional.

A similar "apolitical" planning philosophy underlies the recommendations of the Bangladesh Energy Study for increasing the supply of traditional fuels by encouraging the planting of trees on unused land and expanding the program of seed distribution.[27] These recommendations overlook the fact that it is only the rich who have spacious homesteads and many trees — in Ulipur 16 percent of the families own eighty percent of the trees — while it is the poor who suffer from the scarcity of fuel. Such recommendations fail to distinguish between the effects of absolute pressure of people on resources and the effect of differential access to these resources. Ostensibly designed to help the poor, such programs end up reinforcing the structures responsible for their poverty.[28]

What alternatives are there? Although, given the present social relations of production, the alternatives are indeed limited, this study does indicate some energy-related programs that would benefit the poor.

It is the poor of Ulipur who are forced to buy fuels, and therefore it is they who would benefit most from a national policy that would lower the price of these fuels. Such policies could include the more efficient use of state forests for the production of firewood and subsidization of the rates at which that wood is sold.

Inexpensive solar dryers for drying fuels would benefit the poor, but it is equally clear that if these dryers were distributed through the regular channels (such as the "cooperatives") they would be more likely to benefit the powerful instead. The difficulty in bypassing the rural elite should not be underestimated. As has happened in many other Swarnivar villages,[29] the "landless" subcommittee of the Ulipur Swarnivar program was chaired by a member of the largest landholding family. As Ali Sardar's brother explained: "You know these landless people are illiterate and ignorant, they need an educated person to manage their affairs".

In the few cases where organized groups of the poor exist, bio-gas plants might also have a positive role to play, the Indian experience notwithstanding. A bio-gas program for the poor would stress communal rather than individual units and would recommend appropriate mixes of the raw materials that are available to the poor in different regions. In Ulipur the likely raw materials would be water hyacinth and the excreta of families using the plant.

A striking characteristic of the energy system in Ulipur is the central role played by women: the major use of energy is for cooking food, which is a woman's task in Bengal; it is women and children who collect most of the fuel; it is women who construct the *chulahs*. No program is immune to co-option by the rich, but, because the wealthy women of the village do not work, a takeover by the rich would be unlikely if an energy program were specifically designed for groups of rural working women. Again, specific attention needs to be paid to the problem of class. It is common in Bangladesh to have an elite city woman or even a foreign woman representing "the interests of women". It is essential that poor women themselves become directly involved in the planning and execution of such projects.

Because fuel for cooking is a major use of energy and because the efficiency of fuel use in *chulahs* is only about 15 percent,[30] analysts of rural energy use in the Indian subcontinent have advocated the use of improved stoves as a major energy conservation method. For 20 years the "Hyderabad chulah", reputedly giving efficiencies of about 30 percent, has been available and yet apparently is not widely used. A logical first step in trying to improve the efficiency with which fuel is burned in rural India and Bangladesh would be to evaluate the experience of the Hyderabad *chulah*, to determine how many people now use it, what the social and economic status of these people is, and why the use of a technology that is apparently such a boon has not spread rapidly.

The major obstacles to the success of the solar dryer, bio-gas plant, and women's programs outlined above are not only technical but also political. Because organized groups of poor people threaten the privileges of wealth and power of the dominant classes of society, these groups are suppressed and thus rare. Given the internal and foreign political basis of the government of Bangladesh, it is, the rhetoric of the government notwithstanding, highly unrealistic to expect the state to support such organized groups of poor people or to target programs to them. Consequently, such programs would be most successful when funnelled through the handful of progressive nongovernmental Bangladeshi organizations and necessarily would be very limited in scope.

One perspective on the problem of poverty in Ulipur is that the landless and poor households do a lot of work but with very low returns. To reduce this enormous drudgery what is needed is higher productivity of work, which can only be achieved when energy is used more efficiently. A large part of this change involves the substitution of inefficient human and animal energy with more efficient forms of energy. While a substantial part of these energy needs could eventually be met by the more efficient use of bio-mass and by the direct use of solar energy, energy derived from fossil fuels has a vital role to play in both improved agricultural productivity and in the equally important development of productive rural and small-town industries.

This energy could be provided by the substantial reserves of natural gas in Bangladesh. However, it is likely that much of the gas will be liquified and exported, thus benefiting only the urban elite and the developed countries on which the government of Bangladesh is dependent and strengthening those groups who oppose social change in Bangladesh.[31]

The effect of agricultural and other modernization on the poor depends on the social and economic structure in which the transformation takes place. In Indian villages, the poor have suffered further deprivations as a result of the "Green Revolution", whereas evidence indicates that in Vietnamese villages the benefits of modern agricultural technology have been much more widely distributed.[32] The lesson is that there can be a solution to the rural energy problems in Bangladesh, but only in conjunction with a resolution of the problems of inequity and power.

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# NOTES

1. On energy use in the Indian subcontinent, see Montreal Engineering Co., Ltd., Snamprogetti S.p.A., Meta Systems Inc., and C. Lotti and Association, S.p.A., "Bangladesh energy study", for the Government of the People's Republic of Bangladesh, administered by the Asian Development Bank under the United Nations Development Programme Project, November 1976, Main Report; Roger Revelle, "Energy use in rural India", *Science* 192 (4 June 1976): 969-975; and R. Tyers, "Optimal resource allocation in transitional agriculture: Case studies in Bangladesh," Ph.D. dissertation, Harvard University, January 1978.

2. Colin McCord, "What's the use of a demonstration project?," paper presented at the Annual Meeting of the American Public Health Association, Miami, and reproduced by the Ford Foundation, Dacca, 1976.

3. In understanding how fuels are produced and how and why social relationships influence the production and distribution of energy in the village, an intimate, if informal, knowledge of village life was at least as important as the quantitative information collected. The author speaks Bengali and lived in Ulipur for one year, while his collaborator and principal field worker comes from a poor peasant family in Ulipur.

4. John Briscoe, "The political economy of energy in rural Bangladesh", *Occasional Paper*, Environmental Systems Program, Harvard University, August 1979.

5. Revelle, cited in note 1.

6. A.V. Desai, "India's energy consumption: Composition and trends". *Energy Policy* (September 1978): 217-230.

7. Institute of Nutrition and Food Science, "Nutrition survey of rural Bangladesh, 1975-1976", Dacca University, December 1977.

8. Mead Cain, "The economic activities of children in a village in Bangladesh", *Population and Development Review* 3, no. 4 (September 1977): 201-228; and A. Farouk and M. Ali, *The Hardworking Poor: A Survey of How People Use Their Time in Bangladesh* (Bureau of Economic Research, Dacca University, 1975).

9. Desai, cited in note 6.

10. Revelle, cited in note 1.

11. Beteille suggests the following framework for categorizing classes in a society like Ulipur: "In an agrarian society land provides an important basis for social cleavages. This is particularly true in those areas, like the region of wet paddy cultivation in India, where the agricultural population contains a large proportion of people who are landless. Those who own land not only maintain a better standard of living than the landless, but the former can exercise a direct control over the livelihood of the latter because of the scarcity of land. In this sense the relations between the landowners and the landless are at once economic and political." Beteille has also suggested that class can be understood, not as an abstract and formal scheme, but as a system of social relations only by using the concepts and categories used by the people themselves. [See A. Beteille, *Studies in Agrarian Social Structure* (London: Oxford University Press, 1974).]

In Ulipur the Majumdar family alone is referred to as a Zamindari family. The bulk of the peasants are divided into those who own their land *(krisaks)* and the landless. Although a few families are sharecroppers only, most land that is sharecropped is sharecropped by land-holding farmers. Landowners in Ulipur are described, by the people themselves, as *Dhoni*, *majhari*, or *garib krisaks* (rich, medium, and poor farmers).

Although the dividing lines between rich, medium, and poor peasants are not precise, those that most closely correspond to the classifications used by the villagers themselves have been chosen. The 14 Muslim families who own less than 30 decimals of land are classed as "landless", the 11 families who own between 30 and 95 decimals are "medium farmers", and those 8 families whose landholdings exceed 2 acres are considered "rich".

12. F.R. Wolf, *Peasant Wars of the Twentieth Century* (New York: Harper & Row, 1969).

13. M.N. Srinivas, *The Remembered Village* (New Delhi: Oxford University Press, 1976).

14. Evidence of such change cited in the paragraphs that follow is drawn largely from E.J. Clay, "Institution change and agricultural wages in

Bangladesh," *The Bangladesh Development Studies* 4, no.4 (October 1976): 423-440; M. Alamgir, "Bangladesh: A case of below poverty level equilibrium trap", Bangladesh Institute of Development Studies, December 1976, mimeo; and A.R. Khan, "Poverty and inequality in rural Bangladesh," *in Poverty and Landlessness in Rural Asia* (Geneva: International Labour Office, 1977), especially pp. 137-160.

15. Government of British Burma, *Report of the Land and Irrigation Committee* (Rangoon: 1938), p.51.

16. "Nutrition survey of rural Bangladesh, 1975-76", cited in note 7.

17. J.C. Scott, "The erosion of patron-client bonds and social change in rural South East Asia", *Journal of Asian Studies* 32, no.1 (November 1972): 5-37.

18. The detailed calculations are presented in Briscoe, cited in note 4. To illustrate the way in which Table 2 should be read, consider the case of sharecropping. Ignoring, for the moment, the "actual" vector, it can be seen that the elements of the columns vary monotonically as the paradigm changes from "vertical" to "class-neutral" to "horizontal". When the "actual" vector is compared with the vectors for the three paradigms, it can be seen that there is only one position in which the "actual" vector could be placed while preserving the monotonic progression in the columns. For instance, in the first column the monotonic progression now reads 14, 10, 8, 6. What this placement suggests is that the actual transactions in sharecropping land are as expected in a society in which patron-client relationships are weakened and "horizontal" transactions are most common. For each of the other transactions, too, there is a unique position for the "actual" vector that preserves the monotonic progression in the columns.

19. Desai has come to a similar, although slightly stronger, conclusion in a recent analysis of National Sample Survey data in India. He found that in both rural and urban areas the per capita consumption of fuel did not rise with the level of total expenditure except for the highest expenditure group. A.V. Desai, "India's energy consumption; Composition and trends," *Energy Policy* (September 1978): 217-230.

In the Ulipur study, seasonal variation in fuel use was more marked than class variation. Thus, the amount of fuel used per kilogram of foodgrain cooked was lowest during the late monsoon period (September-

November). In the period following the *aus* harvest (July-August) 20 percent more fuel was used per kilogram of foodgrain, and following the *amon* harvest (December-February) fuel use was 25 percent higher. These increases can be accounted for by the fuel used for parboiling paddy, suggesting that there are not major seasonal variations in the efficiency of the use of fuel for cooking.

20. W.W. Hunter, *A Statistical Account of Bengal, Vol.V, Dacca, Bakarganj, Faridpur and Maimansinh* (London: Trubner and Co., 1877).

21. A.K.N. Reddy and K.K. Prasad, "Technological alternatives and the Indian energy crisis," *Economic and Political Weekly,* Bombay, August 1977, pp.1465-1502.

22. For the Punjab, See A. Makhijani and A. Poole, *Energy and Agriculture in the Third World* (Cambridge, Mass.: Ballinger Publishing Co., 1975). For Bangladesh, see Tyers, cited in note 1.

23. M.N. Islam, "Strategy for rural energy survey in Bangladesh", paper presented at the Institution of Engineers, Dacca, December 1976.

24. On Pakistan, see Roger Revelle, "Flying beans, botanical whales, Jack's beanstalks and other marvels", *The National Research Council in 1978* (Washington, D.C.: National Academy of Sciences, 1978), pp.173-200. On Nepal, see Revelle, "Energy sources for rural development," paper presented at the Conference on Energy Alternatives of the U.N. University, East-West Center, Honolulu, January 1979.

25. See the sources cited in note 1.

26. Srinivas, cited in note 13.

27. Montreal Engineering Co. Ltd., cited in note 1.

28. Robert Cassen, "Welfare and population: Notes on rural India since 1960," *Population and Development Review* 1, no.1 (September 1975): 33-70.

29. S. de Vyler and D. Asphund, "Contradictions and distortions in a rural economy", Policy Development and Evaluation Division, Swedish International Development Agency Stockholm, 1979.

30. Briscoe, cited in note 4.

31. N.M.J., "Murder in Dacca: Ziaur Rahman's second round", *Economic and Political Weekly*, Bombay, 25 March 1978, pp. 1-8.

32. K. Gough, "The Green Revolution in South India and Vietnam", *Monthly Review* 29, no.8 (January 1978): 10-21.

# III.2

# THE DEMAND FOR FUEL: ECOLOGICAL IMPLICATIONS OF SOCIO-ECONOMIC CHANGE

Lee Horne

Dryland ecosystems are characterized by sparse vegetation with a low and widely variable annual productivity. Nevertheless, throughout the Middle East this sparse vegetation is an essential resource upon which depend the livelihood and very biological survival of the local populations. Pastoralism is a major means by which this natural resource is exploited and has been the focus of much technological and anthropological research. An equally essential aspect of the relationship between settlements and environment is the collection of woody vegetation for fuel — equally essential to the populations involved but, in the Middle East at least, hardly studied at all. This chapter explores the requirements and consequences of energy supply and consumption in Khar and Tauran and aims to show that behind average annual fuel consumption figures lies a multiplicity of factors influencing levels of demand and intensities of exploitation.

## THE CONTEXT OF FUEL USE IN KHAR AND TAURAN[1]

Although this study focuses on the settlements of the Tauran Plain, continuous reference is made to the entire Khar and Tauran area (about 3300 km²) which is the more relevant territorial unit for the study of the production and use of fuel.

About half the population of 2500 live in mud-brick villages on the Tauran Plain, and about a quarter live in Khar in three villages on the western side of the sand sea. Most of the rest are scattered to the east and south of the central plain. In 1966, the most recent year for which complete census data are available, there were 15 year-round settlements on the Tauran Plain, including the village of Baghestan where most of the data presented in this chapter were gathered. These villages ranged in size from 11 to 178 persons (mean 80.4) and all but one were less than 2 hectares in extent. Mean household size was 3.9 persons. The Plain as a whole held 10 persons per square kilometer, 1206 persons living in 307 households. The population has increased since 1966 but probably to no more than 1350 (11 persons per square kilometer) at most.

Several villages maintain summer milking stations on the lower parts of the Plain where pasture and firewood are most plentiful. There is only a single winter station on the Plain: during the colder months flocks are either kept at the villages or taken away from the Plain entirely. In summer at least 20 and perhaps 30 households move to summer stations on the Plain and the population becomes more dispersed. Those who leave the Plain entirely move 20 kilometers or more away to where they have rented or bought rights to rangeland which is more productive than the Plain. All these families have been counted in with their home villages in the figures given above.

In addition to those on the central Plain, there are three relatively large villages (mean size 228 persons) in Khar to the west of the sand sea, and a scatter of small outlying settlements throughout the rest of the district. In 1966 outliers ranged between 1 and 17 households with a maximum of 82 persons at any single one, and with a mean size of 31.1 persons. These villages are proportionately smaller in area than the central ones. Khar and Tauran as a whole, including the outliers, contained 0.8 persons per square kilometer in 1966 (2530 persons over 3300 $km^2$).

Most of the impact on the environment around these rural settlements comes not from the amount or type of land given over to residential occupation or irrigated fields but from the use of the natural vegetation as a productive resource.[2] On the Plain, for example, no more than 25 hectares are covered by the structures and spaces of the villages. If abandoned sites with standing ruins and a few seasonal shelters and stations are included, then perhaps another 5 to 10 hectares should be added to this figure. The total is no more than 0.3 percent of the Plain's area. Irrigated fields account for more: about 250 hectares, which still is only 2 percent of the Plain. Even dry farming, the most extensive form of agriculture, probably never exceeds 8 percent of the Plain's surface (although at one time or another a much higher percentage appears to have been ploughed and sown). Settlements and field systems off the Plain are even sparser. Thus, even though residential land and fields are completely cleared of natural vegetation, they comprise relatively little of the area. That leaves well over 90 percent of all land in Khar and Tauran available for exploitation as pasture, fuel and construction material. The productivity of this resource is the concern of the research reported here.

## FUEL USE ON THE TAURAN PLAIN[3]

Firewood, paraffin and farming by-products (such as dung and cotton stalks) are all used for fuel in Tauran. Of these, firewood is the most important in terms of the total number of calories. According to estimates made during the period from 1975 to 1978, firewood is burned at an annual rate of 5.3 tons per household. Paraffin is of relatively recent introduction. Its use is widespread and significant, but limited to certain activities — meal preparation, space heating and lighting in particular. Dung and agricultural by-products are used only incidentally for fuel: dung is used primarily to fertilize and condition irrigated fields. This section details the use of these three fuels in Tauran today as a background for assessing the impact of the local vegetation and as a baseline for understanding how both energy demands and environmental impact have fluctuated in the past.

Fuel is burned in Tauran today for two main purposes: winter heating and food preparation, whether year round cooking or seasonal processing. It is also used in lesser quantities to heat water and to burn gypsum plaster. The equipment used varies with the activity and the fuel. Wood-burning space heaters (*bokhari farangi*) are bought in the city and are made from metal drums, with doors cut into the sides for loading and draught. They are set in the centre of the living room and plastered to the floor, usually in conjunction with a shallow hearth for coals from the heater which are used for cooking and tea-making in the winter. In the summer they are often removed and stored in another room. A narrow stovepipe vents the smoke through a hole in the domed roof. Only the main living-sleeping room is heated, a space about 35 to 40 $m^3$ on the average. *Korsi,* frames supporting an arrangement of quilts heated from underneath by charcoal or dung, are common in colder areas of western and northern Iran, but are not found in Tauran. Almost no one today uses wall fire-places (*bokhari geli*) though some can still be seen in older houses. Paraffin camp stoves are also used for heating, but supplement rather than replace wood stoves. Milking stations occupied only in the summer need no provision for heating; winter stations rely on interior multi-purpose open hearths which burn firewood — they are too isolated to depend on paraffin supplies.

Although clothes are sometimes washed in the cold water of an irrigation channel or storage pond (the villages have no piped water), bathing and clothes washing are often carried out at the same time, and large cauldrons of water are set up over brushwood fires at the water sources. Hot water is dipped out and poured over the body, after which the clothes may be soaked directly in the cauldron or scrubbed in pans. In the village of Baghestan, only two courtyards had private showers; the water was heated from a recess on the outside of the shower building in one case and from a hearth on the roof in the other. Water was hauled up to storage drums on the shower roofs and piped down by gravity into the shower room. The traditional village bath house (*hammam*) in the area is a communal structure, semi-subterranean and of the style sometimes called Turkish, with seating platforms and niches, arched vaults and several chambers of water. Ordinarily it is used only in the winter, when men are hired to collect firewood. The one in Baghestan has fallen into disrepair in anticipation of a modern, government subsidized bath house already under construction in 1978; it will use water lifted from the irrigation channel by a diesel pump and heated by paraffin.

The other major fuel need is for cooking, both for immediate consumption and for storage. Storage products are important in this climate because of the pronounced seasonality of crops and milk and because of the lack of refrigeration facilities. In order to carry almost any food except grain through the winter some kind of drying (often aided by heating) or cooking is necessary. In this way surpluses beyond what is eaten in season can be used to supplement wheat products during the rest of the year. Furthermore, preserving food in transportable, imperishable form facilitates exchange with other communities or sale of surplus in distant markets.

Cooking with firewood is done mainly over open hearths (*kalgah*) and in bread ovens (*tanur*). Outdoor hearths and bread ovens are mud structures built in unroofed courtyards, sometimes hooded by a small domed roof. Hearths are variable in diameter and tailored to the size of the copper pots used. In summer stations these pots hold 120 to 180 kilograms of milk, and are plastered to their hearths, increasing the efficiency of the heating process. In villages and at summer station hearths where ordinary meals are cooked, hearths are usually built side by side in pairs, one large and one small. Cooking involves frying, boiling and stewing; roasting is never done, even for community feasts.

Whilst most villagers can build hearths, bread ovens are more complex and require the aid of part-time specialists. Not every village has an oven-builder, but one can be brought in from nearby. In villages bread ovens are above-ground structures about a meter high, with enough room for the baker to squat on top and reach in to slap flat sheets of bread dough against the hot walls of the clay chamber, which is lined with a fine local clay of ceramic quality. There were 6 to 8 ovens for the 33 households in Baghestan; each housewife would probably like to have her own, but they are not high on the list of domestic priorities. Sharing in fact saves fuel since women try to bake while the oven is still hot from the previous baker's firing. There is no particular pattern to the social relationships in sharing, though usually the women are close through kinship or marriage. In summer stations, bread ovens are usually sunk into the ground, simplifying construction where specialists are not available.

Grape syrup *(shira)* for domestic consumption and for sale is processed from surplus grapes in the autumn. Special oversize hearths are built in the grape gardens to boil down the grape juice — a process taking hours of heating. Not every household grows enough grapes to make this syrup, nor can it be made when the grape harvest fails. With improving transportation facilities to the city, it is likely that surplus grapes will be sold directly rather than being processed into syrup. Tomatoes are preserved by boiling down into a paste *(robb).*

Firewood collection is primarily a domestic, non-commercial activity carried out at irregular intervals without records of any kind. Observed and reported collecting activities were counted in terms of donkey loads, but were not actually weighed. Informants claimed that an average load of dry firewood weighs 75 kilograms (25 *man* in the local system of weights) but they do not ordinarily weigh them. They also say a donkey load of grain in sacks weighs between 75 and 90 kilograms, and unlike firewood, grain is weighed out on standard steelyard scales. Bundles of firewood are unwieldy and less compact than sacks of grain and probably do weigh somewhat less per load. A figure of 75 kilograms was therefore used in these calculations. In somewhat the same fashion a camel load was figured at 200 kilograms. Both figures are within the range given for these animals in other sources, most of which are as much estimates as ours.

Brushwood for fuel is, whenever possible, collected by men: women who have no adult male household members in residence hire men to collect for them. The round trip may take up to half a day and requires travelling several kilometers outside the settled areas. Since a household averages six collection trips a month (less in summer, more in winter) roughly 36 days per year are required to collect firewood. Usually, whole bushes are uprooted with an *adze*, bound into large bundles and balanced on the back of a donkey for the return trip. Women carry firewood on their heads. Generally, people collect wood where they, their kin or their village have grazing rights. There are no other locally imposed management practices.

Firewood is normally stored in roofed storerooms or unused stables, protected from rain, animal browsing and, probably, official eyes, since much of the firewood is green and therefore illegally collected. Usually no more than a donkey load is kept on hand at any one time — two bundles roughly 1 to 1.5 $m^3$ each. At milking stations firewood is used as fast as it is collected and women help with the collecting.

Firewood is collected without cost except for the equipment used (an adze, rope, and a donkey). Paraffin, however, must be bought from the local distribution centre in the village of Zamanabad. From Baghestan the trip by donkey is only 3 kilometers and takes an hour there and back, but for villages at the back of the plain paraffin is much less convenient to obtain. In 1976-78 paraffin cost 2.5 rials a liter ($US.035) in Zamanabad.

The usual social unit for collecting and using firewood is the household, which in Tauran corresponds to a nuclear family, sometimes extended by one or more unmarried adult relatives. As mentioned above, firewood consumption for an average village household is estimated at 5.3 tons per year. In Baghestan (1976-78) average household size was 5.1 persons: the 1966 Census figure for the entire Plain was 3.9 persons per household. Projecting Baghestan's mean annual firewood consumption rate per household to the entire Plain (310 households) produces an estimate of 1650 metric tons per year (dry weight). Per capita figures, sometimes needed for comparative purposes, would be one ton per person if the figure of 5.1 persons per household is used, and 1.4 tons per person if the figure of 3.9 persons per household is used. Using household rather than individual statistics, however, is preferable and more directly representative of actual behavior. Furthermore, the way firewood is used in Baghestan and elsewhere (see for example Earl 1975; Fleuret and Fleuret 1978) suggests that in villages, economies of scale operate at the household level. That is, in similar situations, fuel use varies less between households of different sizes than average per capita figures would suggest.

Because pastoral products (such as yoghurt, clarified butter, and concentrated buttermilk) require so much heating and boiling, summer milking stations use significantly greater quantities of firewood per household than do villages. The milking station included in the sample had about 250 milkers (sheep and goats) and uses 21 tons of firewood per summer. The residential population was composed of members from several Baghestan households who pooled their animals. Taking 2.5 as the average number of households at that station, consumption was about 8.4 tons per household for those five months of spring and summer. When winter firewood use back in the village is included, each of these transhuman households used 12.1 tons per year — a total of 6.8 tons more per year than for a sedentary household from the same village. If 25 households spend their summers at milking stations on the Plain, and if they use similar quantities, then 170 tons of firewood should be added to the total.

There are several alternatives to firewood. As mentioned above, dung is sometimes used, but its primary value is as fertilizer or in construction. Other agricultural by-products are used in minor quantities. For the last twenty years or so, however, paraffin has been an important substitute for firewood in the area. An average household in Baghestan uses 500 to 800 kg per year, depending on the severity of the winter and the need for space heating. Other things being equal, households would burn 25 percent to 40 percent more firewood to replace the calories now supplied by paraffin. Of course, some of this paraffin is used for lighting, replacing lamp oil rather than firewood.

Diesel fuel is used in the one modern bath house and several mills, and petrol for an increasing number of motorcycles and other vehicles. Except for the bath house supply, these uses do not replace traditional fuels and were not included in this study.

## THE ECOLOGICAL IMPACT OF FIREWOOD CUTTING IN TAURAN

A description and preliminary mapping of plant species and communities in the Tauran Biosphere Reserve appears in the case study report of the Tauran Programme (Iran 1977). Species observed or reported to be used as fuel include *Amygdalus* spp., *Artemisia herba-alba, Astragalus squarrosus, Calligonum spp., Ceratoides latens, Convovulus, Cousinia* spp., *Ferula foetida, Goebelia pachycarpa, Haloxylon spp., Lactuca orientalis, Lycium depressum, Salsola spp., and Zygophyllum eurypterum.* Most of these do not die back in the winter, but need their above-ground parts for viability and production. Some of them, especially *Artemisia, Armygdalus, Calligonum, Lactuca and Salsola,* are also eaten by goats or sheep. (The degree of competition for vegetation between people and animals is considered in Spooner et al. 1980.)

Measured biomass and annual production figures are not available for the areas which provide firewood to Khar and Tauran, but some estimates based on harvesting and weighing were made for two tracts near Delbar, 75 km to the west. In one, *Zygophyllum eurypterum* shrubs were estimated at 2.6 tons per ha (above ground, air dry biomass); in the other, *Artemisia herba-alba* shrubs were calculated at 1.17 tons per hectare (Bhadresa and Moore 1982). Different kinds of *Zygophyllum and Artemisia* communities are widespread throughout Khar and Tauran, constituting perhaps one half the total area. Visual estimates for all major communities in Khar and Tauran, including these ranged from 1.0 to 6.0 tons per hectare, *Zygophyllum-Salsola* communities averaged 3.0 tons per hectare and *Artemisia-Amygdalus* communities 1.6 tons per hectare (Breckle 1982). Coupled with extrapolations based on plant cover and densities in transacts run on the Tauran Plain itself (Nyerges 1980), these figures suggest an average biomass of 2 to 3 tons per hectare for plains and stable sand vegetation, with the higher weights found in the sand. Variation is high, however, and some areas are virtually devoid of vegetation, while others may have biomass as high as 8.0 tons per hectare (Helmut Freitag, personal communication). Comparative estimates for similar conditions elsewhere in the Middle East and Afghanistan also support a range of 2 to 3 tons per hectare.

Productivity is much more difficult to estimate. For these shrubby communities, average annual production is likely to be on the order of 200 to 800 kilograms per hectare, based on average annual rainfall and comparative data where productivity was measured directly (for example, McArthur and Harrington 1978; Thalen 1979; and Casimir et al. 1980).

At present, firewood for the Tauran Plain is collected from an area somewhere between 120 $km^2$ (roughly coincident with the Plain itself) and 200 $km^2$, based on collection and travel times and in *situ* observations of cutting. Although nearly all firewood is collected from within this area, cutting is not uniformly distributed. Most collecting takes place at the edges of and beyond the Plain itself for two reasons: (1) the Plain, especially the central zone, offers very little brush suitable for firewood and (2) the risk of discovery and confiscation is far greater next to settlements. During periods in which control is enforced and paraffin is available for cooking and tea-making, collection takes place mostly in a fan-shaped area including moving and stable sand that lies to the north of the Plain, where shrubs are plentiful and the chances of being caught slight. Only when paraffin supplies run out at the local distribution centre is it worth collecting on the Plain proper. Then, however, the entire area is scoured for whatever will burn.

The villages on the plain annually remove 1820 tons of brush over these 200 $km^2$, or 91 kg per hectare. Even though per capita use of fuel is highest at summer stations, those settlements are much more dispersed, and the number of households at each one much less than at the central villages so that the intensity of collection is correspondingly less. Winter sheep pens use the least amount of fuel per capita and are suitably dispersed rather than clustered. The villages on the Plain put the heaviest burden on plant productivity.

If these 200 square kilometers have an average above-ground biomass of 2.5 tons per hectare, roughly 4 percent of all plant material is cut annually for fuel. Or, to put it another way, a biomass equivalent to that of 723 hectare is removed each year. If shrubs of the type used for fuel take five to ten years to grow to suitable size for cutting (Thalen 1979:274) removing 4 percent of the biomass annually might be tolerable. But several qualifying factors must be taken into consideration:

(1) For domestic consumption, brush is not uniformly or randomly cut over the 200 $km^2$ from which it is collected. The area nearest settlement tends to be totally stripped of suitable shrubs, the farther reaches more lightly used. For a very small settlement, less than 100 hectares might be severely affected (probably the case at small summer stations) and recovery is still possible should the settlement be abandoned or moved. For an area the size of the centre of the Tauran Plain the consequences for regeneration are of a much more serious scale.

(2) Plants are differentially selected. Where there is a choice, some shrubs are preferred over others for their burning qualities, odour, smokelessness and so forth. Certain species may become scarce or absent because of their preferred status as fuel. In any case, even where the biomass is mostly shrubby, it is not entirely so, and the rate of removal of shrubs alone will be higher than 4 percent.

(3) Firewood cutting removes the vegetation in a particularly destructive way by uprooting rather than lopping, thereby effectively preventing regeneration (McArthur and Harrington 1978:598; Thalen 1979).

(4) Firewood cutting takes place in concert with other activities which also affect the vegetation, the most important one in Tauran being sheep and goat herding. Because fuel cutting and browsing exploit different elements of the plant community in different ways, it is difficult to assess their cumulative effects.

In the absence of detailed field studies designed to isolate the effects of firewood collection from other types of land use in Khar and Tauran, it is difficult to gauge its overall impact on the environment. There are no rules of thumb establishing tolerable shrub cutting rates the way there are for tree plantations or pastoral stocking capacities. Certainly a marked zone of deterioration from a combination of cutting and browsing in the immediate vicinity of settlement is obvious. From a local point of view, however, the situation is not as bad as it might be. Villagers are not forced to depend on dung for fuel but continue to manure their fields in order to maintain and improve yields. They do not travel long distances to collect wood nor must they buy it from specialists. Moreover, they claim the range at the edge of the Plain has actually improved since the prohibition of charcoal production in the 1960s. Nevertheless both they and outside observers know the range is not as good as it should be. With a growing population the potential for increasing rates of deterioration of vegetation and soils also grows. Because multiple factors, of which population size is only one, determine how much and what kind of fuel will be used at any one time, the next section considers fluctuations in energy demands.

## HOW RURAL ENERGY DEMANDS VARY

Although social differentiation in terms of wealth or status is not great in Tauran, fuel consumption does vary from household to household and from village to village. For example, some households own more sheep and goats than others and have greater quantities of milk products to process. Some have larger grape gardens and process more syrup. The wealthier or more religious are more likely to give community feasts. The wealthier can better afford paraffin and paraffin-burning equipment. Moreover the location and degree of winter insulation (such as wall thickness, tightness of doors and windows, or orientation of houses and settlements) affects fuel consumption for winter heating.

In addition, yearly fluctuations occur in both weather and market conditions which in turn affect local economic strategies and therefore the total quantity of fuel used in Tauran in any particular year. Such fluctuations have so far been observed for only a very short period of time, too short a time to assess how they might affect the vegetation.

Variation over the long term and major changes in the way fuel is used are best studied from historical (both oral and written) and archaeological evidence. In the past, for example, fossil fuels were unavailable and local vegetation was the only fuel source used. Moreover, local industries existed which have since disappeared. Like other productive activity in the area, these industries were dependent on the vegetation, either for fuel (brick baking, pottery firing and copper smelting) or as a resource to be processed (charcoal production). There is no local memory of any of the former activities; they are known from their archaeological remains alone. Charcoal production, on the other hand, was still widely practised until its prohibition by the central government in 1966. It provides an excellent example of a traditional productive activity from the past whose effects are still apparent today.

Just before its prohibition, charcoal production had become so widespread in Khar and Tauran that according to local accounts, "there were pits every ten meters" and the sands were "ablaze" with charcoal burners' fires. How long such intense activity had been going on is uncertain. Gabriel (1935) noted that in the early 1930s charcoal and pastoral products were traded by Tauran villagers for city goods such as tea, sugar and cloth. He either saw or heard of charcoal being made at Torud, Khar, Tauran and Sanjari — that is, from one end of the local area to the other. During our fieldwork, one villager, now in his sixties, said that in his father's time there had been little burning. As he grew up, however, production increased until 100 to 150 camel loads a day (possibly as much as 30 tons) came out of the area. It does seem that such intense production would be self-limiting, in that production at the rates reported for that time could not be sustained for any appreciable length of time without seriously reducing if not completely destroying the preferred woody resources: wild almond, saxaul, pistachio and Calligonum

If charcoal had been used for domestic purposes only, production could be estimated from population size and postulated fuel needs. Since it was essentially a commercial product, however, intended for shipment out of the area rather than for local consumption, it may never be possible to measure how much was produced over any particular period of time. Charcoal pits are not very visible archaeologically because they tend to be located away from settlements, are not associated with particular features such as water or terrain, and may today lie under blown sand. Only a few were actually discovered during the study period, and none were excavated.

A more feasible approach to the impact on the environment and the scale of destruction to the vegetation is through the technology of production. Traditional methods of producing charcoal in Iran include both above-ground stacking or kilns typical of the forested regions of the Caspian and Northern mountains, and underground pits typical of the more arid parts of the country such as the areas around Shiraz (Uhart 1952), Tabas (Mojtahedi 1955) and Tauran. The underground pits recorded by Uhart near Shiraz were small (1 to 1.5$m^3$) and produced only 60 kilograms of charcoal. In Tabas, 200 kilometers to the south of

Tauran, Mojtahedi recorded pits that were larger (up to $10m^3$) and that yielded 500 to 700 kilograms of charcoal, closer to the size of those described to us in Tauran.

In Khar and Tauran wild almond (*Amygdalus*), saxaul (*Haloxylon*), pistachio (*Pistacia*) and *Calligonum* were preferred species, supplemented by several kinds of brushwood. Pits were located in relation to these resources. A basic charge at the bottom of the pit was lit so that the fire would spread as the pit was filled, the top was sealed to carbonize the wood and slowly smother the fire, and the charcoal was allowed to cool before being loaded in sacks to be taken by camel to Sabzevar, 150 kilometers northeast.

According to local villagers, a man could burn two camel loads or about 500 kilograms in a single firing. Today rangeland has been nationalized, but at that time access to grazing territory was controlled by local individuals and groups. Presumably anyone with grazing rights in an area could cut brush and wood as well as graze animals. We do know that at Asbkeshan, one of the Tauran outliers, the local group in control of the range did not allow charcoal production on their pasture.

A Tauran villager told us that at one point he was making bimonthly trips to Sabzevar to sell his charcoal. At that rate he must have been working very nearly full time — a round trip to Sabzevar by camel takes 8 to 10 days, to which must be added time for wood collecting, pit construction if necessary, and the burning and cooling process. It is likely that like other special activities, production was scheduled to take place during slack periods in the agricultural round, and was therefore seasonal rather than continuous. Probably those with insufficient land and animals were more likely to have taken up production. In Khar and Tauran it appears that wood in general was free, at least to those with access to range, and production and transport were undertaken by the same worker, though he might have to hire a camel at 50 to 100 rials per load. We do not know whether a charcoal tax was levied in Sabzevar as it was in Shiraz (Uhart 1952:10). We were told that during the past 40 years or so charcoal in Khar and Tauran rose from 400 rials a ton to 2200 rials a ton, and just before its prohibition would bring as much as 3200 rials. In 1966 there were 71.5 rials to the U.S. dollar.

Charcoal has a calorific value of about 7100 kilocalories per kilogram, air dry wood a calorific value of 3500 kilocalories per kilogram (Earl 1975:24). Charcoal's higher calorific value makes it more compact than wood and easier to store and transport. Transport costs, according to Earl, are a good predictor of whether an area will produce charcoal or firewood for commercial purposes (1975:74); it is a five day trip by camel or donkey from Tauran to Sabzevar. In Khar and Tauran charcoal production, unlike agriculture or pastoralism, was not subject to short-term fluctuations in rainfall, and in fact probably increased during periods of drought when there was less work for shepherds, failure of surplus and cash crops, and rising prices in urban areas whose meagre local supplies were reduced by lack of rain (see also Gronhaug 1978 for similar conditions near Herat). For these and other reasons Khar and Tauran exported fuel as charcoal rather than wood in spite of the labour involved in production.

Because primitive methods do not convert wood to charcoal very efficiently, a preference for charcoal has important environmental implications. In Shiraz, Uhart (1952) conducted experiments which yielded only 8 to 10 percent (from green wood by weight) using the traditional pit method (11% to 17% if the wood had been airdry). At those rates, a single camel load of charcoal (200 kilograms) used perhaps 1200 to 1800 kilograms of wood. A kilogram of charcoal may have twice the calories of a kilogram of dry wood, but it takes at least four kilograms of wood to produce one kilogram of charcoal. Charcoal production rapidly removes and converts vegetation to cash or exchange products: per calorie, it is at least twice as destructive to the environment as is woodcutting.

Unlike firewood collection, charcoal production was not settlement based. A charcoal burner could travel to his site and sleep there during the process if he needed to. The finished product could be sent directly to the city. The commercial demand for charcoal even drew charcoal burners from the towns out into Khar and Tauran to exploit the stands of vegetation which were more abundant there than they were around the towns. Operations were spread throughout the rangeland where only seasonal stations and occasional outliers are found. The density of Khar and Tauran as a whole is only 0.8 persons per $km^2$, a density low enough that brush for firewood and even for charcoal should be plentiful if it were actually collected throughout the area. If Khar and Tauran are considered as part of Sabzevar hinterland, as they appear to have been throughout most of their history, the real intensity of fuel use comes into perspective. In 1956, when charcoal production was at a peak, the population density of the census district of Sabzevar was 8.9 persons per square kilometer according to the National Census of that year. The census district is an area roughly 82 kilometers in radius which, for administrative reasons, stops just short of Khar and Tauran. If Khar and Tauran are included in the district, the density drops to 7.8 persons per square kilometer (192,050 persons over 24,588 square kilometers). Not only is this density figure closer to the real size of the population who depended on the area for fuel, but the form of the fuel, as we have seen, was charcoal and therefore more demanding on the vegetation than firewood would have been. Furthermore, in the area around Sabzevar, charcoal was used for more than just cooking and heating; it was essential to some industrial activities such as metallurgy because of its reducing properties and high temperatures. Other industrial activities, though not requiring charcoal, were nevertheless heavy users of fuel; ceramic production, lime and gypsum production and brick baking especially. Today these industries use fossil fuels, but 30 years ago they still relied on vegetation throughout much of Iran (Wulff 1966; Centlivres-Demont 1971).

Between 1900 and the mid-1950s the population of Sabzevar and its hinterlands probably doubled; between 1956 and 1966 it grew another 5 percent (Bharier 1972; Iran 1961, 1969). The combination of population growth, increasing urbanization and increasing per capita energy need for industries not yet converted to fossil fuels made the pressure on the environment in Khar and Tauran during the 1940s, 1950s and 1960s greater than it had probably ever been. The drought in 1958-63 and the unsettled political conditions of that period intensified the situation, forcing men who could not find work to turn to charcoal burning. Everyone in Khar and Tauran today agrees that the effects of charcoal production during that period were disastrous, and that since its prohibition both firewood and pasture have increased dramatically. The increased use in the central Sabzevar area of alternative energy sources such as electricity and fossil fuels has also had a relieving effect on the hinterland.

# CONCLUSION

When people depend upon the natural vegetation for a livelihood, their settlement pattern and economic strategies are susceptible to changes in rainfall and the condition of the vegetation and soils. Rural economies such as those of Khar and Tauran are also susceptible to changes in market conditions and in the demand for rural products in urban centers. In some cases these products only indirectly involve the local vegetation as in the case of milk products or smelted metals. In other cases the link is direct, as in the traditional dependence of the city on its hinterland for firewood and charcoal. Thus, in Khar and Tauran, while the technology of the production and use of energy has changed little over a thousand years and more, demands for energy have fluctuated. These fluctuations are both spatial and temporal. Some of the variation may be attributed to changes in demography while others are the result of shifts in per capita consumption. Less obvious, perhaps, are changes in subsistence strategies such as switches from camel herding (which does not in Iran include milk processing) to sheep and goat herding (which does). The condition of the vegetation at any particular time is a product of all these events.

Domestic and industrial fuels, whether firewood, charcoal or modern alternatives, have long linked rural and urban economies. In the past urban areas were dependent on their hinterlands for fuel supply, and the demand for firewood and charcoal helped support a dispersed population who might otherwise have migrated to the city. Today the roles are reversing as many rural areas increasingly depend on cities to supply fossil fuels and equipment. Although in Khar and Tauran domestic consumption still relies primarily on locally cut firewood, the transition to dependence on sources from outside has certainly begun. The intent of this discussion has been not to weigh up the advantages and disadvantages of alternative fuel technologies, but to show that levels of demand and environmental impact are tied to events and conditions outside Khar and Tauran, and in ways that may not be immediately apparent. An understanding of the social and economic contexts of the exploitation of rural resources is essential to the study of processes of desertification or to the assessment of potential outcomes of management decisions.

# NOTES

1. Information on fuel use in Khar and Tauran was collected initially in co-operation with a project sponsored jointly by the Materials and Energy Research Centre of Arya-Mehr University of Technology (MERC), Tehran, and the Centre National de la Recherche Scientifique (CNRS), Paris. In 1977 Vincent Wollam of MERC visited Tauran to study the feasibility of solar energy devices in Iran's rural settlements as part of the MERC-CNRS project; the results, based on data supplied by Mary Martin, Brian Spooner and myself, appear in a report filed in 1977 (Woollam 1977) which was revised in 1980. For this chapter I have drawn on Woollam's report, my own field data and that supplied by Siegmar Breckle, Helmut Freitag, Mary Martin, Brian Spooner and many other associates of the Tauran Programme. I am grateful to all of these. I owe a special debt, however, to Mary Martin, who not only provided the bulk of the fuel use data, but has read and made helpful comments on earlier drafts of this chapter. I alone am responsible for errors in fact and interpretation.

2. The amount of land under each type of land use was estimated from aerial photographs and on-the-ground observation. The area of the plain itself is about 120 $km^2$.

3. Most of the quantified data appearing in this chapter were provided by six households from Baghestan, a village on the Tauran Plain. Interviews covered frequency of firewood collection trips, weights of donkey loads, kinds of wood preferred and collected, and quantities of fuel required in various activities. One household supplied similar data on paraffin use. Two of the households move to a milking station for the spring and summer; the rest are permanent residents of the village. These same six households had already been the focus of intensive study for other aspects of the Programme, and the context of their responses and reliability of their information were well known. They made estimates not only for their own households, but for "typical" domestic consumption as well. The head man of a neighbouring village was also interviewed. In addition to this period of intense data gathering in 1977, observations and discussions of fuel use continued over the course of four years of field work by a number of Tauran Programme associates, especially Mary Martin.

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# III.3

# SOCIO-ECONOMIC ASPECTS OF HOUSEHOLD FUEL USE IN PAKISTAN[1]

**Tim Campbell**

## INTRODUCTION: DEMAND FOR BIOMASS FUELS IN PAKISTAN

The demand for biomass fuels in Pakistan is almost entirely a function of population size and household income. Rural and urban populations have grown relatively quickly over the last two inter-censal periods although urbanization has slowed somewhat. Table 1 indicates that the 1981 population of 84 million was up by 29 percent from the previous decade. In turn, this total has swollen to just under 100 million estimated for the end of 1985. It is interesting to note also that in addition to the rate of urban growth falling over the last inter-censal period, down to about 4.5 percent from a previous 6.5 percent, that household sizes in rural Pakistan are generally smaller than their urban counterparts. This trend is contrary to most third world countries and is accounted for by the incorporation of extended family members and help in urban households. The small differential in rural and urban growth rates — 4.5 percent vs. 3.1 percent respectively — and the large rural population mean that the demand for fuels for cooking and lighting in the 4 million urban and 12 million rural households promises to remain strongly biomass in its origin in the decades to come.

The predominance of low income households in the rural areas will accentuate this pattern. Table 2, showing the income distribution by province in Pakistan for 1979, illustrates the relative distribution of poverty in urban and rural Pakistan. Nearly half of rural households in all provinces earned less than Rs. 800 per month, whereas only a third of their urban counterparts earned that little. The 1984 GNP per capita was $390 (World Bank 1985). These income constraints in the rural area strengthen the importance of biomass fuels which are often accessible

**TABLE 1. Estimated Urban and Rural Population Growth 1972 — 1981 — 1985 (in millions)**

| | 1972 | | 1981 | | 1985 (est) | |
|---|---|---|---|---|---|---|
| Province | Urban | Rural | Urban | Rural | Urban | Rural |
| Punjab | 9.18 | 28.42 | 13.05 | 34.24 | 14.72 | 36.83 |
| Sind | 5.73 | 8.43 | 8.24 | 10.79 | 9.36 | 21.23 |
| NWFP | 1.20 | 7.19 | 1.70 | 9.4 | 1.86 | 10.37 |
| FATA | 01 | 25 | — | — | — | — |
| Baluchistan | 40 | 20 | 68 | 3.66 | 80 | 4.38 |
| IFA | 10 | 16 | 20 | 14 | 26 | 13 |
| Totals | 16.62 | 48.72 | 23.87 | 58.23 | 27.00 | 72.94 |
| Households (in 000's) | | | 3,725 | 9,705 | 4,229 | 12,156 |

Overall growth 3.0; urban growth about 4.5%
Source: GOP 1985 and author's estimates.

outside the monetary system in the form of firewood, dungcake and fodder. However, it is also important to note that a large fraction of fuelwood and dungcake is consumed by urban households for cooking purposes. We shall return to this point later. The 1979 Expenditure Survey shows a constant 5 to 6 percent of urban and rural household expenditures go to fuel and lighting. This level of expenditure compares to a similar pattern in 1971 and remains remarkably constant across an income range of nearly 30 to 1 (see Table 3).

## *Fuel Flows*

According to the Household Expenditure Survey, $245 \times 10^6$ gigajoules (GJ) were consumed annually in the domestic sector in 1979. Of this total, over 82 percent was in biomass energy, principally in firewood but also in dungcake. Assuming an expansion by about 12 percent since 1980 in the Pakistan economy, and a population increase of nearly 19 percent, the total energy consumption for 1985 may be estimated at about $619 \times 10^6$ GJs annually. The domestic sector accounts for only about 45 percent of the total energy consumption in the country, providing ample possibilities for substitutions, increased efficiency, and conservation. For although we have incomplete data on the relative fuel mix in households at present, sketchy and anecdotal evidence suggests that firewood has been the key, but not the only fuel source expanded to meet the needs of a growing population over the last several decades. As we shall indicate

**TABLE 2. Income Distribution Urban and Rural by Province**

| Average Household Income Group (Rs) | Pakistan Urban | Pakistan Rural | Punjab Urban | Punjab Rural | Sind Urban | Sind Rural | NWFP Urban | NWFP Rural | Baluchistan Urban | Baluchistan Rural |
|---|---|---|---|---|---|---|---|---|---|---|
| up to 300 | 1.8 | 5.1 | 2.5 | 6.0 | .8 | 2.0 | 1.8 | 4.8 | 1.1 | 4.4 |
| 301-400 | 4.0 | 9.0 | 5.0 | 7.7 | 2.9 | 7.5 | 3.5 | 8.1 | 1.4 | 8.1 |
| 401-500 | 7.3 | 12.2 | 8.7 | 12.7 | 4.8 | 11.6 | 8.1 | 9.8 | 5.6 | 15.1 |
| 501-600 | 8.4 | 14.0 | 9.2 | 13.3 | 7.1 | 16.1 | 7.8 | 12.9 | 10.1 | 19.2 |
| 601-800 | 17.0 | 22.7 | 16.8 | 22.3 | 17.5 | 25.9 | 15.8 | 21.9 | 18.1 | 19.3 |
| 801-2000 | 48.0 | 33.4 | 45.2 | 32.1 | 52.0 | 35.0 | 49.2 | 36.8 | 49.4 | 31.3 |
| 2001-2500 | 4.9 | 1.7 | 4.8 | 1.7 | 5.0 | 1.0 | 4.4 | 2.6 | 6.7 | 1.6 |
| 2500-above | 8.6 | 1.9 | 7.8 | 1.9 | 9.9 | .9 | 9.4 | 3.1 | 7.6 | 1.0 |

Source: GOP, 1979.

**TABLE 3. Distribution of Household Expenditure in Pakistan (in percent)**

| Item | 1971-1972 | | | 1979 | | |
|---|---|---|---|---|---|---|
| | Pakistan | Rural | Urban | Pakistan | Rural | Urban |
| Food & Drink | 55.0 | 57.5 | 49.4 | 50.8 | 55.0 | 46.3 |
| Clothing and Footwear | 10.6 | 11.0 | 9.7 | 9.6 | 10.2 | 9.0 |
| House and Rent | 7.7 | 5.7 | 17.8 | 10.0 | 6.5 | 15.4 |
| Fuel and Lighting | 5.3 | 5.4 | 5.2 | 5.2 | 5.7 | 4.6 |
| Furniture & Fixtures | .9 | .9 | 1.0 | 1.5 | 1.4 | 1.5 |
| Misc. | 20.5 | 19.5 | 22.2 | 22.1 | 21.2 | 23.1 |

Source: GOP, 1979.

later, the increase in demand for energy may also have been met by a diversion of manure from farmlands to household cookstoves and in a shift in cropping patterns to increase fodder and agricultural wastes as a cooking fuel.

Rather wide variations in the consumption of fuels are found in rural as contrasted with urban areas and across region as well as by season. The average rural and urban differential in per capita annual household energy use is 3.32 GJ in urban areas as opposed to 4.40 GJ in rural. The larger figure in rural areas is attributable partly to inefficient combustion technologies. Provincial variations are even larger. The urban households of Sind Province consumed 2.9 GJ per household per year and those in the rural NWFP 4.7. Seasonal variations in temperatures are also extreme in the largely arid climates of Pakistan. The average daily minimum in January is near or below zero in much of the NWFP and Baluchistan, and 40 to 45 degrees C. in much of Sind and Punjab Provinces in mid-June (Johnson 1979).

## *Demand for Heating and Cooking Fuels in Pakistan*

Cooking fuels are composed very largely of biomass resources. Less than 10 percent of Pakistani households are connected with natural gas and perhaps an equal percentage can afford or tolerate kerosene oil. The largest majority of rural households cook with firewood, dungcake and agricultural residues. In addition, a surprising fraction of urban households also use biomass resources. As Table 4 indicates, the proportion of biomass fuels to the total energy in rural and urban areas is about 90 and 55 percent respectively. But in 1979 urban households still accounted for nearly 18 percent of the fuel wood consumed, and 15 percent of the total biomass. The generally higher prices for biomass fuels in cities signifies an important source of competition for rural households. This competition means that a larger fraction of rural household incomes must be devoted to fuel on the one hand, and on the other, that greatly increased amounts of biomass fuels must be mobilized.

**TABLE 4. Pakistan: Total Domestic Energy 1979-1985 (GJs/yr.— est.)**

| | Rural | | Urban | | Pakistan |
|---|---|---|---|---|---|
| | Average per Household | Total | Average per Household | Total | Total (GJ x $10^6$) |
| Firewood | 17.82 | 179.43 | 10.30 | 38.37 | 217.80 |
| Dungcake | 4.98 | 48.33 | 1.19 | 4.43 | 52.76 |
| Charcoal | .49 | .93 | .17 | .63 | 5.56 |
| Other Biomass | .56 | 5.64 | .01 | .04 | 5.68 |
| Total Biomass | 23.85 | 240.14 | 11.67 | 43.47 | 283.61 |
| Total Commercial Energy | 2.54 | 25.58 | 9.61 | 39.80 | 61.38 |
| Total Energy | 26.39 | 265.72 | 21.28 | 79.27 | 345.44 |
| Percent Biomass | 90.39 | — | 54.83 | — | 82.10 |
| Energy Per Cap | 4.40 | — | 3.32 | — | 4.10 |
| Total Households (in 000's) | 6.4 | 10,069 | 6.0 | 3,725 | — |

The evidence is inconclusive as to the source of new fuels to meet cooking demands for Pakistan's increased population since 1979. The Director General of Energy Resources (DGER, in the Ministry of Petroleum and Energy) reports that the fraction of commercial fuels to the total dropped from 47 to 18 percent in the 12 years between 1970 and 1982. Firewood appears to be chiefly responsible for making up the difference in total energy flows, moving from 12 to over 51 percent (GOP 1980). Ambiguity over this fact lies in the difference between reported harvest of wood in controlled areas of the country, and the imputed volume of wood calculated on the basis of observed cooking practices. For instance, USAID estimates that something short of 6 million tonnes of wood were harvested from government and farm lands in 1980. On the other hand, the 1979 Expenditure Survey indicates that fuel wood purchased would amount to nearly 147 million tonnes.[2] The larger figure is derived both from the 1979 survey and from spot checks with households in urban and rural areas.

The difference by a factor of 25 is most probably accounted for by the "hidden" culling, thinning, and lopping of branches of firewood from on-farm tree stands. Forested areas cover less than 5 percent of Pakistan's national territory and are confined mainly in the northwest. Dispersed stands of trees are open to selective culling and thinning as are roadside stands recently planted by the Pakistani Forest Institute, particularly in the Punjab and NWFP. Also, not all wood harvested is reported, fuels are undervalued on the market and in the 1979 survey, and recent spot checks conducted in the field suggest that households could erroneously include some biomass such as brush and agricultural wastes as "firewood". Whatever the source of error, these findings confirm what most energy analysts already know: despite the decade-long alarm over firewood depletion in the Third World, energy statistics at the household level are appallingly imprecise. On the other hand, this large volume of harvested fuelwood has not appeared to reach limits, at least as reflected in the price of firewood. Firewood prices have remained relatively constant in the context of the national economy, staying abreast with inflation since 1970. Price checks in the north, central and southern parts of Pakistan on this mission confirm this trend. Thus, either fuel wood is keeping up with demand or alternative fuels are increasingly playing a role in household cooking. One such possibility is the use of dungcake.

Cattle manure represented the second most important form of biomass after firewood in the 1979 survey. Because it is the cheapest of the energy forms available to households (averaging Rupees 0.5 per kilogram) and because it is easily available outside the monetary economy, as well as for other reasons, dungcake forms the most flexible and an important "slack" fuel for households. A 1980 estimate of biomass resources in Pakistan put dung at about 21 million tonnes per year, but the 1979 survey would suggest that at least 70 million tonnes were consumed as cooking fuel alone in 1980. This represents a large fraction of the total potentially available, calculated on the basis of 25 kilograms a day per animal (FGACS 1984). This would yield a total supply of 112 million tonnes per year, leaving about 40 million for on-land distribution. Naturally, the use of dung varies, as usual, with season, region, and income. For instance, the average household consumption of dungcake per month has a range of 10 to 1, comparing the rural Punjab with urban Sind, and 6 to 1 within the rural areas of the four provinces. It is interesting to note that the use of dungcake persists in cities, and by income group, rising as incomes rise. Some informants were amazed that rural householders who had been living abroad for decades would return and easily reassimilate the use of dungcake as a cooking fuel.

Naturally, a 15 percent increase in livestock since 1975 represents one of the fastest growing fuels in the country. Accessibility to dung, of course, depends upon cattle ownership and whether or not cattle are corraled (as in irrigated areas) or not (in the Barani, where only gathering from nighttime enclosures is easy). Use of dung also depends upon local arrangements concerning ownership and rights of use.

The large volume of dung used as fuel presents yet another possible opportunity cost in dung as fertilizer. Though dung is used by households as a fuel, as we shall explore later, not using dung as a natural fertilizer and soil conditioner may represent a significant opportunity cost. The cost of fertilizer has risen quickly, increasing four-fold in the past 10 years to about 4 rupees per kilogram in 1983 (GOP 1985). Fertilizers, including manure, are typically applied to cash crops, and more intensively on smaller farms. It is not hard to conceive of alternative strategies in which, for instance, fodder crops might be promoted, as Saunders (1983) has suggested, to increase fodder production as well as use of possible fuels from agricultural wastes.

Finally, except for cotton sticks in Sind Province (FGACS 1984), other agricultural residues play a nearly insignificant role as fuel. A quick calculation of the yields per hectare for cotton, rice and wheat (which range from about 1,000 to about 2,600 kilograms per hectare) would suggest that roughly a tonne of agricultural residues would be available to the average household each year. Whether they are used as fodder or as fuel depends on individual fortunes and circumstances. Field observations suggest that agricultural residues are probably more widely used than reported in the 1979 survey (Briscoe [1978] shows that Bangladeshi villagers rely mainly on agricultural residues as cooking fuels.)

The complexity of cropping patterns throughout the year, and consequently the shifting availability of agricultural wastes as fuels, is demonstrated in Figure 1.

## *Environmental Concerns*

At this aggregated level of analysis, the use of biomass fuels in household cooking does not arouse concern for desertification and soil erosion as has been the case in other countries in West Asia, notably Nepal. Because a relatively small fraction of land area in Pakistan is devoted to forestry, deforestation per se may not be as important as the issue of land

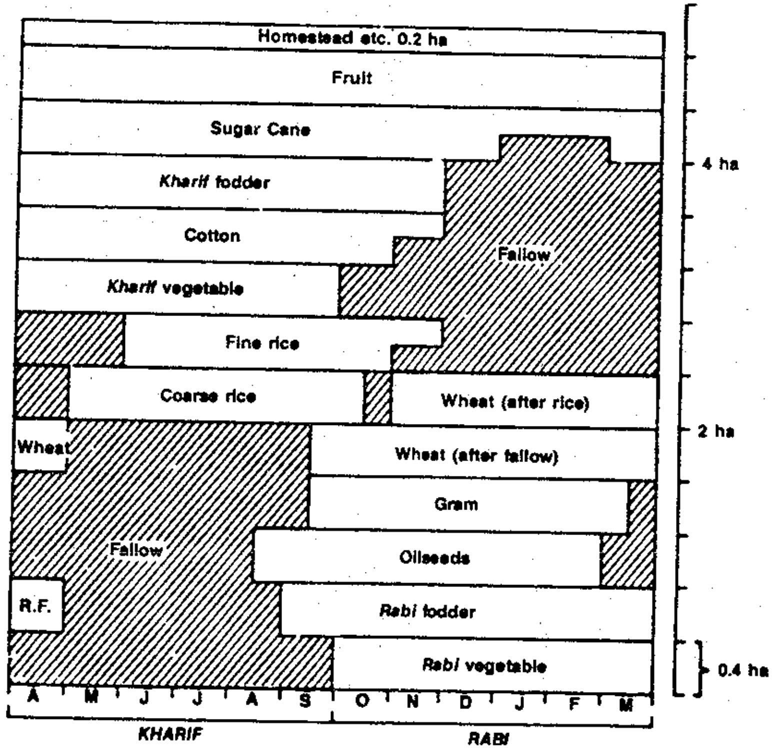


**Figure 1. Cropping Pattern on a Gujranwala Rice Tract Farm**

and resource management generally. Besides, in recent years, planting by the Pakistan Forestry Institute appears to be effective in diffusing attacks on concentrated stands of timber. Rather, an environmental problem of possibly alarming, but unknown, proportions concerns the allocation of cattle manure as fuel, as opposed to fertilizer. The question of optimal use of this natural resource remains open, and deserves further investigation. Finally, an environmental problem of a different sort, that of indoor air pollution due to the combustion of biomass in cooking, has already aroused international concern, as reported by Berry (1983). Emissions from wood fires can be at least 10 times greater than particulates from oil and gas fires, and cause lung diseases — such as asthma, emphysema, and bronchitis — and be a carcinogen. However, parasitologists discount the possibility that parasitic diseases are spread by food handlers who also prepare dung cakes for fuel. Most human parasites are either species specific, require an intermediate host not likely to be present, or, in the case of tetanus, are in the farm environment anyway.

# ENERGY USE IN RURAL HOUSEHOLDS

With this aggregate view of biomass cooking fuels, we now turn to a more disaggregated look at the microcosm of households. The focus of this section is on the dynamics of fuels, interfuel substitution and fluctuations, and integration of fuel use into the strategies of survival in rural and urban households.

## *The Structure of Low-Income Households*

Although Pakistani households vary widely by class status, religion, tribe and income, a few powerful factors restrict operating style and energy strategies to a few common patterns. Most low-income households are engaged in share-cropping or tenant farming of two to ten hectares. Landlords supply water and in return expect one third of the harvest and, in some cases, heavy contributions of labor and sometimes handicrafts by females (Rauf 1978). Low-income households are subject to a strong code of rights and responsibilities, reinforced by Islamic law, which shapes their options and guides their decision (Ishrat 1983). Thus, resources of poor households are subject to significant constraints and demands.

In a larger sense, low-income household production and decision-making is influenced strongly by uncertainties in factors of production.

Ample ethnographic and anthropological evidence supports what might be called an uncertainty model to describe household behavior (Marris 1973; Rauf, 1978; Ishrat 1983; Campbell 1984). In this model, household decisions are seen to strategically offset uncertainties — such as drought, fire, illness or other catastrophe — which may adversely affect their welfare. Thus, the rights and responsibilities of class and of Islamic law may be seen as reinforcing reciprocal obligations among kin, tribe and workmates and have the effect of spreading risks of loss among a wider population. At the same time, peasant households are sometimes called "backward", "primitive" or "near-sighted" for not adopting new technologies. In this sense they are conservative. But ample evidence also shows that behind this conservative impulse are rational calculations which accept change when and if it does not threaten long term survival, regardless of the promise of short term gain. Novel ideas and tools are accepted as long as they further the purpose of households. Fuel use and fuel substitutions are no less subject to this calculus.

## *Meals and Cooking*

Fuel gathering, food preparation and cooking represent a significant fraction of household time budgets in NWFP villages as reported by Ishrat (1983). The daily activity cycle usually includes three periods of cooking, generally lasting an hour to an hour and a half each; sometimes longer during winter months, fewer during Ramadan, and sometimes interspersed with special food preparation for festivals, weddings, funerals, and commercial activities. Women prepare fires and meals, starting in the early morning after cow milking or animal feeding if applicable. The morning meal usually consists of an unleavened bread, tea, and sometimes *lassi* (yoghurt) or hot milk. Morning fires are usually set in a small, mobile, primitive stove, and sometimes in a fixed corner stove (cooking technologies will be described in greater detail below). After the morning meal, young girls and other females in the household gather cow manure for the making of dungcakes, which is usually done in a social circle outside the household compound near a drying wall.

Later in the day, a midday meal is prepared, consisting of the same unleavened bread; and fried pulses, vegetables and boiled rice. Frequently, during the late afternoon, bread is also baked in a special oven, so that sometimes two fires may be going at once in midday and early afternoon. Further, if milk is being boiled for preparation of *ghee* (or *lassi*), a third fire will sometimes be alight at this time. The evening meal, before sundown, is similar to the midday meal, but heavier, and is served with tea and occasionally meat. These foods are prepared in boiling water, or fried slowly in shallow pots. Generally speaking, Pakistani cuisine requires a low, long-lasting fire as contrasted to the brief but intense fire required, say, for "satay" in Indonesia.

## *Gathering and Purchasing Fuel Supplies*

Each of the major fuels — firewood, dungcake, and agricultural residues — offers different characteristics in terms of price, availability, and accessibility. Table 5 lists urban and rural monetary equivalents of the various household fuels. Although the data are probably under-reported,

**Table 5. Distribution of Monthly Expenditure for Household Fuel and Lighting**

| | Urban | Rural | Pakistan |
|---|---|---|---|
| Firewood | 15.08 | 25.88 | 21.72 |
| Dungcake | 1.98 | 7.50 | 5.38 |
| Kerosene Oil | 10.63 | 6.09 | 7.84 |
| Charcoal | .35 | .60 | .50 |
| Coal | .24 | .18 | .20 |
| Gas | 6.38 | .16 | 2.55 |
| Electricity | 16.59 | 2.43 | 7.88 |
| Matches | 2.33 | 1.84 | 2.03 |
| Bagasse | .04 | .06 | .05 |
| Cotton Stocks | .04 | .34 | .23 |
| Sawdust | .02 | .03 | .03 |
| Shrubs | .02 | .24 | .15 |
| Weeds | .01 | .08 | .05 |
| Tobacco Sticks | .01 | .02 | .01 |
| Other | .51 | .72 | .64 |
| Total | 54.23 | 47.07 | 49.26 |

Source: GOP 1979, Table 18.

particularly for agricultural residues, it may give a more or less accurate description of the proportional spread among different agricultural residues. The relative time and monetary costs of these fuels vary by season, household fortune, and availability. Thus agricultural figures are liable to be inaccurate because they fail to account for these contextual variations.

Table 6 gives sample values for the three main fuels by weight, energy value, and per meal cooking costs. With the exception of wheat straw, firewood and dungcakes are almost always more expensive per heat unit. The difference is, of course, the social value of handling, and the rather rapid burning time for low-density materials like dungcake and agricultural residues. A dungcake will burn or smoulder approximately 10 to 15 minutes in the summertime; an equivalent weight in agricultural residue, slightly longer; firewood, about three times as long. Still, the value per meal is much lower for dung. Further, dung and agricultural residues are frequently available as "surplus", and are often outside the monetary system, meeting the characteristic need for flexibility in resource expenditure important among low income households. The relatively low time costs of gathering these fuels extend the dimension of flexibility.

**Table 6. Monetary and Fuel Values of Common Resources**

| | Rps/Kg. | KJs/Rps |
|---|---|---|
| Firewood | .5 - .25 | 14-17 |
| Dungcake | .3 - .6 | 14-28 |
| Fodders | | |
| *Khali* | .1 | - |
| Corn | .1 | - |
| Wheat Straw | .1 | 40-60 |
| Residue | | |
| Cotton | .2 - .3 | - |
| *Jawal* | .3 | - |
| *Burheem* | .1 | - |
| Rice | .5 | - |
| Densified Fuels | .1 - .2 | 20-60 |

Btu's x 1.054 x 2.2 = KJ/Kg divided by Rp./Kg = KJ/Rp

***Firewood*** The steady price of firewood over the years, and the large stockpiles seen in roadside markets and among Afghan refugee villagers in the Punjab, are in apparent contradiction to an alleged fuel wood crisis in Pakistan. Fuel wood is, of course, more difficult to get now than in the past, and a peasant of 30 years in a small village near the NWFP-Punjab border reported having to double or triple the amount of time devoted to fuel wood gathering as compared to 10 to 15 years ago. He now gathers along roadsides, from on-farm stands of wood, and from auctions held by the Pakistan Forestry Institute from culled trees especially planted along roadsides in the NWFP. Much of the fuel wood is of very small diameter and difficult to measure in terms of thermal content or weight. About one day per week is devoted to fuel wood gathering. Elsewhere, firewood sells for about rupee 0.75 to rupee 1 per kilogram. Large inventories are found among Afghan refugee villagers on roadsides, where they sell firewood harvested on concession from landowners in the Punjab. A rough average of about 2 kilograms per capita are burned per day in food preparation.

***Dungcake*** Dungcake can be purchased for half or less the price of firewood, and sometimes less than the price of wheat straw as well. But most often, dungcake is "manufactured" around household clusters by women working 60 to 90 minutes per day to gather and shape dungcakes, place them on sunbathed walls, and collect them after they have been dried. Wheat straw and other residues are frequently mixed in with the dungcake to improve its structural and burning characteristics. Because of its ease of accessibility, dungcake probably serves to take up slack in fuel needs when firewood cannot be purchased. About 40 to 65 dungcakes per day are burned by a rural household roughly in a one to three ratio by volume with firewood and residues.

***Agricultural Residues*** Residues are available in varying quantities according to season, region and livestock needs. Cotton sticks are important and second only to firewood in cotton growing regions. Most peasants sell other residues only after cattle fodder needs have been met. Thus, *burheem, khali,* and corn stalks sell from between Rs. 10 to 15 per *maund*, if there is a fodder excess on the farm. If cash is not needed, the residues can be used as fuel. These, then, also constitute an element of flexibility in fuel-fodder-cash strategies of households.

In short, a mixture of fuels are used in varying proportions according to availability, price and household fortunes. It is not uncommon to see stockpiles of fuel for one or more households in a rural village compound. Piles of fuels consist of small logs; branches and brush; dried grasses similar to, but unsuitable for, cattle fodder; shrubs; and other agricultural residues. Piles of dungcake are also a common sight on tops of houses or beside compound walls, or sometimes kept in baskets for quick access indoors during cooking.

## *Fuel Specialization*

The major household fuels are also keyed to specialized uses. Firewood carries the major load, and is used for "heavier" cooking purposes, such as the making of *ghee*, cooking vegetables, and baking bread. Dung, on the other hand, is used for boiling water and milk, though not bread because of the unfavourable flavor imparted by the smoke. Bread is usually baked on the walls of open ovens, and thus is exposed to smoke from the cooking fire. Charcoal and kerosene are used very little, but sometimes found as a starter fuel and for status purposes. In addition, extra amounts of charcoal and kerosene are required for festivals, weddings, and funerals.

Storage characteristics of the fuels also affect their flexibility and utility. Low density agricultural wastes and dungcake are at a disadvantage in this respect, as they have a relatively high moisture content.

Poor ventilation and poor combustion characteristics of rural household fuels result in the production of smoke, other combustion byproducts, and odors which may or may not offend rural householders. Recent evidence has been developed to suggest, however, that some combustion byproducts, especially in poorly ventilated areas, are the cause of respiratory disease, and possibly may be carcinogenic as well (Berry 1983).

## *Cooking Technology*

Stove design and construction is handled almost entirely by females, and stove technology is remarkably homogeneous across the urban and rural households visited. The smallest, most mobile and flexible cooking stove is the 30 centimeter x 30 centimeter x 30 centimeter, homemade, baked mud vessel resembling a primitive crown, upon which three spires hold a pot, and three spires pointing downward are the legs. A pocket between the opposite pointing spires holds a burning surface about the size of a dungcake. These stoves can be moved around the house to shade or sun or out of the rain or wind.

A stove of a similar function, but larger and stationary, is usually found in the corner of the kitchen or cooking shed, or sometimes under a stairway leading to the roof of a simple peasant one or two-room house. This cooking chamber is for "heavier" cooking, meaning larger pots and frying vessels. Corner stoves both with and without flues are typical. Both stationary and mobile stoves are used at no more than 30 to 40 centimeters above floor level. Adjacent walls and ceiling are covered with a thick black soot. Common folklore says that soot has a repellent effect on insects. Some households also reported that dung smoke repels mosquitos.

A third commonly found cooking vessel is the bread oven. Small ones are frequently found in individual households; larger ovens are held by compounds of households in extended lineage or friendship groups. Bread-baking sessions in collective stoves are common. Smaller, individual versions are fired once a day or every other day for baking of bread. Baked bread is sometimes warmed or heated on the mobile stove in a shallow pan. Less frequently found are kerosene and gas stoves, and sometimes cylindrical stoves especially designed to burn agricultural residues. These are more common in the NWFP.

The small earthen mobile and corner stoves and smaller bread ovens are typically made on site, practically without cost. The woman of the household can make the small mobile stove in a matter of hours. Gas and kerosene stoves are sold for between Rupees 80 and 300. Bottles of gas require a deposit of Rupees 1,500 to 2,000 with about a Rupees 50 refill charge for bottled gas when it is available.

## FUELS AND COOKING IN THE STRUCTURE OF HOUSEHOLDS

The foregoing data and observations on fuels and cooking technologies are illustrative of the important degree to which fuels and technologies are adapted to the particular circumstances of rural households. Household size, location and wealth govern the power and ability to obtain and use various kinds of fuels. Urban households follow similar patterns even though fuel quality, availability, and end use are different in cities.

### *Energy in Urban Households*

The fuel use regime in urban households resembles that of their rural counterparts except that the cuisine, fuels, and cooking technologies are more varied. In this respect, low income urban households can draw from a wider array of fuel types and are insulated somewhat from seasonal variations in fuel availability.

The supply of urban fuels is generally speaking in the monetized economy so that firewood, dungcake, agricultural residues and even discarded woolen or cotton wastes are sold or traded in local markets. This is not to say that scavenging for fuels is unimportant. On the contrary, numerous observations were made of children and women scavenging fuels from local food markets and bazaars. Packing crates, wrappings, cardboard, and other materials are hand carried or dragged to their destinations. On the other end of the spectrum, kerosene and natural gas play an important role in cities. Fuels are purchased on a daily or weekly basis, with interfuel substitutions being effected as a function of income flow. Thus, as in rural households, dung and discarded materials are used more frequently when economic times are roughest.

Fuels and cooking technologies are dedicated to specialized functions in urban households just as they are in rural areas. The same range of cooking stoves and fuel characteristics are found in urban households with the exception that occasionally additional stoves are found for commercial purposes. Frequently this is a kerosene stove used to prepare snacks for sale at roadside stands.

Finally, the generally higher incomes and strong concentrated demand for urban fuel draws a large fraction of fuel resources out of the countryside. The concentration of fuels in local fuel markets throughout urban areas represents a reservior for cyclical variations in household fortunes and external conditions just as it raises the price of fuels for rural households. At the same time, highly organized markets for charcoal, firewood, dungcake, and more commercial fuels suggest that economies of agglomeration and scale may operate in favor of the introduction of alternative fuels in urban areas first. In addition, a more permissive attitude toward women and things new suggests that marketing densified fuels may be easier to achieve in cities.

## *Control of Fuels*

In both rural and urban households, fuels are controlled in accordance with the need to maintain flexibility in choice of fuels, burning characteristics and cost. To a large extent, residual fuels — manure and agricultural residues — are outside the monetary system, and therefore suitable as vehicles to adjust to hard times and unforeseen circumstances. In addition, they are produced locally, and are amenable to either fuel use, fodder, or cash. In this light, the use of dung as fuel versus fertilizer is one tradeoff households make, in a hidden calculus.

Cultural factors moderate this flexibility. It is clear that women play a central role in the gathering and manufacture of fuels, and in the production of cooking technology. At the same time, cultural barriers impede the free access of female members of the household to markets far from home. Thus, males carry out cash transactions for fuel wood and other commodities in the larger regional markets. Cross-cutting the specialized and rather restricted roles of women is the social status embodied in the concepts of "high-borns" and "low-borns". It is of relevance to the densification proposal that restrictions on the entry of females into labor and commercial markets is complicated by subtle cultural influences over the idea of trade between "unequals". In this concept, "high-born" females feel social censure against buying or using personal products — such as handiwares, and knitted or sewn items — produced by "low-borns" (Rauf 1983). These status relationships may also apply to the exchange of fuels, especially in rural areas. Therefore, intervening in fuel cycles and fuel markets must take these factors into account.

# PROBLEMS AND ISSUES OF ALTERNATIVE FUEL STRATEGIES

The chief barrier in any introduced fuel strategy, in Pakistan or anywhere, will be to design and tailor the intervention — the fuel, cooking technology, marketing, and the like — to fit harmoniously with the objectives and purposes of the households using the fuel. In the case of Pakistan, the predominant fuels of firewood, dung, and agricultural residues have been "fine-tuned" over many generations of use in order to meet multiple objectives. Frequently these objectives include long term survival, short term gains, and freedom from uncertainties and risks which threaten to destabilize or upset a delicate balance in the household economy. In the case of rural households, the evidence suggests that dungcake and agricultural residues serve as "buffer" fuels which offer flexibility in their use not only as fuels but as fodder, cash crops, or fertilizer. Recently, it appears that dung especially and agricultural residues as well may have come to play a more important role as human populations outgrow available firewood on nearby farmlands. In turn, cooking technologies have also been fine-tuned to accommodate available fuels, cuisine, and local materials.

The introduction of densified agricultural wastes would necessitate a complicated series of adjustments not only in price and fuels, but also in cooking, the organization of household activities, and possibly the balance of social power among classes and sexes. This is not to say that introducing new fuels is undesirable. On the contrary, some advantages are obvious: cleaner burning, longer lasting, and more efficient fuels, especially in low income rural households, may lead to more efficient use of manure as a fertilizer, reduce the pressure on firewood, and increase local incomes. Environmental health effects may also be positive. But altering the stream of agricultural residues will require an effort to initiate this change and then study its consequences.

## *Acceptability*

The question of acceptability has three main components. First is the extent to which a plausible alternative may be designed to integrate smoothly into strategies of inter-fuel substitutions, the prevailing cooking technologies, and social structures as they have been described earlier in this report. So little is known as yet about inter-fuel substitutions and related factors like burning characteristics, useful energy and the like, that this part of acceptability remains in question.

A second component of acceptability concerns the socio-cultural reaction to a technological innovation per se. Does the innovation itself represent an implausible notion or violate local custom or practice? Recent experience with technological innovation in Pakistan suggests a positive environment towards change. Recent technological innovations in Pakistan include new varieties of rice and wheat in the Green Revolution; on-farm biogas and solar energy technologies, which have been generally well-received rural villagers in selected places; the high efficiency "Lorena" cookstove; and other devices such as thermoses, radios, and so on introduced by a large expatriate labor force working in the Middle East and Europe. New technologies per se need not be considered a serious obstacle to the introduction of densified biomass as a cooking fuel. On the other hand, one might ask why the high efficiency cookstove has not diffused more widely among rural users. Further research on this and related technologies could help improve the prospects.

Finally, local informants have suggested that the packaging of densified biomass may be a key to its success. The concept of packaging has two aspects. First is to enhance the social status of a new fuel by making it attractive, clean to handle, and easily identifiable. A second aspect of packaging concerns the size, shape, and weight of densified biomass, important dimensions in connection with cooking technologies. For the mobile and corner stoves described earlier, small cubes or even disks of 4 to 6 centimeters thick and 10 to 12 centimeters in diameter would be two possible configurations designed to fit the capacity and dimensions of the most popular cookstoves presently in use. Third, an alternative fuel strategy should possibly be accompanied by the introduction of a high efficiency cookstove designed specifically to burn these fuels. Further research on this prospect would also be required. Several experiences elsewhere in the world — World Bank projects in Indonesia, Burundi, Ethiopia — may have applicability to the Pakistani case. Finally, packaging materials must be durable, waterproof, probably colorful, and able to serve as a fire starter.

## Transport of Residues

Field observation and reports from informants suggest that the cross-hauling of agricultural residues from farms to market is a common feature of rural household operations, as is the hauling of fuelwood from great distances. Tractors are hired for rupees 14 per hour, oxcarts for less. These practices suggest that few if any problems would be encountered in the physical transfer of residues to densification locations, provided "transfer vehicles" for densification units could reach within 4 or 5 kilometers of rural households. Further detail on logistical arrangements can be worked out after the mobility and capacity of densification equipment is established.

## Ownership and Participation

Participation in the operation and maintenance of local, small scale densification units would seem plausible under a decentralized strategy. Given mobile and large scale installations, this participation and ownership becomes more complicated and possibly not feasible. Aside from local labor hired to operate and maintain equipment, a participatory scheme organized around what might be called "fuel cooperatives" could help to organize and channel the transportation of agricultural residues into assembly sites for densification. The analog at present is the transport to market of excess fodder and agricultural residues for sale in small town fodder markets. Cooperatives appear to have a mixed record in Pakistan. Many cooperatives are registered as active organizations but appear to have fallen into dormancy in the recent past. The function of a "fuel cooperative" would be to circumvent the complete monetization of fuel exchange, enabling farmers to receive credits for agricultural waste delivered at a densification site. Credits could then be exchanged for fuel briquets on the spot. Whatever the organizational mode, the focus of the participatory strategy would be to increase the emphasis on agricultural residues as fuel, support educational activities to increase energy awareness, promote efficiency, and give increased emphasis to the benefits of using manure for producing fuel.

## Economics of Fuel Substitution

The foregoing analysis — taking into account the observed quantities of fuel and their respective values, as reported in Table 6 — suggests that the present cost of preparing meals in rural and urban households ranges from rupees 3 to 6 per meal for fuel. Preliminary calculations suggest that this price could be cut in half with densified fuels. The unknowns in this conclusion have not only to do with productions costs, especially packaging and distribution, but also with the value households assign to flexibility in the use of dungcake and agricultural residues for cooking. The monetary values reported by households for residues and fodder range from rupees 10 to 15 per *maund* (although reaching 120 Rps/*maund* in winter), or about rupees 0.1 to 0.15 per kilogram. In Table 6, the cost in 1985 rupees by weight and energy value are presented for a wide range of cooking fuels, fodders, dungcake, and residues. Thus, the attractiveness of alternative densified fuels depends upon the as yet unknown strategic calculations by households, giving more and less weight to flexibility, hedging bets, and the need to maintain and serve social networks of exchange. In any case, the cost and utility of alternative densified fuels must fit into this social and economic valuation system.

Strictly on economic grounds, and by this is meant taking into account only monetized cost, densified fuels from cotton sticks and rice husks could be produced at between rupees 0.1 and 0.2 per kilogram. This represents between 40 and 60 kilojoules per rupee, a good value in comparison with other fuels. Adjusting downward this energy value to take into account the cost of transportation and packaging, the cost to the consumer could perhaps be 20,000 to 30,000 kilojoules per rupee, competitive with firewood and dungcake. An additional advantage of densified fuels would be improved cooking characteristics, particularly longer and more even burn times, and if packaged correctly, higher efficiency to fit present or newly designed high efficiency cookstoves.

In addition, the economics of the use of householders' time would appear to be favourable, because the overall time costs of gathering and preparing traditional fuels would be reduced, and the economics of harvesting and selling residues and purchasing fuels could be integrated into routines already established. But again, the costs of time are multidimensional. Social value attached to women's circles during dungcake production, for instance, is reminiscent of the social function of laundering in other societies, in which improved individual laundering units were rejected because the new technology disrupted the valuable social function of gossip, news exchange, and the general acculturation carried on during collective work. It is difficult to predict how the marginal value of time might be calculated by households. At the moment, expert informants guess that the most important use of time in the daily household time budget is attached to laundering and cleaning. After that, socializing during or after work comes second. But these judgments and others need to be tested on an empirical basis.

Finally, as mentioned earlier, the economics of densified fuels will be heavily influenced by the substitution effects of fuels. Thus, the introduction of densified rice hulls might not only substitute for agricultural residues — the householders' gaining profits in the sales or use of residues as fodder rather than as fuel — but might also substitute for cattle dung, which would be another potentially powerful influence. If densified rice hulls or other residues were to substitute for dung, then increased production of fodders, cash crops, or staples might also be expected. This would benefit local households either in cash income from sales or increased fodder for livestock.

### *Summary*

Although the economic and financial aspects of densification of rice hulls and other residues appear on the surface to be favorable, significant uncertainty still surrounds the socio-cultural aspects of densification. At the center of this uncertainty is the reaction of peasant and urban households to new fuels and new technologies, the conversion of traditional "free" fuels into commercial and monetized circulation, and the possible decrease in flexibility for coping with uncertainties in household operations. In some ways, fuel supplies could be stabilized much to the advantage of peasant households, particularly if they are cheaper. On the other hand, bringing fuels into commercial channels not only limits freedom in household operations, it also may alter established patterns for women in fuel making, purchasing, and social relationships. All of these factors must be explored empirically, in an experimental project, before large scale operations are attempted.

## CONCLUSIONS AND RECOMMENDATIONS

This brief study concludes that densified biomass fuels are an attractive possibility as an alternative to firewood and agricultural residue fuels for low income urban and rural households. Published data and personal observation suggest that pressures on fuels, particularly biomass fuels, are increasing, and that households meet these pressures using a variety of strategies in which flexibility and interfuel substitutions are important. The study also concludes that the depletion of cattle manure from farmlands may be proportionately more serious than forestry depletion. Two thirds of cattle manure appears to be diverted into households for cooking; application of a substantial fraction of this presently diverted dung could result in significant benefits through the increased flow of cattle fodder or cash into households. Residues from agricultural production represent the other main source of flexibility in fuel supply, and on this count as well, densification of key wastes, notably cotton sticks and rice hulls, has the potential to improve the costs and benefits of fuel cycles in low income households.

Urban households represent a form of competition for rural fuels that makes life tougher for peasants. But the concentration of fuels, markets, and capital in cities, together with other factors, may make reorganization of fuel flows and marketing easier to achieve in cities than in rural areas.

On balance then, the largest uncertainties surrounding densification as an energy alternative are those having to do with the operation of the household — fuel substitutions, the role of women, use of individual time, and in general the structure and strategy of household operations in rural and urban areas. On these and more technical points — the efficiency of fuels, their burning characteristics, the acceptability of new techniques and technologies, seasonal variations and other factors — many more data need to be collected.

# NOTES

1. The data upon which this analysis is based were gathered in the course of fieldwork in Pakistan, including visits to the towns of Islamabad, Peshawar, Mardan, Charsada, Lahore, and Karachi. Numerous household interviews were conducted with the assistance of Anwar Iqbal of the Department of Anthropology, Quaid-i-Azam University in Islamabad. Excellent technical assistance and advice on rural households was provided by Mr. Iqbal and his associates in the Fepra (Nutrition) Project of Allama Iqbal Open University in Punjab. Visits were made also to numerous low-income households in Lahore with the assistance of Miss Iram Absar, nutritionist with UNICEF, and in Karachi with the assistance of Miss Quratul Ain, also of UNICEF. Altogether some 25 households or fuel markets were visited in urban and rural areas of three provinces in Pakistan. Data were also recovered from interviews with public officials in the energy sector as well as from numerous documents available at the Quaid-i-Azam University, the United Nations Library, and the USAID Library, all in Islamabad. Interviews were also conducted with technical personnel at USAID, the World Bank and at the University of California in Berkeley and Davis.

2. This is making conservative estimates of energy values for a unit weight of wood — 500 kilograms per cubic meter, and 17.8 gigajoules (GJ) per tonne.

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# IV. WOMEN AND NATURAL RESOURCES

# IV.1

# THE IMPACT OF AFFORESTATION ON WOMEN: THE DEVELOPMENT OF MARGINAL LANDS AND FEMALE FODDER COLLECTORS IN PAKISTAN[1]

Carol Carpenter

## INTRODUCTION

Women have a virtual monopoly over the livestock production portion of small farm operations in Pakistan. This means that the sale of animal products is an important source of income for many rural women. This source of income is dependent on the availability and quality of fodder. Yet fodder availability is rarely considered by development efforts aiming to transform agriculturally-marginal (but fodder-producing) land into wood lots or forest.[2] Forestry projects in Pakistan, and in countries where women are similarly linked to livestock, must include substantial fodder-producing components to gain the support of women for afforestation efforts. This paper describes three different patterns of livestock production in Pakistan and their implications for the afforestation of fodder-producing land.

## LIVESTOCK PRODUCTION AND WOMEN IN PAKISTAN

The primary economic activity of women in rural Pakistan is livestock production. Women in all the different agro-ecological areas of Pakistan spend approximately forty percent of each working day on livestock production activities: 41.38 percent in the irrigated portions of the Sind and Punjab, 40.3 percent in the rainfed portions of the Punjab and Northwest

Frontier Province (NWFP) and 40.91 percent in the deserts of Baluchistan and the Sind. The average amount of time women spend on livestock activities each day is five hours (See Appendix for detailed figures). As a pregnant woman carrying a load of fodder said: "I have to feed the animals, for our livelihood depends on them. We have to take more care of our animals than our children" (Khan & Bilquees 1976:259). In less personal terms, livestock provide draught power, transportation, milk products for the household diet and cash sales, and dung for fuel and fertilizer.

## Input: Fodder

Women in Pakistan are typically responsible for providing the essential input for livestock production: fodder. The collection, cutting, carrying, and processing of fodder are women's work all over the country. Women often graze animals as well, or indirectly control grazing carried out by their children.

The economic importance of fodder cannot be underestimated. When fodder and forest compete, fodder usually wins. As Mohammad Rauf (n.d.) writes of hilly Hazara District, NWFP, "the existing land use pattern of the guzara forest owners emphasizes grazing and fodder production rather than tree growth." These districts are characterized by a complex tradition of rights to forest products, including tenants' rights to fodder from individually-owned (malkiat) land, villagers' rights to commonly-owned (guzara) grazing lands, and a variety of usufruct rights to protected and reserved state forests. The battle between grass and tree, and livestock producer and forester, is centuries old in the hilly districts of Punjab and the NWFP: foresters and rural women openly describe each other as thieves.

To the rural people of Pakistan, feeding livestock is more important than educating girls. Women in the irrigated Punjab say they do not send their daughters to school because they cannot be spared from fodder collecting; as one woman said, when girls start reading books they do not tend the animals (Khan & Bilquees 1967:247, 249).

## Output: Milk

Women in Pakistan are typically responsible for the outputs of livestock production, especially milk and dung. Milking, and the processing of milk by churning and cooking into yogurt and ghee, are women's work. A farmer from a hilly district (Murree) of the Punjab said that forty percent of the people in the hills have milk buffaloes and the other sixty percent buy milk from them. Milk is important to the rural economy, and indeed to the economy of Pakistan: in 1984 and 1985 Pakistan imported 520 million rupees worth of milk and milk products. Because of this strong and growing market, the private sector in the country has lately shown increased interest in milk procurement and processing (Economic Adviser's Wing 1987; Agricultural Statistics of Pakistan 1986).

## Output: Dung

Women in Pakistan are also responsible for another important product of livestock production: dung. Collecting dung and processing it for use as fuel or fertilizer is women's work. Dung is one of the most important fuels in Pakistan. And it is widely used as a fertilizer, especially on the rainfed farms of the Punjab and NWFP. Here agriculture depends on manure to sustain the production of fruit and nut trees, corn, and potatoes: close to one half of the orchards, 39 percent of the maize farms, and 70 percent of the potato farms in the rainfed district of Rawalpindi, for example, use only manure to fertilize (Pakistan Census of Agriculture 1980). Field interviews in Murree district suggest that dung is collected by women and children, stored wet, and even sold, exclusively for use as fertilizer.

Most of the milk and dung produced by women is used on their own farms, but surpluses are sold. Women typically make decisions about how much milk to consume and how much to sell, and similarly about how much dung to burn, use as manure, or sell. Women sell surplus milk and dung locally, to customers who are typically other women. In rainfed Punjab and NWFP, for example, 94 percent of women sell animal products to fellow villagers (Freedman & Wai 1988:4). Livestock production is one of the few areas of the economy where all inputs and outputs traditionally flow through women's hands. In rainfed areas, eighty to ninety percent of the women who earn income from sales of livestock products have decision-making authority over this income (Freedman & Wai 1988:4). Any impact on livestock production thus has a direct impact on the activities and income of rural women in Pakistan. Generally speaking, if grasslands are converted to forest the cost of lost fodder is going to be paid primarily by women: it is women who will have to walk farther to accomplish an activity that is already taking up a large percentage of their time, and women whose income will diminish as their milk animals become less productive.

# PATTERNS OF LIVESTOCK PRODUCTION

There are three different patterns of livestock production in Pakistan, with different implications for the development of grasslands and the effects of such development on women.

## The Pastoral Pattern

The first pattern is pastoral, and is typified by the Baluch, a nomadic or semi-nomadic tribal people found in desert Baluchistan and in the Sind west of the Indus. In this pattern some agriculture occurs, but the rural economy is primarily based on livestock production. Agricultural land is less important than grazing land, and the people follow their herds to the latter even if it means abandoning the former.

In this pattern, women do not have the monopoly over livestock that they have elsewhere: the labor of raising livestock (and that of whatever agriculture does occur) is typically divided between men and women, with the particular division of labor varying by tribe. Herds are typically grazed by men rather than stall-fed by women, though women may graze smaller animals. As shown in Figure 1,[3] the bulk of women's work in this pattern is invested in milk production and processing, rather than the provision of fodder.

## The Rainfed Agriculture Pattern

The second pattern of livestock production is typical of the rainfed agricultural areas of the Punjab and NWFP. In this pattern agriculture is culturally more important than livestock production, though livestock are essential and may be more important economically than crops. Men are responsible for agriculture and women for livestock raising, but the two are interdependent.

In this pattern, land is put into agricultural production wherever there is sufficient soil and water, but there is ample land that cannot be cultivated left over for fodder production. Grazing and fodder-producing areas tend to be circumscribed and separated from farms. In the hilly districts of the Punjab and NWFP, for example, several patterns occur: grass belts of commonly-owned land may ring hill villages, separating them from the forest; small tracts of grassland may occur inside the forest, often in ravines or old landslides, and especially on hill and moun-

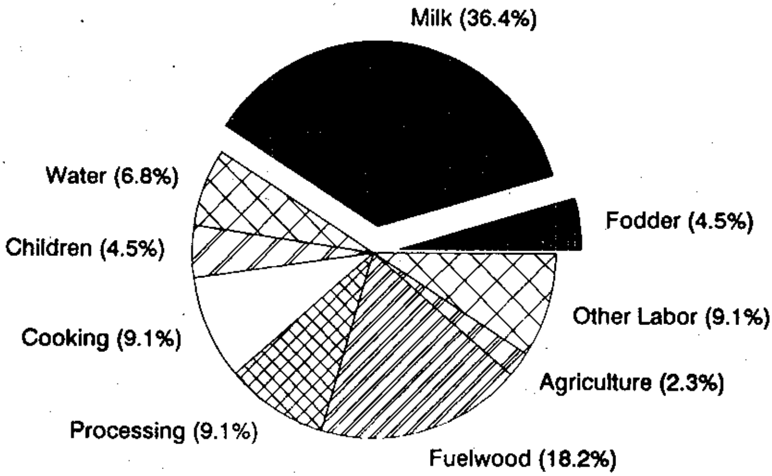


**Figure 1. Pastoral Baluchistan**

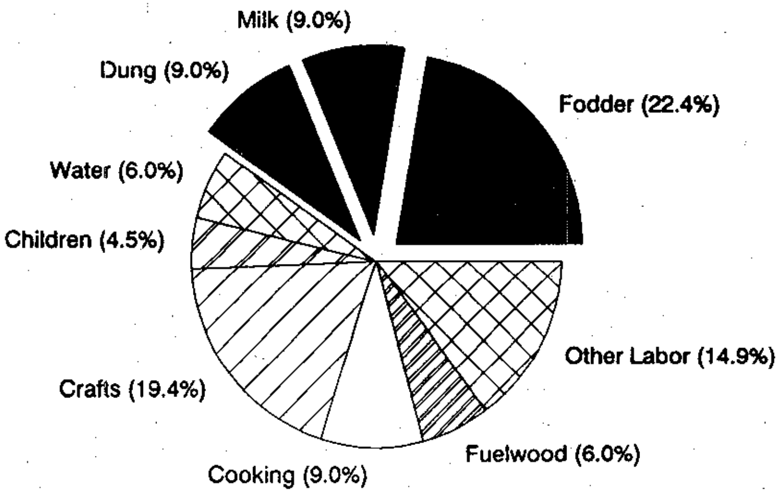


**Figure 2. Rainfed Punjab and NWFP**

taintops; or the bottom slopes of a hill may be cultivated and the upper slopes used for grazing. Though some animals are grazed, stall-feeding typifies this pattern: women cutting fodder or carrying huge bundles of fodder on their heads are common sights in rainfed areas, an observation supported by Figure 2.[4]

In the rainfed areas of the Punjab and NWFP, agriculture and livestock production are interdependent: agricultural production depends on manure, and milk production depends on fodder crops, weedings, or crop residues. As explained in a recent study by Jim Freedman and Lokky Wai,

> Crop and animal production cannot be considered as separate systems; they both sustain the household and they sustain each other. The maintenance of this system, or the interface between the two systems, is fundamental to the viability of the entire farming system. (Freedman & Wai 1988:16)

Freedman and Wai (1988:16) point out that the need to provide fodder for animals "strongly influences cropping strategies," using as examples the thinning of maize for fodder and the inter-cropping of wheat with rapeseed. The interdependence of livestock and agricultural production in rainfed areas has important consequences for any development strategy that decreases the supply of fodder; that is, any strategy that has an impact on livestock production will also have an impact on agriculture, and vice-versa. Freedman and Wai (1988:16) also demonstrate that women are primarily responsible for maintaining the interface between livestock production and agriculture: it is women who harvest crop fodder and take it to the animals, and women who collect manure and take it to the fields. It is clear that any development strategy that has an impact on women's productivity will have an impact on men's as well.

In many parts of rainfed Punjab and NWFP, livestock production is economically more important than agriculture. High population has fragmented small farms, leading to male out migration and thus an acute labor shortage for male agricultural work. In Murree district, for example, only 14 percent of the primarily male labor force is employed in agriculture, while 70 percent work in service industries or in the armed forces, mostly away from their farms in the hills. Women and children typically remain behind, and as a result women's work — livestock raising — is increasingly important, to the point where hill forests are being overgrazed. In the areas studied by Freedman and Wai (1988:4), animal products sold by women contributed an average of 13 percent of total household income, while the sale of crops averaged only 10.8 percent.

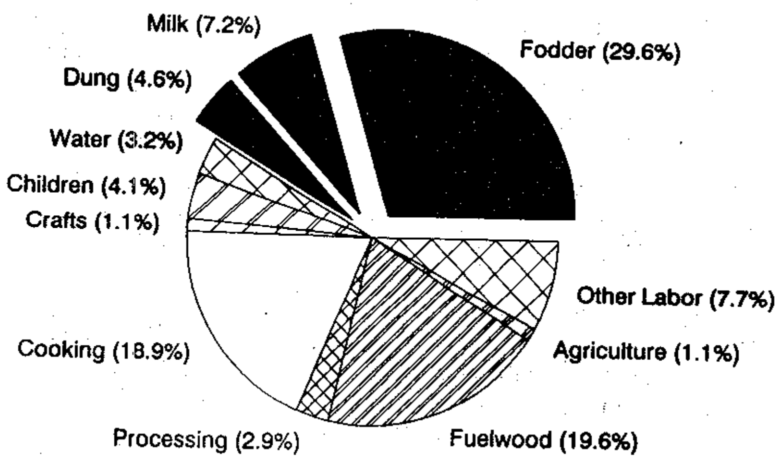


**Figure 3. Irrigated Punjab and Sind**

## The Irrigated Agriculture Pattern

The third pattern of livestock production, typical of the irrigated areas of the Punjab and Sind, is a combination of the first two. In irrigated areas, the subsistence of marginal farmers and the landless often depends, like that of the nomadic Baluch, on grazing livestock. The economy of farmers with sufficient land, on the other hand, like that of the rainfed farmers of the Punjab and NWFP, emphasizes agriculture supplemented by stall-fed livestock.

Irrigation can thus be described as a split economy, in which landowners and the landless pursue two different economic patterns. This split is associated with the caste system, especially in the Punjab: landowners in irrigated areas typically belong to farming castes that were settled in the area when it was first opened up to irrigation, while the landless are often members of service or tenant castes. This division is also historical: today's landless are often descendents of *janglees*, indigenous inhabitants of the area who were pastoralists before irrigation.

Irrigation favors the economy of the landed and puts pressure on that of the landless. It allows those with enough land to intensify both agricultural and livestock production, by stall-feeding their animals fodder crops. Because livestock raising is intensified, the women in these families often work harder than their sisters in the rainfed Punjab and NWFP.

But if irrigation intensifies livestock production for the landed, it makes it problematic for those without sufficient land to grow fodder crops. Irrigation reduces the amount of uncultivated land available for grazing, sometimes leading to the overgrazing of commonly-owned grasslands. The landless or marginally-landed people in irrigated areas, men and women, typically supplement livestock production with agricultural wage labor, a pattern also found in pastoral Baluchistan and Sind. Tenants bargain for the right to cut grass and weeds for fodder in their landlords' cultivated fields, and to purchase their landlords' crop fodder at concessional rates (Khan & Bilquees 1976:242).

The data for Figure 3[5] combines a Punjab tenant's workday with survey data on all classes of women in irrigated Sind; further research will be required to understand how the different livestock production patterns of the landed and the landless affect women's work days. It is evident that both landowners and the landless devote a significant amount of time to providing fodder. In a 1966 study in the irrigated Punjab, for example, twenty percent of the women studied spent more than two hours cutting fodder during the sowing season, and more than four hours during the harvesting season; another thirty percent of the women spent one to two hours cutting fodder during the sowing season, and two to four hours during the harvesting season (Saeed 1966:27-28).

Before the extensive irrigation system of the Indus was developed, the emphasis on livestock over agricultural production probably typified most of Pakistan. Historically, rural women probably took over livestock farming as it became secondary, that is, as agriculture — often thanks to irrigation — became the primary economic activity, and livestock moved off the land and into stalls. In the Punjab, the transition from livestock to agriculture was unshered in by the introduction of irrigation. As Seemin A. Khan and Faiz Bilquees explain,

> An immediate conflict arose between the local inhabitants, *janglees*, and the new settlers, *abadkars*. The local inhabitants were mainly pastoralists who allowed their cattle to roam the countryside. They strongly resisted the settlers who opposed open grazing that destroyed their crops. Law and authority were on the side of the new settlers. The resistance of the *janglees* eventually gave way and the land was brought under cultivation. (Khan & Bilquees 1976: 238)

Khan and Bilquees define *janglees* (1976:238f) as "cattle-breeders and land owners" who, like the Baluch today, "did random cultivation with the aid of rain water."[6]

It is interesting to note that, according to Khan and Bilquees (1976: 257), milking is considered to be a women's job in the settler's community, while women in the *janglee* community "are not allowed to milk because it is considered improper for a woman to touch a cow's teats."[7] The pastoralist *janglees* reserve milking for men, as a sign that livestock production is a male activity. In areas where irrigated agriculture predominates, in contrast, it is typical to have the act of plowing reserved for men.[8]

## WOMEN AND LIVESTOCK PRODUCTION: THREE PATTERNS COMPARED

In Figure 4, the percentages of time women invest in the three main activities of livestock production are compared for the three different patterns of livestock production.

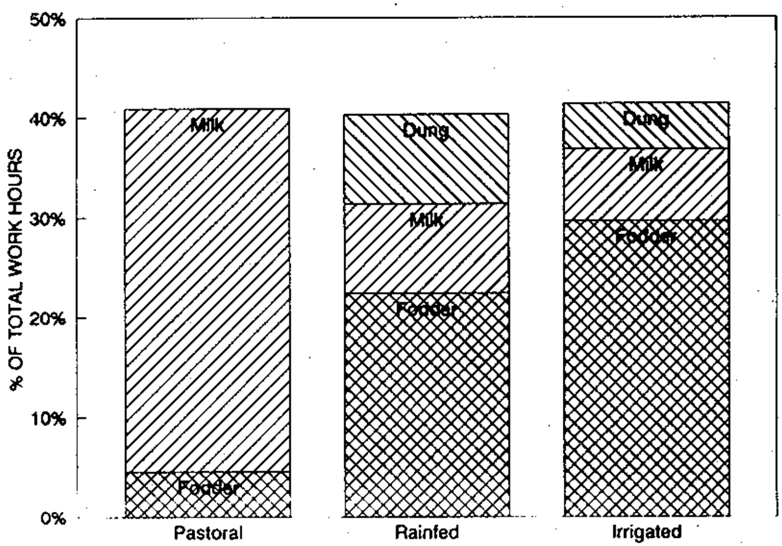


**Figure 4. Women & Livestock Production**

In pastoral Baluchistan and Sind, where the rural economy is based on livestock production, women spend much more time in milk-producing activities than they do in agricultural areas. Since men are primarily responsible for grazing animals, women in pastoral areas spend the least time collecting fodder. Since dung is not needed for crop manure, and because grazing makes dung impractical to collect, no time is spent on collecting dung.

Women in rainfed Punjab and NWFP spend more time than women in irrigated areas collecting and processing dung, which is essential to the productivity of their agriculture. In rainfed areas, women spend less time collecting fodder than they do in irrigated areas, a fact that is probably due to the relative availability of uncultivated, fodder-producing lands.

In irrigated Punjab and Sind, where livestock production is either intensified or under pressure depending on a household's access to land and fodder, women spend much more time collecting fodder than they do in any other area.

## SUMMARY

The fact that women are highly involved in livestock production has important implications for the development of fodder-producing lands. It is immediately clear that women's economic position can be significantly improved by improving the main input to livestock production: fodder. Reaching women with extension advice about livestock could also have a significant impact on their lives. These conclusions are shared by Freedman and Wai:

> Increasing the resources and skills that are available to women for livestock production should significantly augment household income; it should also augment the amount of income over which women, themselves, exercise control; ... it may also help to make access to resources and decision-making authority more equitable among family members and thereby make it possible for women to have more control over their own destinies. This may result in women availing themselves of more health and educational services ... if not for themselves, then for their female offspring. (Freedman & Wai 1988:3)

It is also immediately clear that forestry projects planning to plant trees on land that is now producing fodder or being used to graze livestock must work with women if they are to succeed.

The particular implications women's involvement in livestock production has for the development of fodder-producing lands will differ depending on particular patterns of production. First of all, among pastoralists, men and women will be equally affected by limitations on their grazing land, which threaten their joint livelihood.

Secondly, in areas of rainfed agriculture, men's and women's interests in fodder-producing lands may differ. For example, men may favor raising trees as a cash crop to the exclusion of fodder, while women favor continued grass production. Even if men and women think their interests differ, however, the close interrelationship between livestock and agricultural production means that anything that causes a decline in one will affect the other.

Thirdly, in areas of irrigated agriculture, the landless and marginal farmers will be more affected by fodder shortages than those with sufficient land to raise fodder crops. Like pastoralists, landless men and women will be equally affected. Any development of commonly-owned grasslands that further reduces their access to fodder threatens their already-marginal livelihood, and increases their dependency on fodder crops and agricultural wages from the land-owning minority.

# NOTES

1. This article is loosely based on a July 1987 report entitled 'Women's Participation in Project Activities', which was prepared with the help of Dr. Riffat Sardar, under a Ronco Consulting Corporation contract, for USAID Pakistan's Forestry Planning and Development project. The author alone is responsible for the ideas contained in this article.

2. This article is mainly concerned with the effects of afforestation projects on women, but the same effects result from projects that aim to make marginal lands agriculturally productive.

3. Figure 1 data is estimated, partly from data on a similar people in Iran (Hunte & Sultana 1984; Pastner 1982; Shashahani 1986). See Appendix for details.

4. Figure 2 is taken from data appearing in Ishrat 1981. On rainfed NWFP, see also Rauf (n.d.:137-149). See Appendix for details. On rainfed Punjab and NWFP, see Freedman & Wai (1988). Freedman and Wai give two very different sets of time estimates, one concerning a single (remembered) workday's activities, and one concerning annual averages. The average of these two charts (dividing the annual figures by 365) are nearly identical to Ishrat's figures for fodder, milk, and dung-related activities, that is, 2.6 hours for fodder collection (22% of workday), and one hour each for milk and dung-related activities (8% of workday each).

5. The figures for Figure 3 are averaged from data appearing in Khan & Bilquees (1976: 261) and Qadri & Jahan (n.d.:21-44). See also, on irrigated Sind, Abbasi (n.d.), and on irrigated Punjab, Saeed (1966). See Appendix for details.

6. In Saeed's 1966 study of the irrigated Punjab, the *janglees* were of the Baluch caste.

7. Saeed's 1966 study (p.23) notes that the *janglee* Baluch-caste women milk animals less often than women of other groups, but that their participation is still very high: 74 percent compared to 88 percent.

8. See Ester Boserup (1970:24-31). Boserup notes that plow cultivation (as opposed to shifting cultivation) is characterized by male labor and the veiling of women, who contribute mainly to harvesting and the care of livestock.

# APPENDIX

**Women's Workday in Three Agro-Ecological Zones of Pakistan**

| | Irrigated Punjab & Sind | | Rainfed Punjab & NWFP | | Pastoral Baluchistan | |
|---|---|---|---|---|---|---|
| | Hours | % | Hours | % | Hours | % |
| Cutting, Carrying and Preparing Fodder | 3.81 | 29.62% | 2.69 | 22.39% | 0.50 | 4.55% |
| Milking & Churning | 0.93 | 7.20% | 1.07 | 8.96% | 4.00 | 36.36% |
| Collecting Dung and Making Dung Cakes | 0.59 | 4.55% | 1.07 | 8.96% | 0.00 | |
| Cooking & Feeding | 2.43 | 18.88% | 1.07 | 8.96% | 1.00 | 9.09% |
| Carrying Water | 0.42 | 3.23% | 0.72 | 5.97% | .75 | 6.82% |
| Child Care | 0.53 | 4.09% | 0.54 | 4.48% | 0.50 | 4.55% |
| Other Household Labor | 0.99 | 7.71% | 1.79 | 14.93% | 1.00 | 9.09% |
| Handicrafts | 0.15 | 1.13% | 2.33 | 19.40% | 0.00 | |
| Food Processing | 0.38 | 2.92% | | | 1.00 | 9.09% |
| Agricultural Activities | 0.14 | 1.09% | | | 0.25 | 2.27% |
| Collecting Firewood | 2.52 | 19.58% | 0.72 | 5.97% | 2.00 | 18.18% |
| Livestock Subtotal | 5.33 | 41.38% | 4.83 | 40.30% | 4.50 | 40.91% |
| Total | 12.85 | 100.00% | 12.00 | 100.00% | 11.00 | 100.00% |

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# IV.2

# THE ROLE OF RURAL BANGLADESHI WOMEN IN LIVESTOCK PRODUCTION

**Shelley Feldman, Fazila Banu, and Florence E. McCarthy**

## INTRODUCTION

The purpose of this paper is to document women's participation in the production of livestock in Bangladesh. Based on data collected from four villages in two regions, the study examines the social relations of livestock production focusing primarily on factors of family status and gender. It is hypothesized that the specific activities that different family members perfom in the production of livestock vary by configuration of household membership and the family control of productive resources.

Since approximately 85 percent of Bangladesh's population resides in rural areas, most families are involved in various farming and rural-based nonfarm activities, including the rearing, care, and sale of livestock. Available aggregate data indicate that among households with cultivable or homestead land, representing 6,852,558 farm holdings in 1977, livestock keeping is an integral part of their agricultural activities; an additional 595,385 households owning no land reported rearing livestock (World Bank 1981). The category of livestock includes horses, buffalo, cows, goats, sheep, pigs, and poultry. Unfortunately, there are no available data indicating either the distribution of livestock by type or number among rural households or the differential production relations which determine the kind of livestock reared.

Livestock raising is characterized by a domestic division of labor prescribed within the cultural context of *purdah*, or female seclusion (McCarthy 1967; Feldman and McCarthy 1983); however, unlike the gender division between *bari* (household compound) and field work characteristic of rice production, the ownership and labor invested in animals is more fluid and flexible. For example, women engaged in livestock production may personally own animals, own them with other household members, or raise animals on a sharecropping basis. Women have primary responsibility for selected aspects of livestock care. In contrast, female laborers involved in field agriculture as harvesters of potatoes and chilies or as participants in various aspects of jute cultivation neither own land nor work on land that the household obtained through sharecropping arrangements. This indicates that land ownership is neither a prerequisite nor a required complement to livestock rearing. Such differences in resource control suggest that the articulation of the domestic and social division of labor depends on the kind of productive resources owned or controlled. This study is an effort to specify the social and technical division of labor corresponding to livestock production in Bangladesh.

Furthermore, although it is already well documented that women play an important role in post-harvest processing operations and in the preservation and storage of agricultural products and seeds, their participation in other agriculturally related activities is hardly recognized, nor is it included in national income statistics and planning. Moreover, simple assessments of the diffusion of livestock within the rural economy ignore differences in livestock-rearing practices, as affected by differences in labor availability because of household size as well as in the availability of household surplus income to hire labor for in-kind or cash remuneration. An analysis of these practices would help to elaborate the domestic division of labor and would assist in understanding the class and gender relations matrix among rural-based households. It is intended that this study will begin to remedy these oversights.

## LIVESTOCK PRODUCTION: OUTCAST OF THE AGRICULTURAL SECTOR

Although livestock production plays a secondary role in agriculture, the contribution of livestock to the overall economy is considerable. Animal traction provides approximately 98 percent of draft power for crop production, including plowing and threshing. Livestock provides rural transportation for goods and people as well as animal protein for consumption and also provides cash income from the sale of animal byproducts such as hides, skins, and bones for local and export markets.

Indeed, skin and hide exports are a growing source of foreign exchange earnings in the economy of Bangladesh, increaseing from zero in 1980-81 to Tk 8 million ($US 320,000) by 1982-83. Recent government policy to further increase foreign exchange earnings through the development and expansion of exports is promoting growth in the export of skins and hides — from cattle, buffalo, goat, sheep, snake, lizard, and wild deer — as well as finished leather goods, including shoes. When the export of skins and hides is combined with leather and leather manufactures, they comprise the third most valuable source of foreign exchange for the country. Italy and Sweden are the largest importers of semi-finished and finished skins and hides.

At the household level, manure provides an important source of fuel and farm fertilizer. Wennergen (1983:104) suggests that about half of the estimated 20 million tons of livestock and buffalo dung (dry) produced annually is used as fertilizer, and an additional 20 percent is used for fuel. In the construction of mud homes, the most common type in the country, dung is used to strengthen walls, and in Hindu households, to reinforce house floors. Most rural families use dung on courtyards. In addition, households use cow urine as an insecticide, particularly against earthworms, while potters and those working with clay use it to color their wares.

Despite the assumed integration of livestock and other agriculturally-based production activities among rural households, and despite the expansion of the export market for livestock products, the livestock sector's direct contribution to Bangladesh's GDP (gross domestic product) was estimated at only five percent in Fiscal Year 1983, although World Bank figures suggest that it may have been as high as 10 percent. The difference between these relatively low figures and the image created above could partially be due to nonstandardized reporting; this could be rectified by an improvement in the crude estimates available on the kind, quality, and distribution of animal ownership.

National livestock production figures, summarized in Table 1, indicate only a small increase in the number of cattle, buffalo, and sheep between 1960 and 1977. The production of goats and chickens increased more significantly, but these estimates, given their uncertain data base, should be used only to establish general trends. There are no registration procedures for livestock, and government officials offer only limited extension services, so the only source for most such census data is guesstimates by upazilla (country) livestock officers.

Table 1 indicates that with the exception of chickens and goats, overall growth in the livestock sector has been quite small. The slow growth rate may be partially explained by the nature of the existing resource base and technical infrastructure. That is, the scarcity of land and the relatively high cost of rearing animals have essentially precluded the

**Table 1. Comparison of Number of Livestock and Poultry, Bangladesh, 1960 and 1977**

| | Number of Animals | | | | | % Change |
|---|---|---|---|---|---|---|
| | 1960 | 1977 | | | | |
| Kind of Animal | Total | Under 1 year | 1-3 years | Over 3 years | Total | |
| Cattle, total | 18,961 | 3,182 | 3,005 | 14,322 | 20,509 | 8.2 |
| male | | 1,278 | 1,486 | 7,610 | 10,374 | |
| female | | 1,904 | 1,519 | 6,712 | 10,135 | |
| Buffalo, total | 455 | 46 | 46 | 376 | 468 | 2.9 |
| male | | 17 | 25 | 235 | 277 | |
| female | | 29 | 21 | 141 | 191 | |
| Horses | .. | .. | .. | .. | 28 | |
| Goats | 5,660 | 3,784 | 4,653 | ... | 8,437 | 49.1 |
| Sheep | 477 | 194 | 313 | ... | 507 | 6.5 |
| Chickens | 20,096 | 25,405 | 16,061 | ... | 41,466 | 106.3 |
| Ducks | .. | 4,797 | 7,327 | ... | 12,124 | ... |

Source: Abstracted and corrected from Bangladesh Bureau of Statistics, 1981:293; Wennergren 1983:103; and World Bank 1984:84.
.. = not available; ... = not applicable.

development of a livestock sector that could produce animals solely for food (Wennergren 1983). The animals identified for slaughter are those unable to work or female calves not essential for herd replacement. Moreover, lack of technical expertise and inputs to improve the quality and care of livestock have inhibited significant expansion of primarily subsistence-based production, given the resource base of the majority of rural households.

The available animals are genetically poor and small in stature. Cows calve every other year, and the calf mortality rates are estimated at 25 to 30 percent in the first year. These high rates are caused by nutritional stress, disease, and death caused by predators (Wennergren 1983:198-202). There is limited country-wide veterinary care, and, as already mentioned, the government has only a modest livestock extension service. Furthermore, the increased concentration and fragmentation of landholding has limited the cultivation and availability of fodder, a situation which threatens the ability of subsistence producers to rear buffalo and cows. Not surprisingly, goats and poultry, both scavengers, appear less affected by such changes, so ownership of these animals is more diffused among the rural population.

As is true in many Third World countries, the livestock sector faces serious constraints: weak genetic stock, widespread animal disease, scarcity of feed, limited knowledge of improved feed and animal husbandry practices, weak extension and training services, and limited access to new technology, including genetic stock improvement and disease control.

# RESEARCH METHODOLOGY

This paper draws on data gathered on rural women's involvement in livestock production (Akhter and Banu 1983), in a 1983 study funded by the Agricultural Development Council, Dhaka. Data were collected from one *upazilla* in each of two districts in Bangladesh purposively selected in an effort to maximize regional differences in animal population density, access to markets, and ecological variability. From each *upazilla* two villages were then purposively selected, based on the diversity of animals owned by village residents. The area with high animal population density, in the southeast corner of Rangpur district, is characterized by two rice crops and one winter vegetable crop per year. This area is also a sugar and banana surplus production area. Nearly 60 percent of the net cropped area is double cropped, and 10 percent is triple cropped. In

Rangpur, Gobindaganj *upazilla* was selected because it has one of the country's largest livestock markets and is easily accessible by road.

The second area, Jamalpur district, in the north central region, is characterized by high flooding, extreme erosion, and changes in water levels. The lack of flood control means there is generally one rice crop, the *aman* crop, grown during July through mid-November, and there is minimal production of jute and sugar cane. Changing siltation patterns in the area result in extreme changes in land availability and land use. Dewanganj *upazilla* was selected because it represents an area nearly inaccessible by road and greatly affected by erosion. Erosion in some places causes people to lose land, while in other places people gain additional parcels, called *char* lands, which are strips of sandy land rising out of the bed of a river above the water level.

It was anticipated that the extreme variation in animal density and farm production levels, in conjunction with the ecological variation of the two regions, would yield differences in livestock-rearing practices and that differential household labor demands would be reflected in various livestock production strategies. It was further assumed that road accessibility would affect access to extension and training services as well as marketing facilities and therefore would also have an impact on rearing practices. In sum, these site selections were expected to capture some of the predicted variability in livestock-rearing practices.

Two villages were then purposively selected from each *upazilla*, based on the diversity of animals owned by village residents. After a complete village census, households were stratified by the amount of land and number of animals owned. From each village a stratified random sample of households was drawn. Members of each household were interviewed by using an open-ended questionnaire focused on livestock ownership and rearing practices. In addition, a demographic profile of each household was elicited from the respondents, using structured interview techniques.

The total population of sample households in the four villages was 1229:646 people in Dewanganj and 583 people in Gobindaganj. From the two villages in Gobindaganj, 54 and 53 households were selected; in Dewanganj the sample included 35 and 67 households, for a total sample size of 209 households. The purposive selection of the regions and their proportionate randomization of the households provides assurance of representativeness, given the lack of baseline information.

In the data analysis it was evident that the variations in resource packages and the configuration of resource control required a composite variable that could account for this diversity. In addition to landholding, therefore, households were differentiated into five socio-economic categories: secure, middle, lower middle, poor, and very poor. In estimating family socio-economic status, income security and sources, land and resource ownership and control, and food consumption patterns, health, and education were considered. Only descriptive statistics were employed in the construction of this variable and in the overall data analysis.

## CHARACTERISTICS OF LIVESTOCK-REARING HOUSEHOLDS

Livestock-producing households represent between 93 and 95 percent of all sample households. That is, of all categories of household in the four villages, fully 94 percent of them raised some livestock or poultry, whether compared by amount of land owned or by primary source of income, or whether subsistence agricultural producers or wage-dependent ones. This is quite a dramatic finding, given the limited recognition livestock has received from national planning bodies and foreign assistance programs. The diffusion of livestock production in the rural economy, however, sheds little light on the kind or amount of livestock owned by different categories of families or the social relations of livestock production within the household. The kind or amount of livestock owned is a critical indicator of surplus production and sector expansion potential.

The livestock-producing households in the study were differentiated between predominantly agriculturally-based units and those relying on off-farm, generally wage-based income to supplement on-farm earning. Agriculturally-dependent households may engage in a variety of production relations, depending on their control of land, technical inputs, and labor. For example, a few own some land and sharecrop land in, while others combine primarily agricultural activities with supplemental nonagricultural income sources.

Wage-dependent households combine agricultural labor with petty commodity production, informal sector employment, government service, or other wage-based labor exchanges. Since the majority of the population of the Dewanganj sample had lost land due to erosion, farming was a primary occupation for only 18 percent of all livestock producers. The comparable figure for households that controlled land in Gobindaganj was 40 percent, with 29 percent farming their own land and an additional 11 percent sharecropping land in. The primary occupations of the sample households are summarized in Table 2.

**Table 2. Primary Occupational Category of Sample Households in Gobindaganj and Dewanganj *Upazillas***

| Primary Occupation | Gobindaganj | Dewanganj |
|---|---|---|
| Farming own land | 31 | 19 |
| Sharecropping | 12 | 0 |
| Agricultural labor | 27 | 36 |
| Busines | 13 | 14 |
| Service | 6 | 2 |
| Casual labor | 5 | 22 |
| Female wage labor | 2 | 1 |
| Begging | 7 | 1 |
| Nonresident family support | 4 | 7 |
| Total | 107 | 102 |

Male off-farm occupations in Dewanganj include petty trading of rice, wheat, jute, small livestock, and poultry, and fishing and laboring on small boats which transport goods intraregionally. Men in Gobindaganj villages are engaged in semiskilled occupations such as weaving, wood processing and sales, sweets making, butchering, processing and sale of animal hides, and rickshaw pulling. A few men are employed in government service. Sharecropping opportunities in Dewanganj are likely to be constrained by both the lack of surplus land among owner-producers and/or the lack of a plough and other technical resources, including labor, among families interested in sharecropping land in. Resource limitations prohibit such families from negotiating with landowners. When landlessness characterizes more than a single generation, it is likely that agricultural skills with which to negotiate sharecropping arrangements are also limited.

Among sample families living in Dewanganj and Gobindaganj *upazillas*, married women living with husbands or other family members tended to have limited off-farm employment opportunities. The women who did work were primarily from landless or land-poor families. They found employment in neighbouring villages as household laborers engaged in post-harvest processing, including threshing and winnowing of paddy and grinding of spices, and assisting in housework. Remuneration for harvest-related work is generally two meals during both the harvest and non-harvest seasons.

Migration patterns, also indicative of available labor power within a family or region, are likely to have an impact on a family's ability to rear livestock. Although detailed national census data for intraregional and interregional migration are scanty, available data indicate that Rangpur increased its population through migration flows in both 1961 and 1974, when data were collected. Jamalpur, on the other hand, once part of Mymensingh District, exhibited new outflow of population for these same years (Bangladesh Bureau of Statistics, 1979:90; Table 2.53). It is generally assumed that migrants are either families permanently migrating to new districts to live and work, males traveling alone, or women from female-headed households (McCarthy 1982). Temporary family migration is common only in the areas along the coast where families fish during one season and plant during another (Akhter and Banu 1983). These different migration patterns are important for understanding labor availability and no doubt affect intrahousehold labor allocation supporting livestock production.

Interdistrict seasonal migration of agricultural laborers for agricultural employment was found in both regions. Limited employment opportunities in the rural areas has also generated migration to small towns or the capital city. These patterns are indicative of strategies employed by poor families, where all family members must seek and need employment if the family is to survive as an economic and social unit. In the Gobindaganj sample, no rural households had migration as part of their survival strategy. Two families had husbands who temporarily migrated for employment for 10 to 15 days and then returned home. In the Jamalpur area, on the other hand, household members migrated to Dhaka for work and found employment as day laborers, market coolies, rickshaw pullers, or pushcart drivers. When they migrated as families, all family members sought work. Women found work as housemaids or as unskilled laborers, carrying cement, working on construction sites, or breaking bricks; children worked as street vendors, shoeshine boys, or market coolies. Migration of entire households to Sylhet, Rangpur, Jamalpur, Mymensingh, and Dhaka occurred in 15 percent of the sample households in Dewanganj; if we add male migrant laborers, the figure rises to 18 percent.

Labor availability is determined by the number of household members who are able to work and by the ability of families to hire labor to lighten the workload or replace family labor. Family size is another useful indicator of available household labor. In the Bangladesh context, family size includes members of the extended family, since the majority of rural households continues to live as joint families. The average family size in the sample was 6.33 in Dewanganj and 5.45 in Gobindaganj, while the national average is 5.6 (Chaudhury 1981:198).

Families of 10 or more members comprised 9 percent of the study population, which parallels the national distribution of household size. In Dewanganj 64 percent of all households had between 5 and 9 members, whereas in Gobindaganj only 50 percent of the households were of the same size. Fully 41 percent of the households in the Gobindaganj sample had four or fewer members per household, while 25 percent of the households in the Dewanganj sample fell in this category. This information in summarized in Table 3.

**Table 3. Comparison of Family Size by Area (in percent)**

| Family Size | Nation* | Upazilla: Gobindaganj Sample (N=107) | Upazilla: Dewanganj Sample (N=102) |
|---|---|---|---|
| 1-4 | 36.9 | 41.1 | 25.2 |
| 5-9 | 53.1 | 49.5 | 64.7 |
| 10 or more | 9.8 | 9.4 | 9.8 |

*National data are from Bangladesh Bureau of Statistics, 1985, p.156.

Of the sample households, there was a 50:50 ratio between nuclear and joint families in Gobindaganj and a 62:38 ratio of these household types in Dewanganj. Fourteen of the households in the 1-4 family size category in Gobindaganj were female-headed, whereas there were only four households of this type in Dewanganj. Given the greater tendency for urban migration in Dewanganj, it is likely that widowed women leave the area when they are unable to draw on family support for survival, particularly given the difficulty of securing employment in the village. The lower representation of small nuclear families also suggests that, in the context of changing landowning patterns, nuclear families are more likely than joint families to permanently migrate to urban centers, as families lose land and cannot find either agricultural or nonfarm employment. These highly marginal agricultural households are also the least likely to be able to own livestock or engage in livestock production.

In addition to off-farm employment, migration, and family size as indicators of available household labor, other factors that differentiate among livestock-rearing households include control of land (both owned land and land sharecropped in), agricultural labor opportunities, and subsistence crop production. The landholding pattern of the study population is presented in Table 4.

**Table 4. Landholding Pattern of Sample Households in Gobindaganj and Dewanganj *Upazillas***

| Farm Size | Upazilla | | | | | |
|---|---|---|---|---|---|---|
| | Gobindaganj | | Dewanganj | | Total | |
| | Number | Percent | Number | Percent | Number | Percent |
| Landless | 11 | 10.3 | 38 | 37.3 | 49 | 23.4 |
| Homestead only | 53 | 49.5 | 33 | 32.4 | 86 | 41.1 |
| Less than 2.5 acres | 19 | 17.7 | 19 | 18.6 | 38 | 18.2 |
| 2.5-7.4 acres | 19 | 17.7 | 9 | 8.8 | 28 | 13.4 |
| 7.5 acres or more | 5 | 4.6 | 3 | 2.9 | 8 | 3.8 |
| Total | 107 | 100.0 | 102 | 100.0 | 209 | 100.0 |

An examination of Table 4 reveals that the landholding pattern in Gobindaganj generally resembles the national findings of the Land Occupancy Survey, in which landless households — including the totally landless, those owning only household land, and those with less than 0.5 acres of cultivable land — totalled almost 60 percent of the population (Jannuzi and Peach, 1977). In Gobindaganj 5 of the 19 households in the less than 2.5 acre category owned less than one-half acre, bringing the total number of landless households to 69, or 53 percent of the total sample. What is not revealed in this table is that the five households in Gobindaganj with more than 7.5 acres owned 25 percent of the land owned by all sample households, and the three households in Dewanganj with more than 7.5 acres owned 44 percent of the land owned by the 102 sample households there. Of the latter three families, two sharecropped land out to other villagers, although there were no sharecroppers among the sample households there. Seven Gobindaganj families, however, did sharecrop land in, in combination with owning some land or a service occupation. In the latter case, income from sharecropped land supplemented primary income earned in government service.

As would be expected given the ecology of the region, land distribution in Dewanganj is much more skewed. Seventy percent of the sample households owned no cultivable land, and an additional five households owned less than one-half acre, increasing the total of the effectively landless to 75 percent of the Dewanganj sample. Of the sample households in Dewanganj, 86 percent reported earning supplementary forms of income or transacting in-kind exchanges. For males, this included running a small business or working as casual laborers in farm or nonfarm activities. For women, work usually took place in the homes of more secure families and was remunerated in kind rather than in cash.

The diversity of resources owned or controlled by the sample households — including employment opportunities, social status, and patterns of consumption — indicates a need for reassessing the traditional focus on land ownership among peasant households as the sole indicator of economic solvency. A composite socio-economic variable differentiated into five categories generates the following distribution of sample households when the two *upazillas* are combined: 21 households (10 percent) were categorized as secure; 21 (10 percent) as middle; 43 (21 percent) as lower middle; 101 (48 percent) as poor; and 23 (11 percent) as very poor families. For purposes of national comparison, secure and middle status families fall within the middle 40 percent of the Bangladesh population, while the lower middle to very poor categories are equivalent to the lowest 40 percent of the population and represent generally land poor or landless household without fixed wages. None of our sample households would qualify in the top 20 percent of Bangladeshi families.

This summary statement masks important differences between the two sample *upazillas*. These differences are summarized in Table 5 and can be compared with the distribution of sample households by category of land ownership, found in Table 4.

Table 5 reflects important theoretical and substantive differences in discussions of economic solvency, family survival patterns, and relations of agricultural production in Bangladesh. The recognition of the complexity of income and resource control among families also indicates processes of rural transformation and changes in national agricultural practices. Theoretically, it elaborates a complex notion of rural resources which is capable of incorporating elements of the capitalist sector within traditional small holder resources. Substantively, it emphasizes the diversity of technical and social resources required for the reproduction of the original economy in the country.

At the extremes — the secure and very poor families — income, occupation and status diversity depart more significantly from simple landholding as an indicator than for the households in the three middle categories. For Dewanganj in particular, limited opportunities for landownership among the poor have forced families into the wage sector. Thus the 38 Dewanganj families in the landless category are now divided into the very poor and the poor, indicating how job security and wages

**Table 5. Comparison of Socio-Economic Status of Sample Households in Gobindaganj and Dewanganj *Upazillas***

| Household Socio-economic Status | Upazilla | | | | | |
|---|---|---|---|---|---|---|
| | Gobindaganj | | Dewanganj | | Total | |
| | Number | Percent | Number | Percent | Number | Percent |
| Secure | 16 | 15 | 5 | 5 | 21 | 10 |
| Middle | 12 | 11 | 9 | 9 | 21 | 10 |
| Lower middle | 23 | 12 | 20 | 20 | 43 | 21 |
| Poor | 43 | 40 | 58 | 57 | 101 | 48 |
| Very poor | 13 | 12 | 10 | 10 | 23 | 11 |

Source: Adapted from Akhter and Banu, 1983.

help distinguish a household's socio-economic status and help elucidate patterns of economic solvency and family survival.

# THE PATTERNS OF LIVESTOCK OWNERSHIP

Livestock ownership takes two primary forms, either privately-owned stock or livestock exchanged and reared in a share relation. In the production of field crops, share relations are similar to sharecropping relations. In the former case, households rear their own animals, buy and sell stock, or receive them as gifts. In the second case, households contract with others to share responsibility for certain animals and to divide their offspring. In these arrangements a member of a wealthier family supplies an animal or bird to a person of a second household, with the understanding that the person will raise, care for, and bear all the expense of rearing the animal or bird. In exchange, alternate offspring or a certain number of poultry are given to the owner of the original stock. Such an arrangement lasts for the lifetime of the livestock.

Women are often involved in such arrangements, since sharing gives them access to resources otherwise unavailable to them or beyond their capital capacity, given their limited access to markets. The benefits women receive for supplying livestock in a share arrangement include this return of young stock for which only an initial investment was made. These arrangements also provide a source of income independent of husband or family control.

## *Farm Size*

The study findings reveal that livestock ownership varies by size of landholding as well as by the kind of animal owned. Surprisingly, national statistics for both districts and for the country as a whole indicate an inverse relationship between landholding and the number of livestock owned. This information is summarized in Table 6.

**Table 6. Average Livestock Holding by Farm Size, 1977 (Number of Animals per Acre)**

| | Farm Size (Cultivable Land in Acres) | | | | |
|---|---|---|---|---|---|
| Area | 0.5-1.4 | 1.5-2.4 | 2.5-7.4 | 7.5 or more | Average |
| Rangpur | 1.7 | 1.3 | 1.0 | 0.7 | 1.0 |
| Jamalpur | 3.0 | 1.0 | 0.7 | 0.5 | 0.5 |
| Bangladesh | 1.7 | 1.3 | 0.9 | 0.6 | 0.9 |

Source: Abstracted from Ahsan, 1982.

It should be noted that Ahsan (1982) does not include either the completely landless or those owning only homestead plots. Therefore, Table 6 ignores a significant portion of the rural population owning livestock and poultry. Furthermore, these figures, the only available district and national ones, are not disaggregated by the kind of animal owned. This means that bullocks, cows, and chickens are coded identically; this could be one reason why the information in Table 6 indicates that smaller landowners keep proportionally more livestock in relation to area owned that larger cultivators do (findings supported by a Noakhali District study as well; see de Lasson, n.d.). Disaggregated figures from our data reveals that larger landowners tend to own large animals, although the diversity of animals owned by each household, forms of purchase, and the use made of livestock differ by landholding.

Table 7 highlights the distribution of the animal population by land owned. There are no significant differences between *upazillas* for the landholding categories. The table clearly indicates that subsistence and surplus producers tend to own a greater diversity of animals and are also more likely to own selected kinds of animals, namely buffalo, bullocks, and milk cows. A breakdown of type and amount of livestock owned, by farm size, indicated findings in the expected direction; that is, bullocks and cows, required by rural households for plowing and reproduction, tend to be owned by those engaged in crop production. Of the 41 households who owned bullocks, 71 percent were farming more than 2.5 acres and the remainder owned at least a small parcel of land. Milk cows, on the other hand, were owned by all categories of households. In general, the percentage of milk cows owned within each landowning category increases with amount of land owned. The small sample size, particularly for large landowners, may have caused an underestimate of milk cow ownership in this category of farm household.

**Table 7. Number of Households Owning Livestock, by Total Land Held**

| Livestock Type | Land Held (in Acres) Landless | | Homestead | | < 2.5 | | 2.5—7.4 | | 7.5 or more | |
|---|---|---|---|---|---|---|---|---|---|---|
| | # | % | # | % | # | % | # | % | # | % |
| Buffalo | | | | | 3 | 8 | 3 | 11 | 2 | 25 |
| Bullock | | | | | 12 | 32 | 25 | 89 | 4 | 50 |
| Milk cow | 4 | 8 | 24 | 29 | 15 | 39 | 24 | 86 | 4 | 50 |
| Goat/Sheep | | | 31 | 36 | 21 | 55 | 25 | 89 | 4 | 50 |
| Pig | | | | | 1 | 3 | | | | |
| Horse | | | | | | | 1 | 4 | 1 | 13 |
| Bird | 31 | 63 | 55 | 64 | 30 | 79 | 24 | 86 | 7 | 88 |

Source: Akhter and Banu, 1983.

The ownership of milk cows among landless families is made possible because of access to char land for grazing. Selling of milk on a fairly regular basis becomes a primary source of income for these households. For 28 of the households in the landless and the homestead only category, cow rearing and milk production was the main household occupation.

Buffalo, the most expensive animal, are generally kept for transportation in addition to reproduction. This is because buffalo are not traditionally used as draft animals except in the two southern districts of Barisal and Patuakhali. Therefore, although land ownership is important for the rearing of buffalo, their ownership tends to correspond to the ownership of wooden carts for transporting agricultural goods.

Among the sample households, reasons for owning buffalo and resources of remuneration from buffalo production differ by landholding. For land-poor and subsistence households, buffalo were used with family labor to transport sugar cane, paddy, jute, and timber. Animal fod' was secured by harvesting paddy fields for others in exchange for ha the paddy straw. During the non-harvest seasons, the owners obtain animal feed by securing grazing rights from others, or they may supplement grass cuttings with purchased molasses, mustard oil cakes, and rice bran. In such households buffalo are a production input of the family business, and all inputs are the responsibility of the household.

Among surplus-producing households, that is, those with landholdings of 7.5 acres or more, animal fodder is derived from family-owned property and the market. Unlike those with less land, households in this category rent animals and carts to other landowners to transport their sugar, paddy, jute, or timber to mills or market. Owners of buffalo and carts charge a fixed transportation fee for their use and employ daily, monthly, and annual contract labor for this work. In no case do family members engage in the care of the buffalo or serve as cart drivers. That is, these large landowners are primarily surplus agricultural producers who diversify their income-earning opportunities with small business enterprises, such as transportation companies.

In all landowning categories, women are involved in the feeding of animals, and among buffalo owners with small landholdings of less than 2.5 acres, they are also involved in cleaning the animal shed. The bathing and grazing of the animals outside the homestead is considered men's work.

What Table 7 masks is the total number of animals owned by households controlling different land resources, and the differences between the research areas in their patterns of animal ownership. The survey data indicate that bullocks are owned by more families in Gobindaganj *upazilla* than in Dewanganj. This can be explained by the better accessibility of Gobindaganj *upazilla* by road, which means greater likelihood of extension service support and better marketing facilities. In addition, because one of the largest livestock markets in the country is located in Gobindaganj, households in this area are probably more likely than households in other areas to undertake cow fattening and sales as a household occupation. Institutionalized agricultural credit resources are sometimes available for this type of work.

Small livestock such as goats, sheep, and poultry are generally kept by families in all categories of landholding. Like cow ownership, goat ownership tends to increase with size of landholding; however, it is clear that family landholdings of between 2.5 and 7.5 acres indicate subsistence producers who diversify agricultural production rather than diversify their income and employment sources outside the agricultural sector. Additionally, families with only homestead land generally graze their goats on char land, where the animals are cared for by children.

Poultry, including chickens, ducks, and pigeons, are reared by families regardless of the amount of land owned. Ownership follows the general pattern of livestock ownership noted above. The major constraint on duck rearing is access to water. For poorer families, the ownership of poultry is relatively erratic, as pressure to sell birds in the face of subsistence requirements prohibits families from owning birds on a consistent basis. Moreover, epidemics and attacks by thieves and wolves, particularly in Jamalpur, generate a further ebb and flow of poultry ownership. There are also differences in access to extension services, which provide limited veterinary care. Chicken cholera is a major cause of chicken deaths. Veterinary services, along with temporary inputs from small nongovernment projects, sometimes provide chicken cholera vaccine and information on rearing practices. For resource-constrained families, poultry offers a flexible investment and production opportunity, because it is easy to sell locally and on short notice. Moreover, poultry rearing requires minimal investment and, with homestead land available, does not require additional investment for feed and care.

## *The Impact of Gender and Socio-Economic Status on Forms of Livestock Ownership*

According to rural tradition, livestock of any kind can be owned by the family as a whole or by individual family members. Differences in ownership tend to confer differential decision-making authority and control of money from the sale of the livestock. Ownership is conferred either by direct purchase or through gifts or sharecropping arrangements made with members of other households. Table 8 summarizes the ownership of different kinds of livestock by individual household members but does not show the number of animals owned by each type.

The data indicate that the 178 sample households reared an average of 2.43 kinds of animals, a diversity in household ownership of livestock confirmed by the information in Table 7. Of the total 433 animals owned by the 178 sample households, 30 percent were completely controlled by women, 8 percent were controlled by males, and the remaining 62 percent were controlled by the family as a whole.

Women are highly represented as owners of goats and poultry. Goats are the most likely animal to be secured through a share arrangement, and 67 percent of women owning livestock in the sample households had obtained goats in this way. Poultry is also commonly secured through share arrangements, and women in 44 percent of the sample

**Table 8. Ownership of Livestock among 178 Sample Households***

| Kind of Livestock | Parents | | Children | | Others** | | Family-owned |
|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | |
| Buffalo | | | | | | | 6 |
| Bullock | | | | | | | 34 |
| Cow | 3 | 9 | 2 | | | 5 | 53 |
| Calf | | 4 | | | 1 | 1 | 41 |
| Goat/Sheep | 3 | 17 | 7 | 4 | 2 | 6 | 59 |
| Poultry | 5 | 53 | 6 | 9 | 1 | 25 | 77 |
| Total | 11 | 83 | 15 | 13 | 4 | 37 | 270 |

Number of Individual Household Members: Parents, Children, Others**.

Source: Akhter and Banu, 1983.

* Households may be included more than once.

** Others includes sisters, brothers, father, mother and any other relatives staying in the house.

households had entered into this type of arrangement in raising poultry. In summary, women are highly likely to engage in share relations and to do so primarily for small animals.

Animals are also secured through purchase or may be received as gifts. Women are more likely than men to receive livestock as gifts, although animals are sometimes offered as part of a dowry to sons-in-law, and grandparents may give livestock as gifts to grandchildren. Of the total animals owned by the sample households, 49 percent had been secured in a share exchange. Buffalo and bullocks tended to be purchased; that is, all households with buffalo and 85 percent of the households with bullocks had purchased their animals. Cows, too, are likely to be purchased, but one-third of the households owning cows had secured them through share arrangements.

Women from secure and middle status families are the most likely to maintain purdah as a symbol of family status. Field activities for women suggest a household's inability to hire labor or to have access to sufficient family labor to undertake such work, thus threatening the social position of the household.

Children from such families are removed from the household labor pool by their school attendance. When such children do engage in livestock raising, the work must be coordinated with school attendance, or else efforts must be made to enable the children to graze and tether the animals around the school building. An equally important constraint on participation in livestock raising for children of secure and middle status families is the families' concern with keeping young girls from assuming "public" activities such as grazing animals, since one indication of family status is the ability to keep female family members away from agricultural labor outside the homestead. Secluding unmarried girls increases their individual status as well as the family's status and is likely to improve their chances of securing a marriage partner from a family of similar or higher status.

Women from small and subsistence landholding families rely on their children to tend grazing animals, while women from landless households must often negotiate for grazing rights on fields of other households. Among the women and young girls who do engage in livestock grazing, the majority are either older, past childbearing age, or below the age of twelve and not yet ready for marriage.

Owning livestock through share arrangements means that one household member (the owner) gives a particular animal to a member of another household (the keeper) under specified terms and conditions. These conditions generally include the equal sharing of offspring. Female animals will always belong to the owner; a probable sale price for male animals is negotiated at the time of share arrangement. If the actual sale price is higher than the negotiated price, the difference is shared between the owner and the keeper, even though the owner bears none of the rearing costs. Animal owners do not claim their share if the animal is stolen or dies.

For families dependent on wage income, livestock sharing is seen as a worthwhile venture because it employs household members, including children, and does not require initial investment capital. The most lucrative share arrangements can be made for goats; they are easy to rear, reproduce within two years, and can be sold more quickly than cows and calves. Those who own chickens on a share basis are not allowed to consume the eggs that are produced, as all of them must be incubated for replacement and then shared with the owner.

The share relation is one between a household or person who can afford to invest in livestock and one who has the resources to rear them. Vertical exchange relations are often involved, in which secure and middle peasant families favor poor and landless families by offering them a goat, chicken, or calf on a share basis. This relationship, whether between kin or non-kin, is generally based on trust between the owner and keeper. Horizontal share relations occur within similar socio-economic categories and usually are exchanges between poor families when the livestock owner does not have the required family labor to raise an animal and the livestock rearer lacks resources to initiate production.

Factors that determine the decision to take in livestock include the availability of family labor, sufficient resources to invest in feed, and the ability to secure the animals against theft. Table 9 indicates the kinds of livestock received or given out on a share basis among families of different economic status.

Table 9 indicates both an inverse relationship between family economic status and the practice of sharing animals out, and a positive relationship between family status and the practice of sharing animals in.

**Table 9. Kinds of Livestock Shared In or Out**

| Family Socio-economic Status | Kinds of Livestock Shared | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Bullocks | | Cows | | Calves | | Goats | | Poultry | |
| | In | Out | In | Out | In | Out | In | Out | In | Out |
| Secure | | | | 1 | | | | 5 | | |
| Middle | | 1 | 1 | 2 | | | 2 | 4 | 2 | |
| Lower middle | | 1 | 2 | | 2 | 1 | 9 | 3 | 2 | |
| Poor | 1 | | 6 | | 3 | 1 | 22 | 6 | 12 | 2 |
| Very poor | | | | | 2 | | 5 | 1 | 5 | 1 |
| Total | 1 | 2 | 9 | 3 | 7 | 2 | 39 | 19 | 21 | 3 |

Source: Akhter and Banu, 1983.

As anticipated, goats and chickens are the animals most commonly shared, both in and out, followed by cows and calves. Although middle and secure families are the most likely to share out, usually to poorer people, the lower middle, poor, and very poor families who share animals out generally do so to people within their respective socio-economic status group. The reasons for sharing animals out include unavailability of homestead land, lack of resources to buy or arrange feed, lack of family labor, and fear of theft or attack by wolves. Additionally, among the very poor, occupational constraints such as begging, women working outside the homestead, and migration tend to force a person with livestock or poultry to share it out while maintaining long-term control of the resources.

For women, share exchanges are usually made independently from husbands or other household members and tend to be generated between women of different economic status within the same village. Regardless of status, women express the need to have an income of their own and see share arrangements for animals as one mechanism to realize this. Sharing animals is the primary means for women to gain productive resources without being dependent on cash or income to initiate productive activity. In general, there is only limited opportunity for rural women to earn income within the homestead. Although kitchen gardening, rice processing and hoarding, and handicraft production may provide some income for them, these tend to be seasonal occupatios rather than secure, year-round activities.

Traditionally, livestock share arrangements made between women are based on trust, kin relation, and the reputation of the keeper. A mother of a married daughter may provide an income source for her child by giving her an animal on a share basis. On the other hand, women with no children and/or of a status or age making it impossible for them to meet the labor needs for animal production are not likely to secure animals on a share basis. Moreover, if a husband or other family member has a reputation for taking control of his daughter's, sister's or wife's resources, it is almost impossible for women in that family to arrange to sharecrop animals in. Finally, if a family is unable to protect livestock from theft, they are not likely to be able to engage in livestock share arrangements.

Livestock sharing or owning among poor and very poor families is seen as a family responsibility, and in most cases all available household members engage in the rearing process. For instance, while the wife or female household head may take responsibility for the share arrangement, the care and feeding of the animals may be done by children or the husband, because the benefits received from shared livestock tend to be enjoyed by the family as a whole rather than be a source of personal income for the woman responsible for the exchange. While women tend to be most likely to rear animals on a share basis, men and children engaging in similar activities also consider the income earned as a family rather than a personal resource.

## *Livestock Care*

Livestock care is undertaken by all family members, but the distribution of tasks often depends on a family's social and economic status. Care involves cleaning, feeding, and caring for the livestock as well as cleaning the livestock sheds. The latter is usually done by female family members among lower-middle, poor, and very poor households. Secure and middle status families tend to hire male laborers to do this work. The bathing of cows and buffalo is generally carried out by male family members or hired labor.

The process of feeding cows, bullocks, and buffalo includes watering them. That is often done by male family members or hired laborers, but in marginal subsistence families older female members generally undertake these activities. Taking animals out to graze is mainly the work of young male children and hired younger laborers. In families where male family labor is not available and the family cannot afford to hire labor, however, girls below the age of 12 and women over 40 are often responsible for grazing goats and calves in fields near the household compound. This limits their exposure outside the bari or household compound; however, it tends to restrict their access to more diversified or improved pasture.

Poultry feeding is not considered work in the conventional sense, as the birds are left to roam freely and eat rice or scraps which are fed to them throughout the day. As one woman said, "Chickens find their own food". For ducks, snails are collected from local ponds by women and small children. It should be mentioned that poultry must be kept within the household courtyard to guard against adjacent households stealing or harming them. A number of families mentioned their dislike of poultry stealing food from their yards.

Care of pregnant buffaloes and cows is undertaken by both male and female family members, while goats and poultry remain the primary responsibility of women. In short, with some variation by family status, women take primary responsibility for cleaning and feeding small livestock, and poor women clean the stalls which house larger livestock, while males and young children predominate in grazing smaller animals in addition to providing primary care for larger animals.

## CONCLUSION

Livestock rearing plays an important role in the productive activities of rural households in Bangladesh. While we do not have specific income data, the women in the study reported engaging in livestock rearing as a means of securing personal as well as family income. Approximately 94 percent of the sample households engaged in livestock rearing, although the kind of animals kept and the conditions of rearing differed by family socio-economic status. Households may undertake livestock rearing to support a business enterprise, such as transporting crops, or may do so to engage in milk production or animal fattening. These choices tend to differ by the availability of family land and capital.

The role of women in livestock production is quite significant among rural families, and it is one of the few opportunities they have to initiate and control productive activities. In the absence of other resources, such as personally owned land, given the constraints on their behavior and their negligible access to credit and agricultural services, rural women usually gain control and ownership of livestock through share arrangements for cows, goats, and poultry. These exchanges are contracted with relatives, kin, or neighbours who are able or need to exchange their animals for the labor and care provided by another. Women of most economic categories engage in these share exchanges, as they offer a source of income independent from husbands and other family members.

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# IV.3

# WOMEN AND WATER: EFFECTS OF IRRIGATION DEVELOPMENT IN A NORTH INDIAN VILLAGE[1]

**Pamela Stanbury**

## INTRODUCTION

This paper considers a subject only recently beginning to gain attention among development planners — the impact of irrigation on rural women. The focus is a north Indian village in which anthropological fieldwork was conducted during 1981. Irrigation water was brought to the village in 1954 as part of a large-scale canal irrigation scheme, beginning a very new way of life for the local inhabitants. The paper discusses the impact of irrigation on: a) women's participation in on-farm labor, both paid and unpaid; and b) women's domestic activities, particularly food production and water and fuel procurement. It emphasizes the varying benefits of irrigation to women of different castes, for although irrigation has provided villages with new economic opportunities and resulted in greater economic security, its benefits have not been shared by women equally. Upper caste women have received the majority of the benefits.

Development planners concerned with food production frequently note the benefits of irrigation in increasing agricultural output. The World Bank budgeted 44% of its Indian loans to the improvement of water management systems in 1982. India has the most lengthy and sophisticated network of irrigation channels in the developing world. During the colonial era, the British constructed large scale irrigation works in the Punjab as part of their famine relief efforts. (For a good review of pre-Independence irrigation history see Paustian 1968). Today, the Indian portion of Punjab, constituting the states of Punjab and Haryana, is the country's most intensively irrigated and most productive region. Irrigation development continues to play a major role in India's agricultural planning.

The introduction of new irrigation schemes can have wide ranging effects on women's labor, some of which are noted in the existing literature. Most frequently, it is argued that an increase in household income (which irrigation provides) may draw women out of the paid agricultural labor force. For example, Sharma (1980) observes that in Punjab, increased prosperity throughout the 20th century, particularly since the Green Revolution, has been marked by the withdrawal of women from production. Dixon (1980:60) also has noted this phenomenon, writing that "successful agricultural projects that increase yields and household incomes in traditional purdah-observing societies may lead to the withdrawal of girls and women from the agricultural labor force to the more highly valued (and now affordable) practice of female seclusion."

Epstein's (1962) work, however, is perhaps the most detailed study of the impact of irrigation in India (Karnakata). While she does not discuss the impact of irrigation on women in detail, she does note that in the irrigated village of Wangala, village women achieved greater independence with irrigation through increased income from livestock raising. In the unirrigated village, women had to depend on their husbands who obtained a new source of income from wage work in the nearby town. In her example, irrigation has been a benefit, rather than a curse, in generating income for women.

Finally, Cloud (1982), in a discussion of irrigation in South Asia, indicates that the increased farm income from irrigated agriculture draws women into unpaid household production. She cautions, however, that an increase in family income provided by irrigation may improve the total welfare of the family (e.g., better food and housing), but at a cost of greater female dependency on male earners.

Despite the dramatic changes that frequently occur with irrigation development, very little is yet known about: a) the role that women play in water management within traditional agricultural systems, b) the differential effects of irrigation development on men and women (Cloud 1982), and c) the differential effects of irrigation development on women of various caste groups. This paper presents a single case study focused only on the last of these topics. Though the present data are specific, it is hoped that the problems posed and the lessons learned might have broader relevance.

The paper is based on research conducted almost thirty years after irrigation had been introduced and its consequences had been felt by all villagers. It therefore can only reconstruct what life for village women must have been like before the arrival of irrigation. With these methodological constraints in mind, the paper emphasizes the varying ways in which women of different castes are currently benefiting (or not benefiting) from irrigation. To anticipate the findings, irrigation has provided increased food security for all households; village women have easier access to water for washing and drinking and the cash income of their households has increased. Nevertheless, though the overall impact of irrigation appears to be positive, not all women have had the same experience with development planning.

## THE RESEARCH SETTING

Bagarpur is a small village of 748 people (395 males, 353 females), located on the Haryana side of the Haryana-Rajasthan state border. It is on the northern periphery of the Thar desert with an average annual rainfall below 300 mm. Shifting sand dunes dot the sparse landscape, yet despite the extremely sandy soil and arid climate, agriculture dominates the regional economy. Although some agriculture has always been possible, irrigation now permits an agricultural security not previously known.

The study village is part of a region know as Bagar, a term which loosely translates as "wasteland." The Bagri people are thought to have originated in Rajasthan and, linguistically, the Bagri language is a dialect of Hindi. All Bagarpur villagers, with the exception of one family, are Hindus.

The village is dominated both socially and politically by a few older, larger, and more established clans. Formal village government is almost non-existent. A village *panchayat* (group of five locally elected officers) theoretically mediates disputes and carries out community-wide services such as maintenance of the village pond. Legally, one woman retains a seat in the panchayat. Nevertheless, during the time of fieldwork, the panchayat was highly ineffective and villagers did not even know who the elected woman was.

### *Research Methods*

Anthropological fieldwork was conducted during a ten-month period from January to October 1981. A total of six months was spent living in Bagarpur village, conducting interviews with women and participating informally with them in their work in the fields and in the household. Detailed information was gathered from 40 households (40% random sample) and oral histories were gathered from all households. This paper draws on knowledge of women in the village as a whole, since time was spent working with women not included in the sample and periodic daily work schedules were gathered from women throughout the village. These schedules proved extremely useful in balancing out the discrepancies between what women say they do, what men say women do, and what women actually do.

Methodologically, this study was synchronic and only by talking to older informants and examining historical records, could I understand what sorts of changes had taken place in the lives of the villagers. In addition, household histories provided an excellent way of looking into the past.

## *The Socio-Cultural Setting*

***Caste*** Bagarpur is a multi-caste community, but is dominated by one upper caste known as *Jat*, as shown in Table 1. Jats were traditionally,

**Table 1. Bagarpur Village Caste Composition, 1981**

| Caste | Number of Households | Mean Size | Traditional Occupation |
|---|---|---|---|
| UPPER | | 7.4 | |
| Jat | 66 | | farmer |
| Siami | 6 | | farmer |
| MIDDLE (Service) | | 6.6 | |
| Brahmin | 1 | | priest |
| Sonar | 1 | | goldsmith |
| Lohar | 1 | | blacksmith |
| Khati | 5 | | carpenter |
| Nai | 1 | | barber |
| LOWER (Harijan) | | 7.3 | |
| Chamar | 4 | | leather worker |
| Dhanak | 14 | | weaver |
| Chuerda | 1 | | sweeper |

SOURCE: Field interviews, 1981.
NOTE: Not all households follow their traditional caste occupations. The goldsmith and three carpenters are agriculturalists who own their own land. The data, nevertheless, give a general picture of the types of jobs performed in the village. One Dhanak household left the village for seasonal wage work during the time of census and is not included in the tabulation.

and continue to be, peasant farmers, and are known throughout northwest India for their hard work as cultivators. The *Siami* (6 households) are a caste of farmers considered by the villagers to be equal in status to Jats. For the purposes of this paper, the two groups have been combined. The other major caste group within the village is the *Harijan*, which is spread among three different castes: Chamar (leather workers), Dhanak (weavers) and Cheurda (sweepers).[2] Neither the Chamars nor the Dhanaks perform their traditional occupations, but rather are involved in wage labor, predominantly in agriculture. The single Cheurda family continues its traditional occupation, handling dead animals and funeral preparations. Within the caste hierarchy, such work is considered the most polluting of that done by the low castes. A variety of service castes also are represented in the community, including a Brahmin priest who performs marriages and funeral services, a goldsmith, a blacksmith, two carpenters and a barber. Members of the service caste are not considered to be polluting by the Jats and perform specialized and technical services.

To the reader unfamiliar with India, the relationship between castes may seem confusing. The hierarchical ordering of castes in Bagarpur is not always clear-cut. Nevertheless, the three major categories (Jat/Siami farmers, Harijans, and service caste) provide a framework for understanding village relations.

Differences between Jat/Siami and Harijan households strike the visitor immediately on entering Bagarpur. Harijans live in a cluster of small mud houses at one corner of the village. Children appear less well fed than their Jat/Siami counterparts and their clothes are often old and tattered. Jat/Siami houses, in contrast, are frequently made of fired brick construction and contain elaborate entrance-ways with a room for livestock at the front door. One then enters into a large courtyard, surrounded by small storage and living rooms. Of course, not all Jat/Siami households are equally wealthy, but the distinction between Jat/Siami and Harijans is prominent.

***Landholdings*** Bagarpur is a village of farmers and few other opportunities for employment are available. Wealth is measured in land and to be landless is to be poor. Landholding categories tend to mirror caste distinctions to a large extent. The landed are mostly Jat/Siami; the landless agricultural laborers are mostly Harijan; and the landless specialists are service castes.

No perfect match between caste and landholdings exists, but the general pattern is quite obvious in Table 2. Because the service castes derive a significant portion of income from their trades, they are not considered in this paper. Rather, the focus is on Jat/Siami and Harijan women, since their experiences most dramatically illustrate the role of land ownership, wealth, and caste in determining the impact of irrigation on women.

**Table 2. Average Land Holdings by Caste, Bagarpur Village, India 1981**

| CASTE | ACRES |
|---|---|
| Upper | |
| Jat | 20.86 |
| Siami | 9.67 |
| Middle | |
| Service | 6.04 |
| Lower (Harijan) | |
| Chamar | 4.63* |
| Dhanak | .63 |
| Cheurda | -- |

* One Chamar household claimed to own 24 acres, but this acreage has not been included since the land was mortgaged and the family was unable to farm it.

***The Family*** Villagers adhere to customs of patrilocal residence, patrilineal inheritance, and village exogamy. Thus, women come to their husbands' village as outsiders. Most frequently, a new bride joins an extended household in which a group of brothers and one or both of their parents are living under one roof. Her position as a new bride is a highly subordinate one and, as is often noted in the literature, the burden of household chores is placed most heavily on her.

The composition of the household has a strong impact on the division of labor and subsequent role of women. As in much of north India, the ideal family type is the joint family in which two or more brothers share agricultural, and their wives domestic, work. This ideal, however, is seldom realized and at any one point in time, a variety of family types are evident in the village, as shown in Table 3.

The mean household size of different caste groupings at the time of fieldwork can be seen in Table 1. Some households, however, included as many as 16 to 18 people. The desire to have sons overrides the decision to have small families. A couple may continue to have daughters (despite exorbitant dowry costs) until one or two sons are born. Sons, in general, are more highly valued than daughters since they will remain in the village, inherit the family property, and care for parents in their old

**Table 3. Population of Bagarpur by Household Type and Period**

| | 1945 | | 1951 | | 1961 | | 1971 | | 1981 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Family Type | No. | % | No. | % | No. | % | No. | % | No. | % |
| Joint/Stem | | | | | | | | | | |
| Married brothers and parents | 3 | 11 | 6 | 16 | 8 | 17 | 12 | 16 | 21 | 21 |
| Married brothers and bachelors | 1 | 4 | 1 | 3 | 1 | 2 | 4 | 5 | 6 | 6 |
| Married brothers | 4 | 15 | 4 | 11 | 7 | 14 | 3 | 4 | 1 | 1 |
| Parents and one married son | 10 | 37 | 6 | 16 | 12 | 25 | 13 | 17 | 19 | 19 |
| Total Joint/Stem | 18 | 67 | 17 | 46 | 28 | 58 | 32 | 42 | 47 | 47 |
| Nuclear | | | | | | | | | | |
| Complete | 9 | 33 | 19 | 51 | 19 | 40 | 41 | 55 | 51 | 51 |
| Broken/No adult male | – | 0 | 1 | 3 | 1 | 2 | 2 | 3 | 2 | 2 |
| Total Nuclear | 9 | 33 | 20 | 54 | 20 | 42 | 43 | 58 | 53 | 53 |
| GRAND TOTAL | 27 | 100 | 37 | 100 | 48 | 100 | 75 | 100 | 100 | 100 |

SOURCE: Field Interviews, 1981.

age. Daughters, in contrast, are active members of the household only for the first 15 to 18 years of their lives, hence the term "other's wealth" *(praya dhan)* used to refer to them. Nevertheless, a young unmarried daughter frequently contributes more toward household labor than does her brother, since he tends to continue his schooling while she works in the fields and does domestic chores.

***Purdah*** A bride entering her husband's village observes purdah, a custom that implies a set of prescribed behaviors for a woman's interactions and activities. In Bagarpur, the most obvious way in which this ideal mode of behavior is realized is by veiling the face in the presence of male elders and in public places. Purdah also involves not speaking to elders, particularly a father-in-law and a husband's elder brothers. Purdah restrictions are observed with all village members who occupy the role of elder male, i.e., those who command deference and respect. Nevertheless, as a woman gains status in the village with age and adult sons, purdah restrictions frequently become more relaxed, particularly if she is widowed.

The system of purdah functions to limit women's participation in politics and public events. Women are never seen in the public streets talking or loitering; these are the places where elder men sit, talk to neighbors, play cards, and smoke hookah. Women rarely speak with district officials passing through the village (for example, the tax authorities, officials from banks or credit associations, and irrigation officials) and rarely visit the district center except to visit the doctor when their children are ill. They do not leave the village to purchase household goods and claim they see no need to do so. Husbands and children perform these tasks. While a recently introduced bus service to the district center does provide younger women with opportunities for frequent contact with the world outside the village, the basic system shows few signs of changing.

Purdah, however, in no way restricts Bagarpur women from agricultural work or chores requiring a woman to leave the confines of the household. In fact, a value placed on hard work accompanies purdah. In other parts of north India and among other castes, purdah ideals dictate that women should not leave the confines of their house compound. In Bagarpur, however, women are not secluded within the confines of the household. The notion of deference and respect to elders implies that a young bride will work hard in the household and not be lazy, particularly in front of her husband or a village elder. Women show an outstanding endurance, working a full day in the fields and returning home to carry water, cook, and care for children, all as a matter of their female existence and with the knowledge that this work will one day be assumed by a daughter-in-law.

Despite the government's attempts to legislate change, then, exogamous, patrilocal marriage practices and purdah restrictions ensure that men dominate the public sphere. Women in Bagarpur do participate in work outside the household, but purdah prevents their involvement in politics and public events; these are all arts of a man's world. Life is changing in Bagarpur, but at a slower pace for women than for men.

***Property Inheritance*** While legally a daughter has equal rights to inherit family land, the *de facto* practice of land transfer is partible inheritance to sons. Frequently, a family holding more land than the maximum number of acres allowed under the Surplus Land Act designates a daughter as legal property holder, particularly if no sons are of legal age. Nevertheless, the title to property has little significance. Women leave their natal village at marriage and any claim to land is passed to a brother or other male relative. To demand money for land within the family is culturally unacceptable and transfer of land to sons goes unquestioned.

In the event that a woman's husband dies, she becomes heir until a son comes of age. A widow without a son is at a disadvantage both socially and economically. For example, one elderly wealthy widow in Bagarpur had no male heir. Her land was classified surplus under the reform laws but because she had no son she lacked the clout and social ties with male officials to have her surplus land overlooked, as other wealthy male farmers generally did.

## The Economic Setting

***Irrigation History*** Irrigation water from the Bhakara canal arrived in Bagarpur in 1954, and, in combination with other events, resulted in sudden and rapid economic and demographic growth. Under the Surplus Land Act of 1952, absentee landlords were forced to sell their land within the Bagarpur boundary. This surplus land was redistributed to poorer families already living in the village and sold to families who subsequently migrated into the village. (Farmers displaced by the partition of India and Pakistan in 1947-48 were seeking land and Bagarpur was an attractive location.)

Prior to the early 1950s, the population of Bagarpur was relatively small and consisted primarily of Jat households. Only two Harijan households resided in the village. A full village census conducted by me

**Table 4. In-Migrants by Period, Caste and Occupation, Bagarpur Village**

| Period | Caste | # Households At Entry | Occupation |
|---|---|---|---|
| 1940-45 | Jat | 2 | Farmer |
| 1946-53 | Siami | 4 | Farmer |
| | Jat | 1 | Farmer |
| | Chamar | 1 | Wage Labor |
| | Dhanak | 6 | Wage Labor |
| 1954-60 | Jat | 1 | Farmer |
| | Nai | 1 | Barber |
| 1961-70 | Jat | 3 | Farmer |
| | Sonar | 1 | Farmer/goldsmith |
| | Brahmin | 1 | Priest/wage labor |
| | Khati | 1 | Carpenter |
| | Cheurda | 1 | Sweeper/leather |
| | Chamar | 2 | Wage labor |
| 1971-79* | Jat | 2 | Wage labor |
| | Lohar | 1 | Blacksmith |
| TOTAL | | 28 | |

*last year of in-migration.

and my colleague during 1981 revealed that nearly half of the 1981 households in the village were the result of fissioning among families who had migrated into the community during the irrigation period, as shown in Table 4. As the data indicate, many of these households were landless and have remained so. They came to Bagarpur seeking new employment opportunities and found them in agricultural wage work and service work. Prior to irrigation there was little need for agricultural wage work and little extra income to pay for services.

At present, roughly 80% of the village agricultural land is irrigated. While canal water has increased agricultural security, water is not always available because Bagarpur is at the tail end of a system that begins far away in the Himalayas. Further, tubewells which tap the ground water are rare in Bagarpur since the water table is deep and often saline. Accordingly, although the Green Revolution that has changed much of Punjab and Haryana also has changed Bagarpur, the transformation there has not been as great.

***Agricultural Practices*** According to older informants and genealogical information, the whole Bagar region was sparsely populated before irrigation. Agricultural work was minimal and sporadic, and farmers depended on rain to grow crops. Frequent droughts and crop failures under dry farming conditions made farming undependable. Chick peas, barley, millet, pulses, and small quantities of oilseed were grown when soil moisture was adequate. Due to lack of water and inadequate fodder crops, water buffalo were seldom kept. Livestock thus played a central part in the economy and cattle and small stock were grazed on the open land.

With the arrival of irrigation water, farmers intensified production of traditional crops and began cultivating new crops requiring irrigation. Wheat was introduced as a significant spring (Rabi) crop for cash and home consumption. Cotton was introduced as a fall (Kharif) cash crop. Additionally, chick pea production increased tremendously. While Bagarpur farmers are still largely subsistence farmers, the increase in these crops, both in yields and acreage planted, has increased their involvement in the cash economy. Total cropping intensity has increased from 49% to 109% since the 1940s.[3]

Fertilizers and high yielding varieties also are a part of agriculture in Bagarpur as a result of the Green Revolution. Mandelbaum (1975), in a discussion of the impact of the Green Revolution, suggests that labor is displaced when agriculture is modernized and that this displacement may be most harmful to poorer households which depend on wage labor as a source of income. Bagarpur, however, is relatively unmechanized. Tractors are few (three in 1981) and combines do not exist. Consequently, labor has not been displaced to the extent that it has been in the more fertile and productive regions of Punjab. In fact, the opposite appears to have occurred; demands for both male and female labor have increased.

***Water Management*** Under the current system of canal irrigation, water channels are managed by the shareholders whose land is serviced. The number of shareholders varies from 20 to 85 and may include farmers from different villages. Since the organization of the Haryana State Minor Irrigation and Tubewell Corporation (HSMITC), begun in the 1960s, the shareholder's role is limited to keeping the irrigation channels clean. HSMITC builds and services the watercourses and provides a legal forum for disputes if necessary.

When channels need cleaning, the farmer most affected notifies his neighbors and a time for cleaning is set. The decision is then passed on to the other members. There is no regular leader. One member of each shareholder's family is expected to work for a day. Women play no role in the maintenance of channels and no role in the formal management of the irrigation system. In fact, most of the management decisions are carried out at the state level, although shareholders are repaying a subsidized loan to the state which will transfer title of the watercourse from HMITC to shareholders. When title is transferred, the shareholders will once again be responsible for repairing and, if necessary, replacing the channels.

***Other Developments*** The government of Haryana has made considerable effort to provide services to the rural areas. As a result, Bagarpur is linked by paved road to a district center, 25 kilometers distant. There is direct bus service four times daily. Electricity was introduced in 1971 and two commercial flour mills, which use electric power for grinding and chopping fodder, are located in the village. At the time of the fieldwork, 20% of the houses were electrified (all but one belonged to Jat families). Nevertheless, there were no electrical home appliances, such as fodder chopping machines, home flour grinders, or ghee makers in the village, although one Jat household was considering purchasing a ghee maker. Bagarpur may soon witness the introduction of such labor saving devices, but the costs of purchasing equipment are high and many families cannot afford them.

An extremely important development in the village was the establishment of a primary school there in 1964. Most boys, particularly Jats, graduate from it and many continue their schooling at the high school 2 kilometers away. Education for girls, however, remains minimal, as shown in Table 5.

**Table 5. School Enrollment by Caste and Sex, Bagarpur Village Primary School, 1980-81**

| | Caste | | | | | |
|---|---|---|---|---|---|---|
| Class | Harijan | | Jat | | Total | |
| | M | F | M | F | M | F |
| 5th | 0 | 1 | 4 | 0 | 5 | 1 |
| 4th | 0 | 0 | 3 | 1 | 4 | 1 |
| 3rd | 1 | 3 | 14 | 1 | 19 | 5 |
| 2nd | 0 | 0 | 9 | 4 | 11 | 4 |
| 1st | 2 | 0 | 10 | 3 | 12 | 3 |
| TOTAL | 3 | 4 | 40 | 9 | 51 | 14 |

# IRRIGATION'S IMPACT ON FEMALE AGRICULTURAL LABOR

Among upper caste Jat/Siami women, degree of participation in agricultural labor tends to depend on wealth and household composition. Withdrawal from agricultural labor is a sign of prestige and adult married women are less involved in agricultural work in households able to afford wage laborers. Nevertheless, during the highly demanding harvest, most able women do some work in their family fields. Jat/Siami women do not participate in wage labor for other families. Even the poorest and landless Jat woman did no wage work in the village, although she was willing to migrate out of the village seasonally for work.

The pattern is quite different among Harijan women. They tend to work for daily wages in landowners' fields. Frequently, they are indebted to work for Jat and Siami families due to loans incurred during the slack season and have no option but to work. The working relationship a Harijan woman establishes with a Jat/Siami household is often one that is cemented over the years. Services provided throughout the year may be returned by the Jat/Siami household in the form of old clothing and extra food as well as cash wages and loans.

While very few sources of employment for Harijan landless women are available, agricultural labor is an important source of food and cash. Field data show, however, that Harijan women were underemployed during the 1981 harvest season. Table 6 contains data indicating the

**Table 6. Female Participation in Agricultural Wage Work, Rabi Harvest, Bagarpur Village, 1981 (Data From 7 Sample Households)**

| Within Bagarpur | | Outside Bagarpur | |
|---|---|---|---|
| No. of Person days from | No. of Woman days from | No. of Person days from | No. of Woman days from |
| 155 | 47 | 128 | 21 |

SOURCE: Field Interviews, 1981.
NOTE: Data are for seven sample households only.

number of days worked by a sample of Harijan women during the harvest. Village landowners hired labor from outside the village and village women worked less than half the harvest days of the season. The full potential of the local female labor force, then, was not being tapped. Landowning families may have preferred to hire men, although female labor was hired from outside the village. Conversely, local Harijan women may have chosen not to work and relied on their husbands' income as wage workers because non-employment as a wage laborer accorded a degree of prestige. This proved to be a sensitive topic; while women as well as men complained about working for others, they never complained about the lack of employment. Yet there generally are long periods between harvests when women in particular have no steady source of employment.

## *Agricultural Tasks Performed*

Jat/Siami and Harijan women both engage in weeding, harvesting, hand threshing, and winnowing. As a rule, they do not participate in the preparation of the land (plowing, levelling, sowing, and irrigating). In addition, they do not handle machinery, such as the tractor or tractor powered thresher, which is restricted to men.

Among both Jat/Siami and Harijan women, work in agriculture does not begin until around age 11. Younger girls not attending primary school help with household chores, but rarely go to the fields. Between the ages of 11 and 15, girls work hard both inside and outside the home. At age 15 or 16 a girl is married and begins spending the non-harvest season in her husband's village. A girl's transition into her husband's village is very gradual, and for the first few years she returns to her natal village for one if not both harvests, depending on labor requirements. It is expected by both her in-laws and parents that she will return home frequently, particularly if additional labor is needed.

After a woman reaches about age 40, she frequently may retire from agricultural work, particularly if she has children to assume the responsibilities. Among Harijan women, wage work frequently is extended until ages 45 to 50, despite the labor provided by children. Each added hand is a source of cash and other benefits. Nevertheless, degree of agricultural labor participation is a function of a variety of factors including household compositions, wealth, and health.

***Weeding*** While some unirrigated fields are occasionally weeded, the majority of weeding takes place on irrigated land. Cotton, an irrigated crop, requires the most weeding labor. While both men and women do some weeding, hoe weeding is primarily a female activity. Jat/Siami women also help in weeding as they gather fodder on a daily basis, selectively cutting the smaller weeds and grasses for fodder. When one farmer was asked why he had let his cotton crop get so full of weeds, his reply was that his wife was letting the better fodder weeds grow so that she could harvest them as food for their livestock. Harijan women, lacking land, have less opportunity to collect fodder in this manner, but may do so if permitted by land holding families.

***Harvesting*** Women, both Jat/Siami and Harijan, participate in all harvesting, as shown in Table 7, although their degree of participation varies with the crop. Fodder harvesting, particularly of clover (green

**Table 7. Labor Participation During Rabi Harvest by Caste and Family Type, Bagarpur Village, 1981.**

| Caste | *Family Type* Joint/Stem | Nuclear |
|---|---|---|
| Jat/Siami (unpaid agricultural labor) | 71% (n=39) | 55% (n=20) |
| Harijan (wage labor) | 100% (n=7) | 100% (n=2) |

SOURCE: Field Interviews, 1981.
NOTE: Data are for 40% sample households only.

fodder) is done primarily by women and children. Irrigation has permitted a large variety of new fodder crops to be grown, crops whose quality is better for supporting livestock. A great deal of time and energy is devoted to fodder crops since livestock play a central role in the village economy.

During the fall season, women contribute more to agricultural labor due to the type of crops grown and the cooler weather. Cotton in particular is harvested primarily by women and children since it is considered relatively easy to pick and overlaps with the more rigorous cow pea and millet harvesting, primarily done by men. Even Jat/Siami women, who generally do not work in the fields, invariably do some cotton harvesting. Young children begin their agricultural careers by working alongside their mothers in the cotton harvest.

During both the fall and spring seasons, all land owners interplant melons and squashes with their primary crops. This supplemental planting is done very casually (hand-broadcast) and unsystematically, but the crops provide a welcome variety to the routine diet at harvest time. Harijan wage workers are free to eat melons and squash during the harvest while working in the fields.

***Threshing*** After the crop is harvested, it either is taken to the village for threshing or threshed near the fields. Wheat is threshed by machine and thus is never done by women. Cotton is sold before it is ginned. Chick peas, millet, and oil seeds are first crushed by guiding camels around in a circle over the stalks, then threshed and winnowed by hand using large pitch forks. (The chaff is saved and used for fodder and fuel.) This work is done by men and women together.

## *Summary: Impacts of Irrigation by Caste*

***Jat/Siami Women*** The most apparent impact of irrigation on Jat/Siami women's role in agricultural production is an increase in agricultural work during the harvest season. Cotton in the fall and wheat in the spring have increased both the demand for harvest labor and the total harvest seasons. Cotton and wheat also have affected the scheduling of crop harvesting and consequently the amount of labor required at certain peak periods. For example, the harvesting of cotton overlaps with that of millet, requiring household labor to be divided among two fields.

Changes in agricultural labor brought about by irrigation have been in degree rather than in kind. According to older informants, Jat/Siami women traditionally worked in the fields, but their participation has increased, at least for the present. This increase can be attributed to more intensive and relatively unmechanized farming practices, greater stress on crop scheduling, and a longer harvest season.

Cotton in particular has brought women and children into agricultural work, since it is a relatively easy crop to pick. Irrigation has had a minimal effect on female involvement in threshing and winnowing operations. Cotton is ginned outside the village and wheat is machine threshed. Hence, women's participation in this sphere is limited. Whether Bagarpur agriculture will become increasingly mechanized and women relegated to the home remains to be seen.

Irrigation and the Green Revolution have made agriculture more secure in the Bagar and have brought a new source of income to village landholders. Farmers have been quick to adopt some of the changes. Irrigation has been a boon to those families owning sufficient land. Inequities among Jat/Siami households persist, however, and not all women have shared in the benefits of irrigation.

***Harijan Women*** Irrigation has provided a source of income and/or a source of food for Harijan families. In addition to cash wages, the laborers are free to take vegetables, fruits, and grains to eat during the day. Harijan women also are allowed to cut weeds as fodder for their livestock and, when working, are usually given one meal during the day's work.

Those Harijan women who have secured good working relations with Jat families also can collect cotton, chick peas, wheat, and millet after the landowners are satisfied with their harvest. The work is time consuming and the benefits may seem meager, but this activity can be a very important source of food and cash for poor and landless households.

The benefits of agricultural wage work are of a slightly different nature for women than for men. Women work on a daily basis, rather than on a monthly or yearly contract as men often do. Thus, they have more flexible schedules. Prior to irrigation, little agricultural wage work was available. Irrigation has brought about both a demand for and a supply of Harijan wage laborers and service castes. Whether the Harijan migrants were less advantaged in their place of origin is not known. Today, however, Harijan women make up a relatively small percentage of hired agricultural wage labor. While in part this may be due to land owners' preferences for male laborers, the prestige of not working also appears to enter into the relationships.

With the exception of harvest work, few opportunities exist for Harijan women. Harvest wage work has reinforced caste distinctions between landowner Jat/Siami and Harijans. The traditional occupations performed by Harijan castes are not performed in Bagarpur, but Harijans have become wage workers and are defined as such. Despite the indirect benefits to the Harijan family, wage work reinforces the Harijan's dependency on the landed through indebtedness. Increasing mechanization, in combination with a growing population, however, will most likely force Harijans to seek work elsewhere as the village labor surplus expands. For both economic reasons (employers prefer men) and factors of prestige, women are likely to be the first to be squeezed out of agricultural wage work.

## IRRIGATION'S IMPACT ON FEMALE DOMESTIC LABOR

Despite participation in agricultural production, a woman's primary role is as a worker within the household. Irrigation also has had a strong impact on women's domestic tasks.

### *The Jat/Siami Work Day*

A Jat/Siami woman's day begins before sunrise. She first churns the milk into ghee, a task requiring about an hour. Then she cleans the house, milks and feeds the buffalo and/or cow, prepares food for the family and laborers, brings water from the village pond, and makes dung cakes to dry in the sun. She may bring food to the fields and return home with fodder and/or fuel. If she has free time in the afternoon, she may spin cotton or grind chick peas or millet on the hand flour mill. Toward evening, she again cares for the livestock, carries water, milks, and prepares food. Finally, after the evening meal, she may help chop fodder on the hand chopper and feed the animals.

Jat/Siami women visit their natal village once or twice a year for a period of up to a month once they have become permanent residents in the village (e.g., after the early years of marriage). When they are pregnant, they return home for periods of up to six months and give birth in their natal village. These visits are periods of relaxation from the daily work load in their married home and women look forward to them eagerly.

## *The Harijan Work Day*

The Harijan woman's work day in the home does not differ in kind from that of the Jat or Siami. Lacking the amenities common to Jat/Siami households, however, the Harijan woman has fewer tasks to perform around the household. Most Harijans have few dairy animals, as shown in Table 8, and seldom have surplus milk requiring ghee preparation. Since many Harijan families own sheep and goats which graze near the village, fodder collecting is not required. If a cow is owned, women and children gather fodder grasses along the roads near the village or collect fodder in fields of Jats with whom they have good relations.

Home flour grinding is done infrequently since most Harijans do not have a regular supply of chick peas and millet. Wheat is frequently purchased on credit from Jats and is ground at the electric flour mill. Cotton spinning, a common pastime among Jat/Siami women, is rarely done by Harijans since they lack the cotton with which to make thread.

Visits to their natal village are much less frequent among Harijan women than Jat/Siami. Harijan women cannot afford the bus fares and gifts required, and, as a result, are lucky if they can return once a year. Nevertheless, they do return home when they are pregnant.

Harijan women frequently seek work in the homes of Jats, but such employment is sporadic. (Harijan women rarely perform such work within Siami households). They clean, plaster the homes with mud, and act as midwives, but do not cook since this is considered polluting to

**Table 8. Livestock Ownership by Caste, Bagarpur Village, 1981**

| Caste | Buffalo | Cows | Camels | Goats | Sheep |
|---|---|---|---|---|---|
| | TYPE OF LIVESTOCK | | | | |
| Jat/Siami (N=26) | 1.58 | 1.65 | 1.15 | 0.41 | 0.07 |
| Harijan (N=9) | 0.14 | 0.80 | 0.10 | 2.44 | 0.10 |
| All households (N=35) | 1.08 | 1.05 | 0.75 | 0.80 | 0.08 |

SOURCE: Field Interviews, 1981.
NOTE: Data are for 40% sample households only. Figures reflect mean number per household.

Jats. Cleaning and plastering are performed during weddings, funerals, and other ceremonial occasions. Harijan women are not paid in cash, but instead receive old clothes or grain for their labor. Additionally, they may receive extra buttermilk from the Jat day's ghee making. These services are important to Harijans since they tide the household over between harvests.

## *Food Preparation and Consumption*

Irrigation has brought about changes in diet which are reflected in changes in work patterns. After irrigation, wheat began to replace millet as the staple grain for making chappattis (flat bread). Villagers claimed that long ago, they ate barley and chick pea chappattis, then shifted to millet and now increasingly use wheat.

The Jat/Siami diet generally consists of two meals during the day that include chappattis, ghee, a thin curried vegetable, and buttermilk. Women are strict vegetarians while some men infrequently purchase meat from the district center and prepare it themselves outside the home. In Harijan households, the diet consists of chappattis and perhaps a chutney (made from chilies); vegetables, which must be purchased, are rarely eaten except during the harvest.

An important feature of the introduction of wheat into the diet is that it can be ground at the commercial flour mill. Village women prefer to grind millet in the home just before eating since it spoils quickly. Wheat, however, is rarely ground at home, greatly decreasing the total time spend in hand grinding. The increase in chick pea production has not significantly altered the pattern of food preparation or consumption.

Village women continue to hand-grind chick peas since they claim the commercial flour mill cannot grind the flour as fine as they would like. Despite irrigation, chick peas retain their central importance in the agricultural economy.

Many of the foods grown in the village are not available to Harijans. Chick peas may be obtained from the leftover harvest in Jat/Siami fields and wheat is bought on credit from landowners with whom the Harijans have good relations or from the village shop. (Prices tend to be higher in the shops, however). Thus the benefits of irrigated crops and increased production of indigenous crops have not affected the diet of the Harijans as significantly as that of the Jat/Siamis. Securing good relations with Jat/Siami farmers is the best means of improving the family's diet under the current system.

Of all food items, milk and milk products are the most highly valued by the villagers and make up an important part of the diet, both nutritionally and for social and ceremonial purposes. Villagers claim that prior to irrigation they were more dependent on milk due to uncertain crop yields under dry farming conditions. Dairy animals, however, continue to play a central role in the lives of the villagers. Milking and processing butter into ghee are primarily women's tasks.

Milk is rarely sold. Surplus milk is made into ghee which is sold both within and outside the village. Women are responsible for the supply and sale of ghee within the village. Often men are unaware that their wives sell ghee and rarely know how much surplus is available in the home.

Irrigation has increased the security of and dependence on grains and pulses, but milk and ghee remain the most important food items in the villagers' diet. Harijans, however, eat milk products infrequently. Irrigation has permitted villagers, particularly Jats and Siamis, to maintain water buffalo which produce a much higher quality and quantity of milk than the local variety of cow.

## *Fuel Use*

The primary source of fuel available to Jat/Siami women are cotton sticks, dung, and occasionally dead branches of trees. Cotton sticks are used primarily for cooking chappattis on the hearth. Slow heating for processing milk and fodder on a clay oven is done using dung cakes.

Dung remains an important fuel source and all families (whether Jat/Siami, Harijan, or service caste) have at least one small dung pile. Dung is mixed with straw and made into cakes which are dried and stored to be used as needed. Dung is increasingly used as fertilizer. It also is used to make fired bricks for wealthier homes, decreasing its availability for home use. Cotton sticks, however, have filled this gap.

Jat/Siami women rarely expressed problems of fuel shortage. During the months of September and October, cotton sticks are scarce until the harvest. When the sticks are depleted, women gather dried stalks of chick peas, mustard, and cotton from the previous season. While the process is time consuming, the shortage is only for a few months. No Jat/Siami women reported any critical problems in finding fuel on their own fallow fields.

Fuel is an acute problem, however, for Harijan families. They either must purchase wood on the market, if cash is available, or depend on gifts of dung from Jat families, resulting in increased social, if not economic, indebtedness. If these sources of fuel are unavailable, Harijan women seek roots and dead shrubbery along the roadside. All Harijans, as well as Jats/Siamis, have some dung, though Harijans may not have cows and buffalo. Since the animals are stall fed in the Jat/Siami homes, Harijans can only gather dung when the animals are taken out of the stalls occasionally.

Since the arrival of irrigation, vacant land available for fuel gathering has decreased. The landed, however, have been more than compensated due to the introduction of cotton. Jats and Siamis can gather enough fuel to last throughout most of the year on one acre of cotton-producing land. The landless Harijans, in contrast, have received no natural benefits; public land is a scarce commodity and Harijans must spend time searching for fuel wood or purchase it from the landed.

## Livestock

All landowning families own livestock, usually one camel (for plowing and transport), one or two buffalo, and perhaps a cow. Villagers consider their animals on a par with land and sons; they are an indispensable part of life. Although all family members care for livestock, women play a more prominent role in feeding, milking, and general maintenance of dairy animals, while men tend to care for camels.

Livestock are stall fed during most of the year. Buffalo, while producing milk, are fed a mixture of cottonseed (purchased on the market) and chick peas, in addition to grasses. This combination is said to increase milk yield and fat content. The amount of time required to prepare the fodder is quite extensive. A woman first cleans out the better chick peas for human consumption and splits the peas on the hand mill. The seeds are then heated during the day to soften before being fed to the milk-producing buffalo.

Goats are to the Harijans what cows are to the Jats and Siamis, a back-up for the primary milk producer (water buffalo), and in the worst of times, the sole source of milk. Goats are grazed along the roads and ditches and in communal acreage near the village. Harijan women and children are responsible for care of the small stock, milking them and gathering fodder. While grazing land along the irrigation channels is good, the problem of food to maintain animals is a key issue.

Irrigation has permitted Jats/Siamis to keep water buffalo, which need a sufficient amount of water in which to puddle daily. Irrigation also has permitted fodder crops, e.g., clover, millet, and cow peas, necessary for the maintenance of buffalo, to be grown. Harijan households lack the necessary capital to purchase buffalo and cows and cannot produce enough fodder to maintain them. As the land has become more intensively utilized and vacant acreage has become scarer, Harijans are finding less and less room on which to graze their small stock. The final result is a lack of dairy products in the Harijan diet.

## Domestic Water Use

Villagers obtain water for drinking, washing and cooking from a single village pond. The pond consists of a drainage area which is fed by irrigation water as needed. There are no wells or piped water available due to problems of political organization within the village.

Village women carry water from the communal pond in large clay pots twice daily and each pot takes about 15 minutes to fill. Water carrying is symbolic of women's work; as a bride first enters the home of her husband, she is greeted at the door by her mother-in-law who places a pot of water on her head, symbolizing the work she will have to do in her new home. After childbirth, a woman does no work for a month but her reentry into the household is marked by a ceremony in which she takes her first pot of water from the pond. The pond is a focal place for women to meet and talk and information flows rapidly among village women there.

Prior to irrigation, whenever the village pond, then fed by rain water, went dry, women walked three kilometers to the next village for well water. The more permanent water source in the village has benefitted the poorer segment of the population especially, as was witnessed during fieldwork when the irrigation channel was closed temporarily for repairs. Wealthier families sent their sons on camel with water tanks to get water from the neighboring village. Poor women from households not owning camels had to go on foot. Irrigation also has relieved all women of having to carry water to the fields since now most farmers have easy access to water either in the irrigation channels or in small storage tanks.

## Cotton Spinning and Weaving

Cotton spinning and weaving are done in spare time by wealthy young women and upper-caste older women who do not engage in agricultural work. A portion of the cotton harvest is saved and ginned for home use. Thread is spun by hand on wooden spinning wheels. The men make this into string, some of which is dyed and woven into colorful rugs by the young women of the household to use as part of their dowries.

Cotton thread and the crafts produced are not sold, but rather are used in the home. Only Jat/Siami families who grow cotton engage in these tasks; Harijan women do not have access to the cotton lint. Harijans occasionally may sell goat hair, but do not use it for spinning in the home.

Spinning and weaving are considered leisure activities and are carried out during the non-harvest season and by elders. It is difficult to measure the degree to which leisure time has increased for women with the coming of irrigation, but it appears that irrigation development, coupled with other modernizing forces, has increased agricultural labor requirements while decreasing household work, particularly for the landed. Clearly, factors such as family composition, size, and sex ratio, as well as agricultural changes, all influence the degree to which women have leisure time.

## Barter and Cash

Bagarpur remains primarily a subsistence agriculture village, despite the increase in cash cropping. Barter exchange is an important part of the village economy as a whole, particularly for women. Grain frequently is exchanged for vegetables from peddlers or from small village shops. While men are involved in cash transactions when marketing their produce, women and children tend to play a greater role in the barter exchange system within the village.

Harijan women prefer to exchange their services for durables rather than cash. Those hired to work in Jat/Siami households prefer to be paid in grain or clothing since cash is turned over to the household head who may spend it on drink or gambling. Payment in kind assures the family of food and clothing.

Wheat and other grains frequently are "purchased" with labor. Harijan families work for the seller during the harvests and the cost of grain is calculated against work days. In this manner, the cash transaction is eliminated. Jat women are less involved directly in the barter economy than Harijan women. The one area in which they may be involved in cash is in the sale of ghee. Most women also receive small amounts of cash which they use to buy bangles or ribbons.

It was difficult to discover how cash is spent within the household economy since the topic was sensitive among the villagers. Nevertheless, although no data were collected on exact allocation of cash, observations indicate that women retained little control of cash income. Often, cash and cash loans would be spent on alcohol and gambling by men.

## *Summary*

Traditional cooking methods continue to be used by women, but changes in cropping patterns have brought about some changes in diet and fuel consumption. Wheat is replacing millet as the staple grain, but the transition has been slow. Chick peas remain an important food as well as cash crop. Irrigated farming has introduced new varieties of fruit and squash into the diet seasonally. The introduction of cotton has replaced wood gathering for the Jat/Siamis. The increased use of dung as fertilizer and for firing bricks has meant a decrease in its use as a cooking fuel.

Milk and ghee remain the most important food items for the villagers. Despite the high costs of fodder, milk products remain popular and their nutritional and prestige benefits far outweigh their cost in the villager's eyes. Poorer families, particularly the Harijans, do not have access to many milk products because they lack the necessary capital to invest in dairy animals and have no means of providing fodder.

Access to leftovers of the harvest provide grain and pulses for Harijans, but the landless continue to buy grain from landed families or in the local shop or district center. Purchase of grain and other food items within the village brings the Harijan family into a series of economic relations with and obligations to Jat/Siamis. These relations assure the Harijan family of food on a daily basis during the work season and loans during the off-season.

The decrease in time required to maintain the household has been complemented by an increase in agricultural work. Household labor requirements have decreased in the areas of water, fuel, fodder procurement, harvesting, and grain grinding. Although the decrease in household work does not necessarily mean an increase in agricultural work, this tends to be the case, particularly among the less wealthy families who cannot afford to hire wage workers. Jat/Siami women's participation in agricultural work may affect Harijan women negatively since their labor is in the least demand. If such is the case, encouraging time-saving devices as steps towards modernization may result in even greater agricultural unemployment for Harijan women.

At present, however, few modernizing time-saving devices have entered village households. No women have electric ghee makers, fodder choppers, or grain grinders. The traditional wood burning stove continues to be the only type of stove. Water is carried from the pond and traditional home cooked foods are preferred to commercial foods. Women and children perform the bulk of household work while men either work in the fields or relax in the village.

## CONCLUSIONS

Irrigation has brought about major changes in the life of Bagarpur residents. Specific cultural patterns of labor allocation within the household and among different segments of the population in large part have determined the direction of change. The future may witness a situation paralleling Sharma's (1980) in which women are drawn out of the labor force. To date, however, there is little evidence of this, perhaps because farming is still relatively unmechanized in Bagarpur. The impact of irrigation, however, has been felt in different ways by women of different castes.

a) Irrigation has made possible an increase in cropping intensity and scheduling, thereby raising landed women's participation in agricultural work. Since landownership and wealth tend to follow caste lines, these women usually are Jat and Siami. Landless Harijan women, however, now engage in agricultural wage work, although their employment remains extremely seasonal. If farming becomes more mechanized, Harijan women are likely to lose their primary source of cash income — wage work in agriculture.

b) Irrigation has allowed the village to support an increased population by bringing more land under cultivation, providing more jobs for the landless, and increasing the desirability of the community. While families previously did not want to marry their daughters into Bagarpur because of its poverty and lack of amenities, they now do. Migration into Bagarpur is an important feature affecting current social organization.

Most likely, many Harijan households and service caste households would not have moved into Bagarpur if irrigation had not arrived to provide new jobs. Whether those migrant households fare better in Bagarpur than they would have in their place of origin is unknown.

c) Irrigation has decreased the time required to do various household tasks. Fuel and fodder procurement and water carrying are the most prominent examples. Both Jat/Siami and Harijans have benefited from labor savings in their respective households. Nevertheless, Harijan women have been hurt by labor-saving developments in the households of their potential domestic and agricultural employers.

d) Livestock raising continues to be an important economic and social feature of the village. The change from extensive to intensive livestock raising has affected women's labor since women play a central role in livestock management. This is one area where training and extension work could reach women and is not competitive with agricultural work.

e) Despite the increase in cash and greater contact with urban centers, village women remain relatively isolated from economic activities and decision making. The custom of purdah and the cultural features surrounding it play a significant role in determining the subtle and indirect changes in women's socio-economic sphere.

Women in Bagarpur have never played a public role in political or managerial decisions. Irrigation's arrival has meshed well with the cultural system and brought about few contradictory changes. Nevertheless, it does appear to have increased the gap between the opportunities available to landless and landed women. The scenario of Bagarpur may caution against assuming that irrigation benefits reach all women equally. Rather, its effects are felt very differently by different segments of the female population.

# NOTES

1. This research was carried out under contract Purchase Order No. IN-P-1-074, US/AID, New Delhi, India. Dr John Westley of the AID Mission in Delhi provided much appreciated comments and suggestions. The author would especially like to thank David Groenfeldt for his support and guidance both during the fieldwork and during the data analysis and writing. All tabulated data included in this paper are derived from census and questionnaires conducted by David Groenfeldt and the author during 1981.

2. The term "Harijan" refers to all Untouchable castes in the Indian caste hierarchy. Under Indian law, Harijans are classified as being particularly disadvantaged and hence eligible for certain benefits. They are also referred to as "scheduled caste".

3. See Groenfeldt (1981) for a detailed account of the impact of irrigation on farming strategies in the village.

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# V. DEVELOPMENT AND CONSERVATION

# V.1

# CONSERVATION AT THE LOCAL LEVEL: INDIVIDUAL PERCEPTIONS AND GROUP MECHANISMS

Mary A. Martin

In much of the ecological literature on the Middle East and Southwest Asia the rural agricultural and pastoral populations stand accused of accelerating the process of desertification by various strategies of pastoral and agricultural production and firewood collection. Both farmers and herdsmen are often portrayed as being unaware of the negative effects of their practices — or if aware, as pursuing them anyway and displaying insensitivity to their own and others' future interests (see, for example, Dasmann 1976:70-71). Often both ecologists and historians treat all pastoral strategies as the same and equally unresponsive to the environment upon which they depend (see, for example, Pearse 1971:15; Ashtor 1976:17). There is however, a growing literature that demonstrates significant variation in environmental knowledge and perception in the practices of rural populations. There is also evidence of adaptation to ecological change.

Some strategies, especially pastoral strategies, are described as *inherently* destructive, but there are many studies of resource use in drylands which claim that particular strategies are not inherently destructive, though they may result in varying degrees of stress under certain but not all environmental or socio-economic conditions (see Sandford 1982). Such strategies and conditions include, for example, firewood collection, charcoal production for urban markets, grazing in situations of prolonged drought, border closure, and enforced sedentarization.

For a better understanding of desertification we need to examine the social and ecological processes which generate certain incentives and constraints affecting decisions about the use of resources. Of particular concern is the degree to which people are aware of environmental variables, how and to what degree they relate degradation of resources to their agricultural, pastoral or other uses of vegetation and how this relation is translated into individual or collective strategies. Although extraneous political, economic or climatic factors intervene to affect local populations, this chapter concentrates on decision-making at the local level. It is concerned with the decisions of the farmer and herder in the villages — not the bureaucratic and political processes at a provincial or national level, although the information and argument presented here will be relevant at that level. Examination of agricultural and pastoral strategies in Tauran suggests that certain patterns of resource use may contribute to environmental stress and potential desertification, whereas others are responsive to environmental change[1] and serve to prevent or reduce stress.

The 308 households of the Tauran Plain are divided among thirteen villages ranging in size from six to forty-six households. These villages are separated from the nearest provincial centers of Shahrud and Sabzevar (population 44,000 and 54,000 respectively)[2] by natural barriers such as sand, mountains, and a salt river, and the roads that traverse these barriers are often rendered impassable by sheet run-off, mud, or loose sand or riverbed gravel.

These small, isolated settlements are unable to support themselves by either pastoralism or agriculture without exploiting the underground water table. Pastoralism is the primary economic activity in the larger region and over 95 percent of the Tauran Plain (12,000 hectares) is grazed. Irrigated agriculture is practised on a small scale — at present only 160 hectares, or not quite 0.5 hectare per family. Various types of rain-fed farming are also practised but are not reliable, although in a good year up to 240 hectares may be ploughed for this purpose.

Even with the use of ground water for irrigation and watering animals, the current population cannot support themselves entirely from the Tauran Plain. Some families always seek additional income both on and off the Plain. Today this additional income comes from shepherding, truck hauling, and less often, from labouring in urban brick works. In the past the additional income was obtained with greater difficulty through charcoal production, shepherding, hauling by camel, occasional brigandage, and collection and sale of vegetation (for fuel, food, spices, medicine and tanning). What follows is a discussion of the production strategies that are most likely to cause environmental stress by reducing the vegetation cover on the Tauran Plain.

# AGRICULTURE

Settlement in Tauran has depended on the *qanat*. *Qanats* were introduced in Iran during the first millennium BC. They consist of an underground channel that carries groundwater by gravity flow from an aquifer underlying relatively high ground out on to the surface at a point lower in a valley or plain where there is good soil (see Figure 1, and Spooner 1982).

In Tauran *qanats* are relatively short and meagre and the largest area watered by one qanat is only 30 hectares. Each village on the Tauran Plain has access to one or more qanats which provide water for all needs, and most families own one or more shares in the flow, which is divided into cycles of 12-14 days. The *qanats* receive no maintenance, except occasionally in cases of severe damage from run-off, and it is not possible to reconstruct the co-operative arrangements involved in their original excavation, which was carried out by an earlier population.

The limited water supply from *qanats* is manipulated in order to grow a combination of staples such as winter wheat and barley, cash crops such as tobacco and cotton, and fodder crops, such as sorghum, millet and alfalfa. Scarcity of water is a persistent problem. The problem varies according to both direct precipitation and the effect of the previous year's precipitation on the water table. When *qanat* flow is reduced the villagers change their cropping emphasis in order to maximize productivity by, for example, growing less cotton and more tobacco; when water flow is high sesame or cumin may be planted.

Within living memory the major cropping pattern has changed little with the exception of a change in variety of cotton, and cessation of opium cultivation when it was prohibited in 1955. Figure 2 illustrates the present day cropping pattern on most of the Plain, and Figure 3 shows how it varies with distance from the water source. The actual amount of land planted in a certain crop varies from year to year depending on water supply and the availability of family labour. There is some variation within Tauran based on differences in microclimate, wind force, soil, water salinity and *qanat* flow. However, in all villages the amount of land planted in walled gardens remains constant from year to year since this land is devoted primarily to grapevines, fruit trees, tomatoes and herbs.

Each farmer is responsible for his own small plots and individual farmers pursue various techniques to increase production. These techniques involve different combinations of the application of animal dung and chemical fertilizer, weeding, double cropping and fallowing.

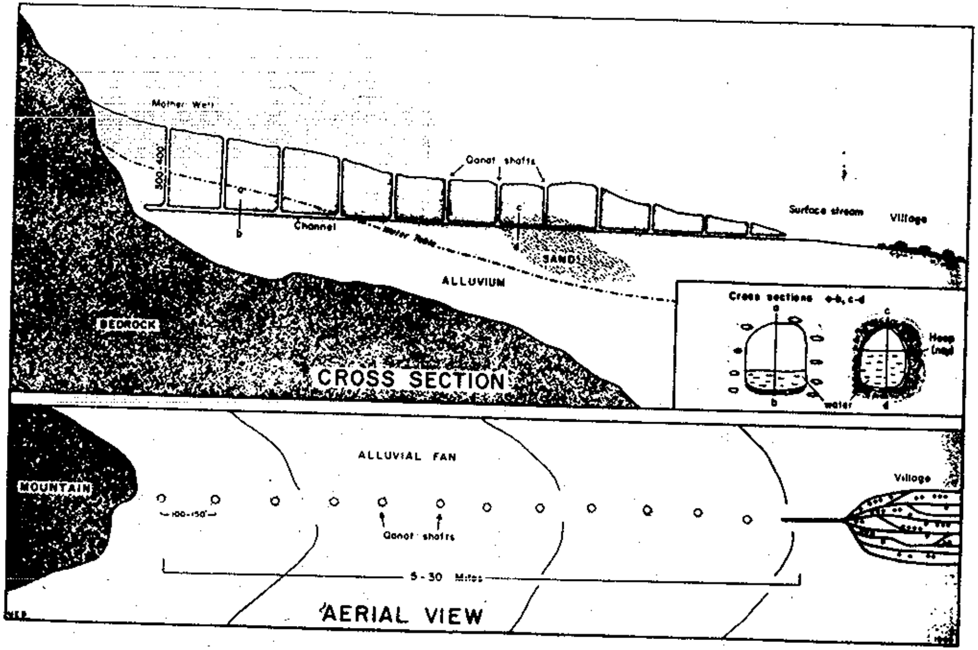


**Figure 1. Diagram of a Typical Qanat**

Permission from University of Wisconsin Press and author (originally published in "City and Village in Iran" by Paul Ward English 1966).

**Figure 2.Tauran Crop Cycle and Land Use Pattern**

| | N D J F M A M J J A S O | | |
|---|---|---|---|
| Open fields-irrigated<br><br>(no rotation) | Wheat<br>Barley<br>(opium, cumin) | | Millet, sorghum<br>Fallow<br>Tobacco |
| | Alfalfa | | |
| (rotation) | Cotton | Fallow | Cotton |
| | Fallow (alternates with cotton) | | |
| Walled gardens | Grapes, fruit and nut trees, herbs, tomatoes, tobacco seedlings[a] (mulberry trees for silk worms) | | |
| Open fields-dry farmed<br>(no rotation) | Fallow | | |
| | Fallow | Barley<br>Wheat | Fallow |
| | N D J F M A M J J A S O | | |

[a]Sometimes grown in open fields.

Note: the irrigated agricultural cycle begins in November with the planting of winter wheat.

Crops in parentheses are those grown 30 years ago.

The dung available from livestock stabled in the village is applied as fertilizer — most intensively to those fields which will be double cropped. Chemical fertilizers have been introduced in the last ten years. They have not replaced dung yet (except in a few cases) but are used in conjunction with it.

There are several reasons why fallowing is useful. According to local villagers, good farmers plough their fallow fields and the "lazy" farmer does not. Whereas the unploughed fallow fields may quickly become weed-covered and hence protected from wind or other erosion, this is at the expense of moisture retention (cf. Dasmann 1976:71; Antoun 1972:8),[3] and may aggravate conditions of low nitrogen content (cf. English 1966:159; Ault 1972:7).

The practice of ploughing fallowed land could increase erosion. However, the ploughed soil is left in heavy clumps which are not susceptible to transport by wind in contrast to the finely pulverized soil

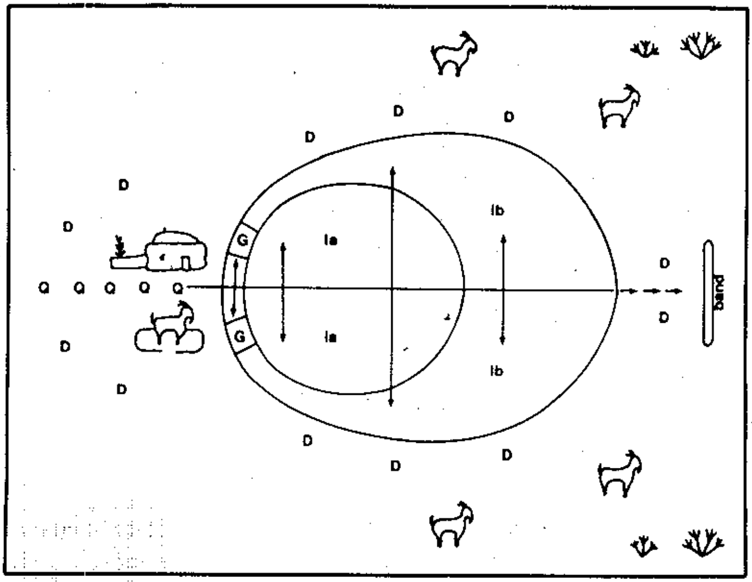


**Figure 3. Land Use Pattern in Relation to Quant Opening**

D = Dry Farming; G = Walled Gardens; Ia = Irrigated Fields: Double Cropped; Ib = Irrigated Fields; Fallow/Crops; Q = *quant* System; ——→ = Irrigation Channel; = Grazing (Goats and Sheep), = Animal Pen; = Firewood.

outside cultivated areas regularly trampled by animals. Wind erosion was generally not perceived as a problem among farmers on the Plain, though they felt that the wind itself was a problem for agriculture close to the kavir. Water erosion is not a problem in irrigated fields because of the small size of the individual fields, which average about one tenth of a hectare and are bounded by small ridges to retain water during irrigation (see Figure 4). Only irrigated fields which border dry river beds are vulnerable to water erosion.

Dry farming is important in Tauran for several reasons. It is inefficient to use irrigation water on crops that may not need it. There is also a local preference for dry-farmed wheat for bread-making. In recent years there has been an increased demand for barley to supplement the diets of sheep and goats and dry farming can help to satisfy this demand. Pastoralists feel additional pressure to take advantage of years of good rainfall and plant as much land to barley as the law (which since 1966 prohibits further extension of dry farming) and their labour resources allow. This increased demand is related to the state of the range and the increasing number of animals. In the past the range is said to have supported the animal population except in drought years. As grazing, dry farming and the collection of vegetation for other purposes increased, vegetation cover, particularly on the Tauran Plain appears to have decreased. Since the decrease was in shrubs, flocks became increasingly dependent upon annuals for spring and winter forage. Consequently, in most years — and even more so in drought years — the demand for supplemental feeding increased.

Dry or rain-fed farming (*deim*) includes several strategies of cultivation which have different environmental impacts. The most widely-known form is that which relies on direct rainfall only. This form is currently found in Tauran close to settlements, but it is limited in area because of the irregularity and insufficiency of rainfall.[4]

Other forms of dry farming in Tauran depend less on direct rainfall. During the winter, unwanted quanat water is channelled on to otherwise unirrigated land. In this case the water may not belong to the owner of the land. This winter-watering may then be supplemented by spring rainfall to build up sufficient soil moisture for a crop, such as melons. Another strategy is known also as *band* or check dam farming. Either run-off or unwanted qanat flow is captured behind the band in the winter and spring and is supplemented by direct rainfall (see Figure 3). The land is farmed by those who contributed to the building of the band.

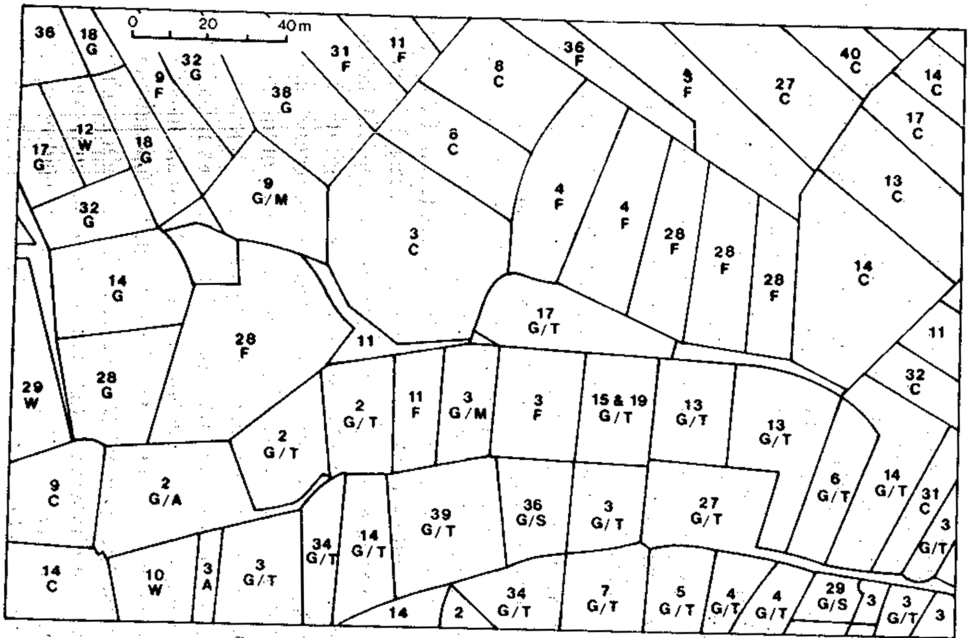


**Figure 4. Distribution of Plots**

Numbers represent different households. Lines indicate ridges seperating plots. Slash (/) indicates double cropping. A = Alfalfa; C = Cotton; F = Fallow; G = Grain (Wheat of Barley); M = Millet; S = Sorghum; T = Tobacco.

*Bands* are constructed throughout the Plain wherever either type of run off can be caught. Both types encourage the accumulation of silt which has been the source of much of the good farmland in Tauran (see Dennell 1982). The availability of tractors with earth-moving attachments have increased the number of check dams constructed on the Plain in the last ten years.

In all forms of dry farming various factors limit potentially negative environmental effects. Generally dry farmed land is not ploughed after harvesting. The grain is harvested primarily by sickle. Stubble is not ploughed under until spring planting. Weeds which have grown up with the crop are not removed until spring ploughing which will only occur if rainfall is promising. The plant *Goebelia pachycarpa*, whose root systems have good soil binding qualities (Iran 1977:29), is allowed to remain and protect the land against erosion. However, where ploughing is done by tractors brought into Tauran in the autumn and spring, more disruption is caused to soil-stabilizing root systems than is the case with the traditional scratch plough.

In addition to government restriction and irregular and limited rainfall, there is another factor which has limited the extent of dry farming. Small families may not plant grain because of insufficient labour. Depending on the timing of the spring rains the labour demands of dry farming may conflict with those of pastoralism within the family. During the spring animals are taken off the Plain by owners (even if they are grazed in the mixed village flock during the rest of the year). It is sometimes necessary, therefore, to choose between dry farming and the increased milk production which will result from the spring graze. The decision will be related to whether or not a man has sons or other male relatives who can help him out. In recent years the availability of tractors for ploughing in the spring has alleviated this problem to some extent.

The individual farmer is in a position to deal with most agricultural problems independently — except those involving the *qanat*. Individual farmers are responsible for their own land and no one but themselves will suffer if they let the fertility of the land decrease. Agricultural maximization depends on controlling the factors that will continue sustained production such as manuring and fallow. If a man begins to neglect his field (for example, because of opium addiction), only his own yields will be affected. But when the village *qanat* needs cleaning or rebuilding, the cultivator must co-operate with other water owners and find some group solution to the problem. However there is no mechanism for group co-operation beyond the individual need for water. There are, for example, cases of villages that were abandoned when problems of reduced *qanat* flow resulting from moving sand and flooding were not solved.

Dry farming poses a special problem of control and communal organization because unlike irrigation it competes with pastoralism and collecting for the same land. When unirrigated land is not planted, it may be grazed. It is not clear to what degree local populations are aware of the positive or negative effects of dry farming but local control of dry farming would anyway be difficult now because of the current lack of endogenous social mechanisms to facilitate group action.

Because of the variety of factors involved, therefore, agricultural strategies in Tauran cannot be considered inherently destructive or conservative. *Qanat*-dependent cultivation on individually owned plots is generally aimed at sustained production and current techniques do not contribute to erosion, salinization or loss of fertility. Dry farming includes a number of techniques which in the long term counteract erosion (particularly those associated with bands). The environmental threat posed by dry farming derives: (1) from new technologies such as tractor ploughing and the increased demand for grain as supplemental animal feed, and (2) from the fact that it often constitutes an additional pressure on land that is already being used for grazing and fuel collection. So, some types of dry farming may not only affect current and future crop yields — but also the potential for grazing and fuel collection.

## FUEL[5]

Removal of shrubs for use as fuel affects the quality and quantity of grazing and can contribute to loss of soil through wind and water erosion. The most important fuel need for the local population is domestic. Villagers classify wood into two types: *hizom* — shrubs, especially *Artemisia*, for bread ovens and space-heaters, and *konda* — thicker branches from species such as *Haloxylon* for longer cooking, for processing of milk, grapes, tomatoes and pomegranates, and for heating water for bathing and washing clothes. Until 1975 village bath houses used wood fuel, but these have all been replaced by new government diesel-burning bath houses.

Since about 1965 kerosene has been available through a co-operative, reducing somewhat the demand for firewood. It is used in samovars for tea making, in cooking stoves, in lamps, and more and more in wealthier houses for kerosene space heaters. In 1977, an energy use survey conducted in Tauran indicated that in one village approximately 1 ton of firewood was consumed per person per year. An additional 21 tons were used for processing the milk of 254 sheep and goats by two families at summer milking stations.

From the point of view of ecological impact the use of vegetation for fuel in Tauran constitutes two separate problems. Domestic fuel use has been one problem, but export of vegetation in the form of charcoal was another. Villagers with insufficient land or animals needed other sources of income if they were to remain in Tauran. In the past charcoal burning was one of the available options for earning additional income. Local use was minimal but urban demand was high — particularly in the period just prior to the introduction of kerosene. The government finally prohibited charcoal production in 1966 throughout Iran.

The collection area for charcoal was different than for domestic fuel. Domestic fuel was collected much closer to villages (Figure 5), whereas the distribution of charcoal production was independent of village location. In addition there was a different effect on vegetation. For domestic fuel a wide range of species were collected including *Artemisia, Haloxylon, Calligonum, Lactuca, Ceratoides, Zygophyllum, Amygdalus,* and *Ferula*. Charcoal production required the larger shrubs which had pretty much disappeared from the village collecting range, especially *Haloxylon, Pistacia, Amygdalus,* and *Calligonum*. The species which are good for fuel are also preferred for grazing (see Nyerges 1982). *Artemisia*, in particular, is considered the mark of a good range and its disappearance from the Plain has been a cause for alarm among villagers, who prize it for grazing as well as oven fuel. Ten years before the government outlawed both charcoal production and the cutting of live vegetation (1966) residents of Asbkeshan in the southeast of Tauran, who depend primarily on pastoralism, banned charcoal production in their territory. This action was unusual not only because of the nature of the decision but because they were able to enforce it. But this community was small, closely-knit and of tribal origin whose members did not themselves need to supplement their income by producing charcoal. None of the communities on the Plain had these social and economic characteristics.

The 1966 government decree prohibiting the cutting of live vegetation was difficult to enforce because there was not enough dead vegetation to meet the demand despite the increased availability of kerosene. The gendarmerie and later the Department of the Environment game guards, who were charged with enforcement, became unpopular in their attempts, especially when sometimes they burned a load of firewood they had intercepted. Their position was made more difficult by their

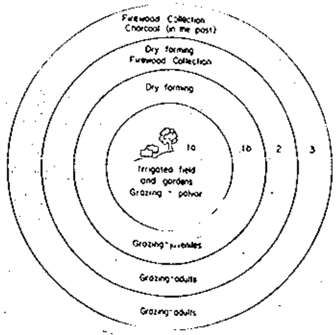


**Figure 5. Distribution of Village Land Use–Tauran Plain**

| Zone | Estimated biomass | Average stocking rate | Pastoral land use | Agriculture | Firewood gathering |
|---|---|---|---|---|---|
| 1a | 300 kg/ha | 1·2 ha/animal | Village flocks<br>Palvar<br>Kids/Lambs<br>Other fattening operations | Qanat irrigation<br>Dry farming | Prohibited |
| 1b | 300 kg/ha | 1·2 ha/animal | Village flock | Dry farming | Prohibited |
| 2 | 2–3 tonnes/ha | 2 ha/animal | Summer/winter stations of local villagers | — | Allowed (dead vegetation only) |
| 3 | 2–5 tonnes/ha | up to 3·4 ha/animal | Transhumant stations and occasional village stations | Occasional bands | Allowed (dead vegetation only) |

own families' needs. Nevertheless they were effective to the extent that fuel collection ceased on the Tauran Plain. Some residents claim that certain species of shrubby vegetation are beginning to reappear.

Other changes have affected the pattern of fuel collection in recent years. Game guards were transferred off the Plain leaving enforcement in the hands of the gendarmerie alone. Since 1974 the number of vehicles which could be used for hauling firewood have increased. Many of these vehicles were hired by men who were away working as shepherds and needed fuel for their families or by flock owners who needed fuel at summer milking stations. Probably the quantity gathered has not changed because of truck hauling but the pressure may have increased on certain species such as *Haloxylon* — especially close to the main tracks.

There is no mechanism to regulate fuel collection in relation to grazing requirements. When shrubs disappear or are severely reduced, grazing becomes more dependent on weedy plants and annuals. This change in vegetation composition is more important because in the winter or in drought years when annuals are less abundant, shrubs are less available for grazing and flocks require supplemental feeding — particularly the pregnant ewes (and occasionally does). The most common supplemental feed in Tauran is barley because of the absence of other low cost fodders. Larger stock owners may therefore try to expand dry farming operations in years with sufficient rainfall in order to obtain additional fodder as cheaply as possible.

Fuel collection has caused a desertification problem in Tauran primarily as a function of urban demand, especially for charcoal. Although fuel needs continue to be a major cause of desertification in many developing countries, this problem has become less severe in Tauran as a result of a combination of factors including the availability of fossil fuels, governmental restriction and general economic change.

# PASTORALISM

The environmental impact of grazing varies, depending upon which of several management strategies are followed and whether the particular grazing area is also subject to collecting or dry farming.

Most flocks in this part of Iran are transhumant. They enter the area in October-November and leave in April-May and graze away from the main villages (see Table 1). The remainder — some 25,000 locally-owned animals — are managed in three ways. Large flocks belonging to

**TABLE 1. Significant Factors in the Ecology of Pastoral Systems in Tauran**

| | Type of Pastoral Group | Access to Grazing | Control of Stocking Rate | Production Emphasis | Shepherd Wages[a] ($ = 70 rials) |
|---|---|---|---|---|---|
| I. | Sangsari long-range transhumants (winter only in Tauran) | Restricted to flocks whose owners have rights to water wells and pens through ownership, rental or permit. | Individual owner | Meat — primarily for Teheran market. Milk and wool for subsistence or sale in summer area. Buy up and fatten Tauran animals for sale in Tehran | Head shepherd: 20,000 rials ($285) per month Assistant: 15,000 rials ($214) per month. |
| II. | Village owned flocks which graze year-round at sheep stations | " | " | Meat and milk products for sale or subsistence | 17,000 rials ($242) per month |
| III. | Village owned flocks which spend the summer at milking stations and winter in the villages | " | " | Meat and milk products for sale and subsistence | |
| IV. | Mixed village flocks which graze in central Tauran (chekana) | Unrestricted within grazing distance from home village (formerly restricted to traditional village territory) | None | Mainly subsistence milk products and meat for owners. Occasional sale of extra animals or products locally | 16,000 rials ($229) per month |

[a]These figures are for 1978.

individual Tauran owners are maintained away from the villages at year-round stations. An alternative pattern involves wintering in the villages while the summers are spent at milking stations. The third pattern affects most Tauran residents although it represents only a small proportion of the total animal population (see No.4 in Table 1): in each village there are one to three mixed flocks (with animals from several owners) which are grazed on village commons in the Plain by hired shepherds. These flocks return to the village daily to water at the qanat, for milking in the summer, and for barley-straw rations and night shelter in the winter.

Local villagers practising each of the three strategies just described all share in one additional management pattern. All villagers have animals which are kept out of the big flocks at certain times of year and are grazed in the area directly surrounding the village (see Zone 1a, Figure 5). For example, in the spring young lambs and kids are grazed close to the villages until they are weaned and can be grazed with the larger flocks. A few other animals (known locally as *palvar*) are grazed close to the village and fattened for winter consumption, gift or sale. In the spring each family selects one to a dozen or so from the main flock. They are grazed daily by an aged or young family member on agricultural stubble and the nearby land (Zone 1a, 1b, in Figure 5). These zones contain primarily *Goebelia pachycarpa* (eaten only from mid-summer on), a variety of thistles, *Peganum harmala* (rarely eaten even dry), and various annuals. But the *palvar* also receive a daily supplement of agricultural weeds gathered from the irrigated fields and water channels and a mixture of barley, barley flour and washed straw.

The nature of the pastoralist's right of access to his grazing determines his ability to control his own and others' use of it. There are two basic types of access in Tauran: individual access through permit, ownership or central; or access as a function of village residence. Sangsari flocks and the large local flocks have access to areas with shallow wells and sheep pens. Traditionally rights to these areas have been transferred by sale or rental. They are neither surveyed nor fenced; they include an area with an average three kilometer radius (roughly the distance which can be travelled to and from the water source comfortably and allow for grazing during a short winter's day, see Iran 1977:23). Although there is provision for legal control of grazing ratios in these areas, effective control rests with the shepherd or flock owner. The situation in village territory presents a different management problem. The majority of households had a few animals which were grazed in joint flocks *(chekana)* by hired shepherds (see Table 2). Any villager may graze his animals in village territory and there is no provision for control of grazing ratios.

**Table 2. Household Ownership of Animals in a Tauran Village**

| | 1975 | 1976 | 1977 | 1978 |
|---|---|---|---|---|
| Total number of households | 33 | 33 | 31 | 32 |
| Households with no animals | 1 | 1 | 1 | 1 |
| Households with palvar only (not kept in village flock) | 2 | 2 | 2 | 2 |
| Households with animals in village flocks | | | | |
| a) Year-round | 23 | 22 | 21 | 23 |
| b) Winter only | 3 | 3 | 3 | 3 |
| c) Summer only | 1 | 1 | - | - |
| Households with animals away year-round | | | | |
| a) With relatives | 2 | 2 | 2 | 3 |
| b) With outside flock for whom owner is hired shepherd | 1 | 1 | — | — |

Iran's move to protect its rangeland from overgrazing and fuel collection by nationalizing rangeland is consistent with the actions of other Middle Eastern countries in the last 50 years and with the policies of FAO and other development agencies. In some respects these moves have provided the protection needed by small communities against exploitation of their resources by outsiders — and by themselves. However, in Iran and elsewhere this action has often weakened traditional village or tribal controls. This situation has been reported for nomads in Syria (Draz 1977) and is the case in Tauran for the sheep stations off the Plain.

The land grazed by village flocks is particularly vulnerable to overgrazing because the number of animals is under no one's control and the same land is also used for dry farming and collecting. The government has tried to enforce the restrictions on the amount of fuel collection and dry farming, but not on the numbers of animals. Oral history suggests that grazing pressure on the Plain has increased over the years. While this increase is difficult to substantiate, it is feasible given the changes which have occurred in the area over the last century. Formerly villages of Tauran were divided into opposing factions which raided and sometimes fought each other. According to oral history, in the 19th century, villagers acted to protect their resources (particularly their animals) against theft by other villagers and by outsiders such as nomadic Turkmen from the north and Basseri from the west. Both of these threats — from inside and outside the region — probably served to draw villagers together to protect their resources including the grazing of traditional village territory. With final pacification of the area in the late 1950s, the gendarmerie provided security for grazing, trade (including charcoal), and travel. The large flock owners of Tauran, who had grazing areas off the Plain, provided summer grazing areas for many village families who now e.g. graze animals in the Plain year round. These families now speak of spending summers away at milking stations in the 30s. Individual owners are free to keep as many animals as they wish. The constraints are the limits of space for the animals at night, money to pay the hired shepherd who herds them with other village animals, and grain and straw for supplemental winter feeding. The shepherd decides how many animals he will herd, but he usually herds for a number of families who have agreed to co-operate with each other in hiring him, paying him, sending someone to join him nightly in the summer and bring him food.

The situation in the 1970s for the combined village flocks resembles what has been termed the "tragedy of the commons" (Hardin 1968) or "common pool" situations (Ostrom 1977:15). However, common pool situations are only problematical when the following conditions are present:

1. Ownership of a resource is held in common.
2. No one owner can control the activities of others.
3. Total use or demand upon the source exceeds the supply.

When these conditions exist, Ostrom argues, use of the resource by one individual reduces its value to the others. Since Ostrom does not imply that a common pool situation will automatically become a "tragedy of the commons", it is worth considering the variety of mechanisms which may serve as constraints on the increase in livestock. For example, in the Sahel, until circumstances led to changed conditions in which carrying capacity was exceeded, a variety of mechanisms such as freedom of movement, timing of movement, and control of movement by individual groups existed which served to prevent overgrazing (Hardin 1977). In Tauran the mechanisms inhibiting overgrazing have varied. They have been designed to enhance milk, meat and wool production for subsistence and market — rather than retaining specific sex ratios or numbers of animals as in Sahel or East Africa where animals have been kept for subsistence and social and economic security. In Tauran all owners are concerned with milk and meat production, although to varying degrees (Table 1). Both Sangsari and local large owners produce primarily for markets, although for large local owners subsistence needs are also important. Sangsari concentrate on the raising of sheep breeds with higher meat/fat yields per animal than Tauran sheep which are primarily all-purpose breeds good for wool, meat and milk. Sangsari meat is destined for the Teheran market, whereas Sangsari milk products are taken for family use. All owners see production of milk, meat, and wool as a function of range condition, but it is the large owners who are in a better position to maintain the range in good condition by controlling the number of animals.

One strategy for assuring the best grazing possible (and hence to avoid overgrazing) is to keep outsiders off. The Sangsari, who only use their territories in the winter, often hire persons to patrol their grazing territory — a strategy which is resented by local owners who would like to have access to the untouched annuals which are being guarded for Sangsari winter grazing. In addition both Sangsari and large local owners try to reduce grazing pressure by acquiring a number of areas and grazing them in alternate years. Other local owners have one area for winter use and another elsewhere for summer use. In the last ten to fifteen years, however, there has been an overall decrease in the number of owners who have been able to retain empty grazing areas. Several factors may account for this shift. Since 1973, the end of the last drought period, herds have been expanding. In addition this period has been one of great prosperity in Iran during which several large Sangsari and local owners bought up sheep stations and hired more local shepherds. If stocking rates have increased, it has primarily been a response to a series of good years. This pattern of increased stocking rates in good times may also have occurred in the past as security and weather conditions changed.

The villagers who are obliged to share grazing on the Plain are aware that they are getting less milk, meat, and wool per animal than they would if their animals grazed elsewhere (Table 3). On the one hand their options for grazing elsewhere are limited. For example, at least two Tauran owners summer off the Plain but must winter in the village because there are no available sheep stations to buy or rent year-round. On the other hand, for the villager with few animals there are pressures to keep animals in the village flock — which means accepting lowered production. If the animals are grazed away from the village in the summer, then the family is deprived of fresh milk[6] — or must leave the village for the summer and live by the animals and process the products. Although some women enjoy this life away from the village, most consider it a hardship. In addition agricultural labour needs must be co-ordinated with pastoral labour demands — which is easier in the village.

**Table 3. Grazing Pattern and Annual Production of Meat, Milk and Wool**

| Product | Year-round on Tauran Plain | Winter on Tauran Plain Summer off the Plain | Year-round off the Plain |
|---|---|---|---|
| Wool | Low | Medium | High |
| Lamb weights[7] 6-8 mo | Gross weight: 20-21kg | — | Gross weight: 25-30 kg Meat yield: 12 kg |
| Clarified butter (per animal) | 300-400g | 750g | 750-1500 g |

The villager is constantly seeking a solution to the problem of finding better grazing off the Plain. In a few cases villagers who have relatives with large flocks away at sheep stations for the summer or year will persuade or cajole their relatives into taking some or all of their animals. It is not just the male owner or shepherd who must be convinced: an arrangement must be made with his wife and daughters who will have to do the milking and process the milk. This type of co-operation between families is rare, but may be exchanged for help with weeding and harvesting. Other options for grazing off the Plain occur in the winter when milking is not a problem. At this time those village men who work as shepherds for Sangsari or other large flock owners may take their own animals with them. This action reduces the need for supplemental feed because they are grazing better range. They are also reducing the grazing pressure on the Plain although this is not their goal. They wish to find better grazing and raise production, save shepherding and feed costs, and relieve the family of the additional responsibility of looking after the animals while he is gone.

Another constraint on the increase of livestock in Tauran and hence a check on overgrazing is what has been termed the managerial cost (Brokensha *et al.* 1977:12) — which refers to labour availability. It was noted earlier that for Tauran families without enough land and animals to support them, shepherding for the Sangsari has enabled them to meet expenses and even to save money to buy land without migrating to the cities. Sangsari wages are higher than those paid locally (see Table 1) and their is the added advantage that shepherds can limit their work to only part of the year (winter only or summer only) which frees the shepherd for family and agricultural obligations in Tauran. However, it is often difficult to find competent shepherds for village flocks. Village shepherds not only receive lower wages but must deal with several owners. The men available for the village positions are those who have chosen lower wages for various reasons — or who do not have the choice to be higher paid shepherds (some are mentally retarded, or have other psychological problems; others are too young). Some local shepherds are therefore less attentive to the sheep than the top Sangsari shepherds who receive higher wages for being trustworthy and having the knowledge and skill that will serve to protect an owner's animal investment (for example, matching up mothers and offspring in the spring). For this reason, it is likely that village flocks suffer higher mortality rates because of inadequate shepherding, although Sangsari flocks may have higher mortality due to wolves and snakes. Mortality due to disease is a significant factor in Tauran. Both individual and mixed flocks are subject to higher disease mortality than are flocks in centrally located regions because of lack of veterinary care. Presently local owners have inoculated their own animals on the basis of their understanding of animal diseases — but this is an individual strategy dependent upon money for drugs and individual understanding of the proper drugs for various diseases.

Other labour factors which may affect animal numbers in village flocks are a result of the obligations of the owners to assist the village shepherd. For example, as noted earlier, village animal owners have an obligation in the summer to go (or send a substitute) to take food and spend the night with the shepherd out on the range. In the spring, they (or their substitute) must take turns grazing kids and lambs separately until the two herds are merged. The amount of time they spend is figured on the basis of the number of animals owned. Also in the spring some owners take their animals out of the village flock and move away from the Plain for about a month in the spring when the annual vegetation is most lush. This is difficult since it conflicts with ploughing and planting, but essential if there is to be any hope for good milk production. The more animals a village owner has, the more essential it is that he invest more time in their maintenance — particularly in spring and summer when demands on his labour are high. If a man has few family members to help him out, he will have to choose that year between various pastoral and agricultural tasks — and may decide for the time being not to expand his animal holdings.

Various mechanisms have been operating to ensure access to good grazing and the consequent higher yields. These strategies are: (1) for large owners — individual control over grazing areas ensuring exclusive access to these areas, acquiring a number of areas and grazing them in alternate years; and (2) for villagers to graze some animals off the Plain with relatives taking animals out of the village herd for the spring graze. However, in the common grazing land should animal numbers increase to levels exceeding carrying capacity, the problem of control arises.

## THE PROBLEM OF CONTROL

In this discussion, three strategies of production — dry farming, collecting, and village pastoralism, all primarily for local consumption — have been singled out as potentially destructive towards vegetation on the Tauran Plain, particularly where they compete for the same land. With regard to collecting, during the period of research, dealing with governmental control was perceived as a more acute problem for local residents than were the effects of the practice. With grazing, however, the situation is more complicated. Villagers are aware that by grazing on the Plain they must settle for lowered milk, meat and wool production. To raise production they will try to move animals off the Plain whenever possible or supplement the diet with barley and straw. Although they are aware that the vegetation quality is poor, it is not known to what degree they see dry farming, fuel collection, and increased numbers of animals as contributing factors. It is no doubt also true that perception of the problem varies and those who use the range most — particularly older residents and those who go out daily (such as shepherds) — are more aware of the state of the range. Assuming that villagers recognize the negative impact of these activities on pastoral production, why do they not organize to protect communal grazing and fuel resources? What differentiates them from, for example, northeastern Afghanistan (Edelberg and Jones 1979; Shahrani 1979), mediaeval England (Ault 1972), Greece (Koster 1977), the Swiss Alps (Netting 1976) and Mexico (Lewis 1959), where local communities have established control over common resources?

The lack of communal organization has been explained in a variety of ways. One explanation refers to national character, which, for example, would suggest that there is a "strongly individualistic, indeed anarchical, strain in Iranian character which so often prevents sustained cooperation..." (O'Donnell 1980:viii). Another suggestion is that this behaviour is the result of people following an unwritten cultural "rule". For example, Banfield (1958) in his discussion of southern Italian society suggests that the people there behave as if they were following a "rule" which he calls "amoral familism" in which one will "maximize the material, short run advantage of the nuclear family; assume that all others will do likewise..." (Banfield 1958:83).[9] A similar explanation of the behaviour of peasants, in Tzintzuntzan, Mexico claims that they act on the basis of a model termed the "image of limited good". According to this view, there is a common perception in peasant society that...all the desired things in life such as land, wealth, health...exist in finite quantity and are always in short supply, as far as the peasant is concerned...there is no way directly within peasant power to increase the available quantities...an individual or a family can improve a position only at the expense of others...mutual suspicion seriously limits co-operative approaches to village problems (Foster 1965:296-7, 308). These examples illustrate various attempts to explain the lack of co-operative effort on the basis of national character or cultural rules or "ethos".[10] But none explains why co-operative behaviour *does* occur in some situations for control of areas of common grazing, fuel collection or agriculture.

What then are the conditions under which co-operation occurs which will help us explain co-operation or the lack of it in a peasant society like Tauran — or for that matter in any type of society? In the *Logic of Collective Action*, Olson suggests that though all of the members of a group (large or small) "have a common interest in obtaining collective benefit, they have no common interest in paying the cost of that collective good" (1965:21). In Tauran one of those costs is setting up a formal village or Plain-wide organization for enforcing grazing, fuel cutting, and dry farming. Olson's contention that "the cost of establishing an organization entails that the first unit of a collective good obtained will be relatively expensive" would find agreement among Tauran villagers. They have in the past only co-operated in smaller groups primarily as shareholders in the qanat water, co-operating to clean the storage pool or arrange for repair in case of serious damage interrupting the essential flow of water.

Another important factor is that "the behaviour of the individual in the group is due partly to the fact that each individual in a group may place different value upon the collective value wanted by his group" (Olson 1965:22) and that willing participation can arise only if the resource in question works the same way for all users (Doherty and Jodha 1977:7). When we examine the Tauran communities we see that in fact resources are not used in the same way at all. Fuel is used differently by different families depending upon the size of family, the number of animals owned, and differential ownership of garden lots (which affects fuel needs for making pomegranate and tomato paste and grape syrup).

Charcoal production also affected communities differently. In Tauran only one case was found of a village which protected its territory against outside exploitation — the village of Asbkeshan cited above. The inhabitants of this village were closely related and led by a strong relative at a time when Iranian villagers were armed and could enforce such a ban. They also had no extensive agriculture and were solely dependent upon their pastures which were threatened by charcoal production. On the other hand, on the Plain the social context of charcoal burning was different. It supported local men rather than outsiders. In addition, it may not have threatened grazing territories of large flock owners as much as it did in Abkeshan. It may have affected small village owners but they would not have the power or organization to control it.

The degree of use of the Plain for grazing by a household is determined by the size of its holding, its access to a summer or year-round station, access to relatives who can take animals off the Plain, their ability to supply supplemental barley and straw, and to meet the labour requirements of milk e.g. processing, and assistance to the shepherd. Dry farming depends on the amount of family or hired labour available for ploughing and harvesting which is linked to the demand for labour for the household's irrigated farming and pastoral interests. In the case of each family, these factors combine in a variety of ways to give each a different interest in the use of the Plain. Even if there may be a general consensus that the range on the Plain is worse than off it, the next step — to seeing this as due to overgrazing, dry farming and collecting (singly or together), and a further step of organization for control — is lacking. The "individual benefits of participation are not equated with group benefits...and group pressure for participation in an organization for control is not very strong" (Bennett 1979:10).

These explanations of lack of collective action have been phrased in terms of the individual decision-maker and the benefits he would or would not receive by paying the costs associated with co-operative action. It is important to consider these individuals in their socio-political context. For example, the groups listed above which effectively exercise communal control of a common resource range from tribally organized groups in Afghanistan to feudal society and autonomous small villages in Europe and Mexico, and the nature and extent of their group control, varied considerably. In the present context the tribally organized groups are the most interesting. The presence or absence of tribal organization within a society is important because it can serve as the basis for resource control in the absence of a political superstructure such as might be provided by the central government.

The recent history of the Middle East is filled with examples of the disintegration of tribally organized society and its replacement by the social and administrative framework generated by the rise of the nation state. This change has occurred at a time when population growth and other changes have increased both local pressure and general demand on natural resources. In Tauran the tribal structure was changing by the turn of the century for a number of reasons which were difficult to reconstruct because of the limited time depth of the oral histories and travellers' reports upon which we are primarily dependent. For example, residents' and travellers' reports refer to the power of khans whose position seems to have derived from a tribal base in the area. Until the 50s villages were endogamous communities interrelated by intermarriage among elite tribal families. With the social and economic change that began to accelerate in the larger society in the late 50s, and the unprecedented rise in the power of the central government and its extension into previously isolated districts, the political and economic base of this tribal elite disintegrated, and most survivors migrated to the towns. In addition, in the 60s, the central government nationalized rangeland and water resources — which negated many of the traditional rights of villagers over their resources. Village territories were greatly reduced and villagers do not have legal recourse to government agents such as the gendarmerie to protect the larger area they exploit. Currently we are left with a situation in which the only control mechanisms on the Plain are imposed from outside such as those on dry farming, charcoal burning and firewood collection. The government has not yet imposed grazing restrictions on the Plain but individual villages can no longer control their own territory even if they should organize to do so. As a result villagers attempt to avoid grazing on the Plain whenever possible within the limits of their family capabilities.

This chapter has argued that in Tauran traditional forms of resource use are not inherently destructive, common use is not always a tragedy of the commons and central government policies may overlook or compromise valid local strategies. Although desertification undoubtedly occurred to some extent before the modern period, there appears to have been a social mechanism — in the form of tribal organization — that may have facilitated communal control and conservation. In the last two decades or so that internal mechanism has disappeared as a function of change in the larger society, and the associated administrative changes have not been sufficient to replace it. It is not too late to re-evaluate the problems of control in regions like the Middle East where tribal organization may have offered some solutions.

# NOTES

1. The data from Tauran derive from ethnographic field research conducted over a period of 17 months between November 1974 and December 1978. I wish to acknowledge my appreciation to the MAB Secretariat, UNESCO, Paris and Sigma XI for financial support and to the residents of Tauran, the director, staff and local game guards of the Department of the Environment (Tehran), the research division of the Ministry of Agriculture (Tehran), and the botanists who worked with the Tauran Programme — S.W. Breckle, H. Freitag, K.H. Rechinger, H. Runemark, and P. Wendelbo — for their invaluable assistance. I am also grateful to Brian Spooner, John Bennett, Lee Horne, A. Endre Nyerges, and Stephen Sandford for suggestions which were helpful in analyzing and interpreting the material presented here, and to Lee Horne for drawing Figures 3 and 4. The final responsibility for both facts and arguments is of course my own.

2. All figures are taken from the National Spatial Strategy Plan — First Stage Report (Iran 1976) and an unpublished Agricultural Census conducted by the Statistics Centre (Iran 1973).

3. Antoun (1972) conducted anthropological research in an Arab village in Jordan. His discussion of the effects of ploughing fallow land is based on interviews with villagers and references from Shihabi (1935) and Keen (1946).

4. Rainfall and dry farming records for the area are incomplete but are supplemented from oral history and a denro-chronological study of a dominant shrub. 1958-1963 and 1968-1973 were bad years, with 1971 especially bad. During the earlier period the Chubdari, a group of nomads, settled at the northeast corner of the area. An analysis of *Zygophyllum* growth rings suggests that over an 88 year period bad years occurred every 2-3 years (see Bhadresa, in Iran 1977:69). A bad year for *Zygophyllum* may not necessarily be a bad year for flocks or agriculture, depending upon the timing of the rains. For grazing, even a low yearly rainfall will not be disastrous if spring rainfall occurs at the right time and the crop of annuals flourishes.

5. A more comprehensive discussion of fuel is given by Horne (chapter III.2 in this volumne). The present chapter is concerned only with aspects that bear on the problem of conservation and control.

6. A few families with many children do have milch cows — despite the problem of finding adequate and inexpensive fodder. Alfalfa is grown in small amounts only, because it needs at least weekly watering.

7. For *palvar* which receive supplemental feeding, lamb gross weights can be 30-35 kg and meat yield is 18 kg. These animals do not graze with range flocks.

8. There have been discussions about the problems of hired shepherds elsewhere in Iran — mainly among nomadic groups such as the Basseri (Barth 1961, 1964), Komachi (Bradburd 1980), and Qashqai (Beck 1980).

9. Banfield's thesis is criticized by Silverman (1968), who argues that the social system is the basis not the result of the ethos of "amoral familism" and that social structural features of a society have their basis in the agricultural system. She compares two areas in central and southern Italy, and attempts to show how the agricultural organization is related to several features of the social structure.

10. See Goodwin for other explanations of this type concerning peasant un-cooperativeness (1979).

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# V.2

# INSIDERS AND OUTSIDERS IN BALUCHISTAN: WESTERN AND INDIGENOUS PERSPECTIVES ON ECOLOGY AND DEVELOPMENT

**Brian Spooner**

We have generally become used to the idea that ethnographers are a part of what they study. They live in the community they study and participate in the events and (ideally) in the social and cultural processes which they analyze and interpret. They cannot stand either theoretically or methodologically outside what they study — even though we do not perhaps all of us always manage to follow through with the implications of this condition.

The evolutionary ecologist knows implicitly that his professional activity, like all other human activity, takes place within the evolutionary process. But this orientation towards his subject matter tends to be very different from that of the ethnographer. Other investigators, and particularly economists and development planners, study unequivocally from without — they translate the laboratory-objectivity tradition of Western scientific method into the field. The growing emphasis on popular participation in development planning and implementation draws attention to these differences of orientation. In this chapter a case from Baluchistan will illustrate the significance of the difference.

## ECOLOGY AND ETHNOGRAPHY

We use the word "ecology" in two senses. It was coined to denote the scientific study (*-logia*) of "household" (*oiko-*) relations in and between communities, in and between biological populations, and between them and their physical environment. It has come to be used also for sets of those relations themselves. We often confuse these two meanings.

Ecology as a type of study has been pursued in various paradigms, most particularly a systemic "ecosystems" paradigm, and (more commonly in recent years) an evolutionary paradigm. In either of these paradigms it has been understood mainly as a natural science, deriving historically from biology, and using natural-science assumptions and models. Where social scientists have talked ecology — calling it cultural ecology, human ecology, or anthropological ecology — in their studies of human activities in relation to their natural matrix, they have explicitly borrowed concepts from biological ecology, and have talked in terms of adaptation, niche, etc. They have been concerned with the problem of explaining how human activities and experience are caused, conditioned, or affected by natural processes and conditions, rather than the other way round. Having no concepts that apply to both sides of the equation, physical-biological and human-cultural, they have tried applying concepts borrowed from the biological side.[1] Whether they begin from systemic or evolutionary assumptions, they run into similar problems: on the one hand we have not yet found a way to relate ethnographic data to evolutionary models; on the other, although for a time we had great hopes for systemic models of society, we have become disillusioned with them.

For this reason a serious dilemma underlies the attempts of biological ecologists, development planners, and anthropologists to work together in specific projects. This dilemma vitiates most ecologically oriented work related to development. (It is worth noting that in the past it has also had the effect of separating ecological anthropologists theoretically from their colleagues.) The dilemma is rarely faced. Whatever the focus of their work, biological ecologists tend implicitly to include human activity and its effects in their studies. However, as biologists they cannot treat human activity on the same level as the activity of other species, because as fellow human beings they impute values and intentions to it. Perhaps partly for this reason, they tend to treat it as intrusive.

There is good reason for them to treat human activity as intrusive. The organization of human activity commonly transcends the boundaries of ecosystems or habitats, and cannot therefore be usefully analyzed in terms of the ecologists' universe of study. Although human societies and cultures may be products of biological evolution, social and cultural processes do not fit into ecological systems or "communities". But ecologists' reasons for treating human activity as intrusive are more complicated than this, and not always entirely explicit: if they can manage to exclude it, there is nothing to prevent them from formulating their problems, hypotheses, methods, and solutions with the objectivity that is de rigeur in the Western scientific tradition. If they admit the presence of human activity on a level with other (nonhuman) activities, they find themselves in the position of having to deal with members of their own species (if not their own actual "population" or "community"), with whom, unlike the members of other species in their universe, they are unavoidably related (in the sense that their objectivity is compromised) by differences of interests and values — essentially, that is, by a political and moral (rather than a scientific) relationship (cf. Tucker 1977). They avoid this problem by treating all human activity as extraneous to the ecosystem. By thus reserving scientific objectivity for themselves they deftly condemn as beyond the pale all human opinion that differs from theirs.

Natural scientists are untrained to deal scientifically with questions of politics and morals. Social scientists are prepared for questions of politics and morals, but with rare exceptions do not adequately understand ecology. Not even those rare exceptions have yet proposed how to integrate the essential positivist objectivization of ecological science (which sees science as extra-cultural and absolute) with the semitic approaches of social science (which see scientific arguments, like all other arguments, as socially and culturally conditioned or filtered), in order to arrive at a somewhat humbler and more practical scientific ecology that would not treat human activity as intrusive. Ignoring the problem has led many (including many social scientists) to the general conviction that we know what all human beings should think and do in relation to the productivity of the renewable natural resources to which they have access, irrespective of the legitimate interests of other people in those resources.

To return to the initial distinction between objective ecology and ecological analysis: unlike ecological reality, ecological analysis is (like ethnographic description) not absolute but relative; it is relative to the social and cultural experience of the scientist. Although the ecologists' situation is far less obvious, they are in fact as much a part of what they are studying as are ethnographers of what they are studying. The identity of Western (as well as non-Western but Western-trained) ecologists derives from their place in their own society, and their society's position in the world, as well as from ideas from the cultural repertoire of their society which presently include (for example) positive thoughts about stewards of nature ("we are responsible to God and to future generations for the condition of the natural world") and negative thoughts about the destructiveness of the "frontier mentality" ("there will always be more out there for us to exploit to our advantage").[2]

It is not too difficult to grasp and to explain the possibility of cultural variation in ecological orientation. We have become accustomed to the idea that different people from different cultural backgrounds have different values and consequently are likely to have different perceptions of nature and of their relation to it. But the ability to appreciate social differences seems to lie deeper in our cultural consciousness. Though we recognize them instinctively, we repress them, or at best proceed on the assumption that they are artificial and easily overcome, whereas in fact the more we seek to overcome them, the more they control our daily lives. Our feelings towards nature and the natural environment turn out to be a reflection of the way we relate to other people. Our ecological values are to a large extent a function of our social values.

This social dimension of ecology obscures our view of development problems. It is therefore on social variation in relation to territory and natural resources that I shall focus in the remainder of this chapter.

## ECOLOGY AND SOCIAL CONTEXT

Social variables have to do with interests. Interests relate to individuals and to groups. In some cases (especially in the West) individual interests tend to take priority over group interests. In other cases (especially in some tribal societies — *pace* Hardin) group interests may take precedence over individual interests. Every ecological issue involves a range of different interests, representing conflict between individuals within a group, and between groups, between insiders, and between insiders and outsiders.

The classic case of an ecological issue between insiders and outsiders is the issue between "us" and "them", between the ecologist-consultant and the indigenous community. Mary Douglas, who has done more than anyone to sensitize us to the social mainspring of human experience, puts it this way:

> Unlike tribal society, we have the chance of self-awareness. Because we can set our own view in a general phenomenological perspective, just because we can compare our beliefs with theirs, we have an extra dimension of responsibility. Self knowledge is a great burden (1975:230-231).

If we are to acknowledge the burden that Douglas identifies, we must take account of the fact that statements about ecology are not just right or wrong. Apart from being objectively right or wrong, they have different meanings, more or less significant, according to whether one is a member of the ecological community in question or not, and (if one is a member) according to the particular position in that community that one occupies. Both the habitat and the ecological future look very different according to whether one is a hunter in a small closely knit society; or a dry-farmer, a pastoralist, or an irrigator in a society that may also include people with different resource interests; or a steel worker in a modern complex society, where one is not committed to a particular occupation or a particular relationship to the natural environment, but may (perhaps unconsciously) feel locked into a particular economic class. Just as there is more than one recognized valid interpretation of a modern industrial economy (the differences correlate with different political ideas about the ideal economy), so the ecosystem may look very different according to the niche one occupies within — or outside it.

For comparison let us imagine ourselves in Disneyland. Take the case of a gazelle in an open steppe ecosystem. Although everything is indeed connected to everything else (cf. Commoner 1971:29), the survival interests of grasses and forbs, shrubs, herbivores, and predators are obviously in conflict. The ecologist stands outside the system but bases his research design implicitly on certain interrelated assumptions about productivity and diversity. However objective his research design, the ecologist is led by his assumptions to discriminate against the interests of individual creatures in favor of the survival of what he perceives as "the system". The survival of the system may, of course, be in the long-term best interests of the totality. It is definitely not, however, in the best interests of all the component species, let alone of all the living individuals, some of whom will inevitably sooner or later fall prey to predators. A reduction in the number of predators would, therefore, be in the best interests of some at least of the living herbivores. Similarly, a reduction in the number of herbivores would be in the best interests of many living plants.

If a gazelle could produce a study of the same ecosystem, we might expect the results to differ from those of the ecologist, inasmuch as they would, as a matter of course, be based on different values, which would derive from a different social situation. The gazelle's assumptions would of course not be disinterested. A member of the system, such as the gazelle, whose personal interests are at stake, would argue for his own survival first. But what about the ecologist? The ecologist can argue in terms of the survival of species and of the system, because survival on that level suits his own social values best. Both arguments may be equally objective and scientific, but differ on grounds of morals and personal interest, which are socially relative. The conflict between them is always in the end resolved politically, as a function of the difference in power of the individuals or the communities or the populations in question (cf. Spooner 1982a:7). Social scientists will also recognize here the familiar problem of the actual individual versus the abstract society. However, the issue of the conflict of interest between the cheetah, the gazelle, and the shrub is introduced in order to clarify the difference of interests between the Western-trained ecologist and the nomad, the horticulturalist, or the irrigator, each in relation to (not an ecosystem, but) all the other human, biological, and physical factors that impinge on their lives. A particular case from the Third World will show the significance of this argument for problems of development (standard of living) and ecology (habitat and natural resources).

# A CASE STUDY FROM BALUCHISTAN

Baluchistan is the western province of Pakistan. The name comes from the Baluch, who comprise the majority of the population throughout most of the province, as well as in the neighboring province of Iran and the adjoining part of southern Afghanistan. The total population is estimated tentatively at four million. In all three countries the territory is arid and poor, and has remained for many centuries in comparative isolation from the major economic and political centers of the region. Baluch identity is symbolized in their language and oral literature and code of honour. Otherwise they are a heterogeneous collection of tribes of various origins, and the land they inhabit varies from high plateau with cold winters to subtropical coastal lowlands. They live by a mixture of dry and irrigated agriculture and pastoralism. Community organization varies between extremes of highly stratified villages (often in the past dominated by strong forts) and small egalitarian nomadic groups.

In Makran, the southwestern division of the province of Baluchistan in Western Pakistan, and across the border in Iran, the nomadic pastoralists play a particularly significant social role. Their continued activity provides a communications network among the settled village communities and symbolizes for those communities the values that support traditional Baluch identity. They contribute significantly, that is, to both the logistics and the morale that are essential to the continued viability of Baluch society in the area. Unfortunately, these variables do not show up in either economic or ecological analysis.

Nomads are important for the local economy, both for what they produce and as a source of seasonal labor. They bring milk products to the local market, and they supply the necessary labor for the date harvest in the villages — the most important event in the traditional agricultural cycle, which coincides in late summer with the slack season in the pastoral cycle. They are also agricultural producers themselves. Much of the subsistence-crop production of the area depends on unpredictable river flow and runoff, which only the nomads know how to use. Small pockets of soil scattered throughout the area produce crops when a downpour happens to bring water by — if a nomad is there to channel and apply it. Although no one in the towns wants to live that life anymore, the idea of it remains an important cultural value: nomadic life is still thought of as the genuine Baluch life, which embodies the authentic Baluch virtues of honesty, loyalty, faith, hospitality, asylum for refugees, and so on.

There are no reliable figures to indicate how many of the Makran population of some 230,000 are now nomadic, nor how many of those who are nomads by socialization still spend most of the year in tents or other temporary dwellings with their families and flocks rather than taking one of the modern options of wage labor in the (until recently) booming Gulf Emirates, or wage labor in towns outside the province. We may estimate, conservatively, over 50,000.

The significance of the nomads for the future development of Makran far outweighs their numbers or their economic contribution. They are the only people who use or are ever likely to use some 90 percent of the territory of Makran. Without them the greater part of the population would be marooned in isolated oases, which on their own do not have the resources to be economically independent, and with increasing dependence on outside subsidies would gradually lose population to more attractive opportunities outside the province. With the nomads, the Baluch population as a whole forms an interdependent social and cultural, as well as economic and political, network covering the whole of the area. As long as the nomads are there, the whole of the area continues to be inhabited by people who consider it to be their territory. If the nomads leave, the settled population will see itself simply as an economically disadvantaged appendage of the national economy. As long as they remain, the total population shares a conception of ethnic provincial autonomy.

The nomads depend on the primary productivity of the semi-desert and desert areas which cover the greater part of the territory. Traditionally they make no improvement in either the pasture or the watering resources. Based on comparison with other areas of similar climate and soils, ecologists evaluate most of this rangeland as severely degraded. Their evaluation is made without reference to the fact that the Baluch continue to make a living out of it, and without the possibility of direct comparison with earlier data. It is an outsider's evaluation, which focuses on the vegetation rather than on the evolving process of interaction between the vegetation and the pastoralists.

Pastoral activity is an essential component of the Baluch economy, and it contributes significantly to the social interaction and the culture of the province. Range science condemns Baluch pastoral practice. But no one has yet shown how the principles of range science might be integrated with the social conditions of this type of situation. The national economy is intruding more and more into the life of the area, helped by programs financed by USAID. A major consequence of these programs is increasing dependence of the population on the national and regional economies. For the time being, however, the pastoralist sees his main interests in continued exploitation of the range, of localized runoff, and of the socio-economic resources of the scattered settlements of the area. The farmers in the settlements depend both on the pastoralists and on the outside economy. Loss of the pastoralists would significantly reduce the viability of most of the settlements. The pastoralists can use help, but what they need is not enforced improvement of their range through enforcement of Western range science principles, but defense against the effects of the national economy. The best defense would probably be in the form of management by government of the terms of trade, manipulating prices in such a way as to reinforce local values, instead of subverting them.

Western range ecology, as its name implies, starts with the range. The range scientist is the self-designated steward of the plant communities of the Baluch's range. According to the principles of this science, no more herbivores should be allowed onto the range than can graze without degrading its plant communities. The pastoralist, on the other hand, sees range, domesticated animals, and people in interdependent interaction. It would probably not be too much of an oversimplification to characterize this view as one that would emphasize the convenience of the family group in the context of its social matrix. The nomad's first priority is to avoid disruption of his social relations. If this would mean reduction of the productivity of the range for future generations, that is of secondary importance. In these times of rapid change, who knows what future generations will need?

However, there is evidence to suggest that the range has remained in its current "degraded" state for a long time, over a century (Hughes-Buller and Minchin 1906-1907), and we do not have convincing evidence that current trends are adverse. Unfortunately, no one will finance the studies that would be necessary to establish what the trends are. Such studies — which would construct an insider's ecology — would need to focus on interactions of pastoral technology, animal behavior, and plant communities over a period of time (cf. Nyerges 1982).

## COMPARABLE CASES

Such cases of insider's ecology are beginning to appear. In Africa pastoralists have the reputation of seeking to maximize numbers of animals. Recent work by Sandford (1982 and in press) has provided a rational basis for this emphasis in range-science terms by synthesizing accumulated existing information on what might be called indigenous range-management practices. Cossins (in press), using data gathered by ILCA (International Livestock Centre for Africa) research teams, has demonstrated that many pastoral systems in sub-Saharan Africa are also in fact more efficient in terms of productivity per hectare than ranching systems in either developing or developed countries. But as Legesse (in press) has shown in his study in northern Kenya, in order to understand what is going on ecologically among the Boran and the Gabra pastoralists, it is necessary to study the inter-dependence of their two sets of activities. What we need more than anything else, however, is some reconstruction of what has actually happened in the relationship between pastoralists and their resources over a significant period of time. Cassanelli is probably the first historian to work in the historical ecology of pastoralists. He brings the skills of an historian to bear on the problem, without the biases of either the ecologist or the anthropologist (in press).

In each of these cases there are obviously several different ways of defining the universe of reference — each producing different results. The Western ecologist wants primary productivity at the expense (if necessary) of current livelihood — on the assumption that we are otherwise sacrificing the livelihood of future generations to the interest of the living, and that we should not do that. The Baluch pastoralist sees market centers and agriculture as a resource on a level with the range. He wants more in return for his product, but his first priority is the security of his social life. Else he will think of leaving his niche. The range ecologist considers that the local range, and therefore also the global resource base, would be better off if the pastoralist would leave his niche. The Baluch farmer sees the nomads as a resource. He wants to keep them where they are; otherwise only economic subsidies will keep him where he is.

It would be easy to add examples of other forms of land use. A similar case could be made in the much more complex situation of the Punjabi irrigator (Spooner 1984b:28-39). But perhaps more interesting here is the case of the Susu in northwestern Sierra Leone (Nyerges 1985). Susu swiddeners do not have enough labor to produce an adequate food supply, though shortage of labor leads them to clear plots inadequately, with the result that the degradation of the forest proceeds at a slower pace than might otherwise be the case; recurrent famine keeps population and the labor force down; they cannot intensify to produce more food, because of insufficient labor; they cannot reduce labor inputs and de-intensify to fit labor availability, because they dare not risk lower production of food. But we cannot help them, because if we introduce labor or technology from outside, what we introduce will have a higher value for them than the local resources and they will degrade faster and have less interest in conserving local resources.

Since people do not fit easily into ecosystemic frames of reference, the shift from a systemic to an evolutionary paradigm in ecology has helped us to develop ways of incorporating local interests and points of view into ecological analysis. However, in case I may have appeared to argue that social relativism is more important than global survival, let me in concluding emphasize that this is not my view. As I stated at the beginning, ecology is real; but ecological analysis derives from a particular social and cultural (and perhaps even ideological) position. To return to the Bambi-like example: without human intervention the gazelle population would probably never expand to the point where it disrupts the eco-"system". Malthusian factors would take care of them first. But human populations, having culture, are not always restricted by Malthusian pressures. On the contrary, they are often able to act out the scenarios of Marx and Boserup, and have done so periodically from the Neolithic up to the Green Revolution.

Furthermore, human beings, having culture, have rights — not only human rights but civil rights. We scientists and consultants learn our morality in two different arenas. When we mix them we do so as amateurs. If we stand outside the ecosystem (as we do in the case of the gazelle and the Baluch) we artificially keep morality out of the discussion. In fact, however, every ecological question that involves human activity is not only an ecological question, but also both a moral question and a political question. Development has tended to ignore the political and moral dimensions of ecological (among other) problems, and has concentrated on the scientific and technological solution of the problem qua objectified ecological problem only. In the long term it cannot be done. The ecological dimension of the problem will be resolved only as part of a comprehensive resolution of the whole problem, including its moral and political dimensions. The primary productivity of the rangelands of Baluchistan must be taken care of not by ecologists but by politicians, using ecological among other information, at the level of national planning, adjusting the terms of trade so as to reinforce local values insofar as they are politically and morally desirable, making economic planning an instrument of social planning rather than a victim of ecological planning.[3]

# NOTES

1. It is not pertinent here that some of these concepts, such as "community", were originally derived from social studies. This borrowing has been written up by Rapport and Turner (1977) and Richerson (1977).

2. Passmore (1974a) reviews the history of these various attitudes towards nature in our own history in a book that helps in many ways to "remove the rubbish" (Passmore 1974b) from our everyday thinking about ecology.

3. This essay builds on three earlier essays in which I argue that (a) ecology is relative (1982b), (b) assessments of the ecology of dry lands should be assessments of the evolving relationship between human culturally organized activities and natural processes (1982a), and (c) the relationship between a population and its territory may be as valuable and as fragile as the ecosystem, and perhaps should be given planning priority over the ecosystem (1984a). My aim here has been to show how, without giving in to cultural relativism with regard to ecological analysis, there may be a valid ecologically relevant local point of view that would direct our attention to more fruitful development objectives.

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# AFTERWORD — RESEARCH NEEDS, METHODS, AND TOPICS

**Michael R. Dove & Carol Carpenter**

The readings in this volume offer some insight into the current and desired state of research on the sociology of natural resources in Pakistan and its neighboring countries. First, they suggest that good, in-depth, quantified research is sorely lacking. Campbell's comment that data on household fuel use are 'appallingly imprecise' applies to almost all natural resources and their use. The basic information needed to tell us what resources are available, how they are being used, and whether availability and use are decreasing or increasing, are all lacking. In their absence, development planning tends to be based on 'common sense' or 'intuition', but this can be dangerous. When in-depth research is carried out, its results are often counter-intuitive, confounding accepted wisdom. An example of this is Briscoe's finding in Bangladesh that the rural poor burn more wood than the rich, because although the rich own most of the trees, they mostly use their own crop residues for fuel, leaving the poor to gather twigs and branches from their trees. Another is Horne's finding that fuel use does not vary between households in proportion to their size, because of economics of scale in fuel use in larger households.

The readings in this volume not only demonstrate the need for and value of good research, they also suggest some innovative ways of carrying it out. It is no accident that virtually none of the readings were based on the sort of large-scale survey research that has become standard in government departments and development projects. In all cases, sample size was very modest: it ranged from just 6 households for Horne's study, to 308 for Martin's — with most being under 100. These samples are too small to generalize about national characteristics, but they were clearly not too small to be able to draw important and scientifically valid conclusions about people's use of natural resources — and it is the latter not the former that is needed in the typical development study. Many of these studies also include innovative methodological techniques. For example, Bharara based his study on data gleaned from the memories of his informants, on events as far back as 1899. (Note that this technique, like those employed in the other studies, does not depend upon the literacy of the informant; a farmer does not have to be literate to be a good informant in a well-designed study.) Briscoe a gathered data from each of his study households at two week-intervals, over a period of 8.5 months (a technique recently employed to good effect in a study of household fuel economy carried out by the Pakistan Forest Institute). Stanbury's study makes an important methodological point regarding research on the activities of women: what women do is often very different from what men say women do. This means that interviews of men must be complemented by interviews of women, and that this must be done by women researchers. One characteristic that all of these studies share is duration: they are all the work of months (and in some cases years) of research. Good research takes time, bad research does not.

Finally, the readings in this volume suggest the value of breaking away from traditional survey questions to investigate more innovative research topics. These include the analysis of the research process itself, as in Thorp's critique of government surveys in Bangladesh based on his own in-depth research in the area. For the purpose of stimulating thought and discussion, a few such topics are listed:

(i) What are the direct and indirect impacts of the out-migration of male labor on afforestation and deforestation in rural areas (through shifts to lower-labor cropping patterns, increases and decreases in numbers of livestock kept, etc.)?

(ii) What are the direct and indirect impacts on rural deforestation of the raising of livestock for urban meat markets?

(iii) What are the traditional range management knowledge and techniques of semi-nomadic people?

(iv) What is the impact of central government administration and control on tribal systems of controlling use of natural resources?

(v) How do local systems of resource use in the Federally Administered Tribal areas compare with those in adjacent settled areas?

(vi) What is the ethnography of the use of fuel in cooking, including techniques of fire-making, fuel substitution, and seasonal and geographic variation?

(vii) What changes are taking place in the percentage of tree cover in Pakistan's forests, rangelands, and farmlands (using remote-sensing data)?

(viii) Carpenter's typology of livestock production, which may hold for India and Bangladesh as well as Pakistan, needs to be tested in more detailed research. Is it true that the livestock-production activities of marginal landholders and the landless in irrigated areas had deleterious effects on forests and rangelands? When livestock production contributes to agriculture, does it also have beneficial effects on the rural environment?

(ix) How does the role of women in livestock-based rural economies compare to their role in agriculture-based ones? In other words, when livestock production becomes a secondary rather than a primary source of subsistence, how exactly does women's involvement in livestock raising change?

(x) How do women manage fodder resources located in non-agricultural grasslands or forests? How do they adapt to fodder shortages brought on by population growth, immigration, the privatization of common lands, or agricultural intensification?

(xi) How can rural women be reached with information and technology to upgrade livestock production? Are female extension agents effective? Where do rural women now go for veterinary advice? How do they select animals for breeding, or for purchase? What sorts of fodder do they prefer for milk-producing cows and buffaloes? How do they maintain the non-agricultural sources of fodder?

# CONTRIBUTORS

Fazila Banu, Intensive Rural Works Programme, Ministry of Agriculture, 19 Sukrabad (3rd Floor), Sher-e-bangla Nagar, Dhaka 7, Bangladesh

L.P. Bharara, Central Arid Zone Research Institute, Jodhpur (Raj.), India 342003

John Briscoe, The World Bank, 1818 H Street, N.W., Washington, D.C. 20433, U.S.A.

Nek Buzdar, Development Consultant, 1532 Shasta Way, Placentia, California 92670, U.S.A.

Tim Campbell, The World Bank, 1818 H Street, N.W., Washington, D.C. 20433, U.S.A.

Carol Carpenter, East-West Environment and Policy Institute, 1777 East-West Road, Honolulu, Hawaii, 96848, U.S.A.

Michael Cernea, The World Bank, 1818 H. Street, N.W., Washington, D.C. 20433, U.S.A.

Michael R. Dove, East-West Environment and Policy Institute, 1777 East-West Road, Honolulu, Hawaii 96848, U.S.A.

Shelley Feldman, Department of Rural Sociology, Cornell University, Ithaca, New York 14853, U.S.A.

Lee Horne, University of Pennsylvania, Department of Anthropology, Philadelphia, Pennsylvania 19104, U.S.A.

Abeedullah Jan, Ministry of Food, Agriculture & Cooperatives, Pakistan Secretariat, Block "B", Islamabad, Pakistan

N.S. Jodha, ICIMOD, P.O. Box 3226, Kathmandu, Nepal

Richard Kurin, Office of Folklife Programs, Smithsonian Institution, Washington, D.C. 20560, U.S.A.

Mary A. Martin, The Middle East Center, University of Pennsylvania, 838-839 Williams Hall, Philadelphia, Pennsylvania 19104-6305, U.S.A.

Florence McCarthy, Field Studies Office, New York State College of Human Ecology, Cornell University, Ithaca, New York 14583, U.S.A.

Douglas J. Merrey, The International Irrigation Management Institute (IIMI), P.O.Box 2075, Colombo, Sri Lanka

Bimal Kanti Paul, Department of Geography, University of Dhaka, Bangladesh

Abdul Latif Rao, National Council for Conservation of Wildlife, House No. 3, St. 84, G-6/4, Islambad, Pakistan

Brian Spooner, University of Pennsylvania, Department of Anthropology, Philadelphia, Pennsylvania 19104, U.S.A.

Pamela Stanbury, International Irrigation Management Institute (IIMI), P.O.Box 2075, Colombo, Sri Lanka

John P.Thorp, Department of Social Science, Ferris State University, Starr 111A, Big Rapids, Michigan 49307, U.S.A.

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