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OPPORTUNITIES FOR ECO-DEVELOPMENT IN BUFFER ZONES:

An Assessment of Two Cases in Western India

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EXECUTIVE SUMMARY

As Phase II of a two-part assessment of buffer-zone ecorestoration in India, a team, funded by USAID/New Delhi and fielded by the Biodiversity Support Program, visited two locations in Western India to explore opportunities for ecological rehabilitation and sustainable development of buffer zone resources. The locations, identified in a series of case studies prepared in Phase I, were selected for their contrasting settings. Hingolgadh Nature Sanctuary in Gujarat is small and manageable, and is under moderate pressure from resource poor villagers surrounding the sanctuary. Ranthambhore National Park, a large tiger reserve of international repute, faces immense pressure from increasingly desperate residents along the periphery.

Main Findings

The team's main findings (reported in Section II of this report) are summarized below:

> Continuous commitment and presence of NGOs at the community and hamlet level are catalyzing development efforts in the buffer areas of both Hingolgadh Nature Education Park and Ranthambhore National Park. Although the process has been slow, the trend is clear: local communities do respond to efforts aimed at assisting them to do more for themselves. NGOs can play a unique and critical role both in working with local villagers, and in mediating between the villagers and outside agencies, particularly the Forestry Department.

> Village panchayats have been poor custodians of village common lands (in both Hingolgadh and Ranthambhore), and have been unwilling or unable to play a role in managing the designated buffer zone (in Ranthambhore). It would be unwise for a buffer zone development strategy to rely entirely on the panchayat system.

> Formal agreements between local communities and the Forestry Department can serve as important mechanisms for establishing rights to buffer zone resources and responsibilities for managing and protecting those resources.

> Simple, low-cost ecological restoration techniques that provide quick results are available and are being demonstrated by the park management (Forestry Department) in both Hingolgadh and Ranthambhore.

Buffer areas in both sites are severely degraded and indications are that the process of degradation is continuous and relentless.

> There is clear physical and technical potential for substantially increasing biomass-based production in the buffer areas of both study locations through range improvement, afforestation, and (on private land) improved agriculture and livestock.

> Successful application of these restoration technologies, however, will depend on 1) their adaptation to site specific conditions within the Buffer Zone System, and 2) the institutional linkages formed to promote their transfer to local groups.

Suggestions

Based on these findings, a tentative set of suggestions are made (in Section V) to begin to address key constraints to ecological restoration of the target sites, and to initiate the eco-development process. These are summarized below.

> Park managers need to work more closely with local communities, NGOs, and other government agencies in searching for solutions to buffer zone management problems. Training in technical extension and community outreach for park guards and forest rangers, and management training for mid- and senior-level park staff appear to be high priority needs for enhancing the Forestry Department's ability to respond to the new demands of buffer zone development.

> Local communities need to become involved in practical field research for ecological restoration. Research needs to give greater emphasis on how to adapt known technologies, including local indigenous technologies, to particular settings.

> Management plans need to be developed for dealing with livestock in the buffer area. These plans should be developed jointly by the Forestry Department and representatives of local and migratory grazing communities to arrive at fair and sustainable solutions to persistent problems.

> New livelihood opportunities need to be developed in the buffer area including minor forest products, eco-tourism and value-added environmentally benign enterprises.

> Family planning and resource substitution programs need to be incorporated into eco-development strategies for the Hingolgadh and Ranthambore sites, in light of increasing and unsustainable pressure on system resources from surrounding populations.

Specific recommendations to USAID are presented in the form of suggested follow-up actions designed to address some of the immediate policy and operational concerns identified in the report. Readers are referred to Section VI (Recommendations for USAID) for a full discussion.

A Note to Busy Readers:

The most important sections of this report are the **Main Findings** (Section II) and **General Lessons Learned** (Section V). Descriptive information about the two parks are found in Section III (Hingolgadh, in Gujarat) and Section IV (Ranthambhore in Rajasthan).

Please note that the location and setting of the two parks are presented only in the descriptive chapters (Sections III and IV) and are not repeated elsewhere. You may wish to glance through these sections to gain a flavor of the locations.

Readers interested in more specific information about the two sites are referred to the annexes. ANNEXES 1 and 2 provide lists of woody and herbaceous vegetation by species, common name and local use found at the Hingolgadh and Ranthambore sites, respectively. ANNEXES 3 and 4 offer specific suggestions for future on-site development activities at each location, and ANNEX 5 presents an introduction to the modeling methodology (see p. 13) being developed to analyze the Ranthambore Buffer Zone System for future planning and management.

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PREFACE

With financial support from the USAID/India mission through the Biodiversity Support Program (a joint venture of World Wildlife Fund, The Nature Conservancy, and the World Resources Institute's Center for International Development and Environment), a team visited two locations in Western India to explore opportunities for ecological rehabilitation and sustainable development of buffer zone resources. An earlier, companion report (VIKSAT/CEE, 1990), prepared for USAID by the Nehru Foundation for Development, identified these contrasting sites for further analysis by the team: Hingolgadh Nature Sanctuary in Gujarat is small and manageable, and is under moderate pressure from resource poor villagers surrounding the sanctuary; and Ranthambhore National Park, a large tiger reserve of international repute faces immense pressure from increasingly desperate residents along the periphery.

By viewing two such different settings through the eyes of the consulting team, the USAID mission sought to gain insights into the eco-development dilemmas not only of buffer zones *per se*, but of wasteland development as a whole. While it is for the reader to judge the insightfulness of the present report, there is no doubt that the two study locations highlight the challenges of meeting both the environmental objectives of preserving biodiversity and the human welfare objectives of economic security. In addition to describing the problems, this report also attempts to point to solutions, or to put it more honestly, to point in the direction where solutions may be found.

While there is always a danger in making prescriptions on the basis of a brief study, given the rapidity with which buffer zone plans are being formulated and funds allocated, there is an urgent need for broad-based dialogue about how best to proceed. It is in this spirit that these rather rough findings are presented.

The authors would like to acknowledge the extremely useful collaboration of Dr. B.K. Mishra, and Dr. Ajith Kumar, both on the faculty of the Wildlife Institute of India who joined the team for a period of four days during the visit to Ranthambhore National Park. The team is also grateful to the many people we interviewed during the two weeks of data collection, in particular (in chronological order of our meetings): Mr. R.K. Shama (Deputy Conservator of Forests, Gujarat), Mr. K. Chandarana (Range Forest Officer, Hingolgadh), Mr. U. Vora (Assistant Director, GEER Foundation), Mr. J.P. Aggarwal (Conservator of Forests, Gujarat and Director, GEER Foundation), Mr. B.P. Lakhani (Principal Chief Conservator of Forests, Gujarat), Mr. S.A. Shaw (International Tree Crops Institute), Mr. Y. Sahu (Deputy

Director, Ranthambore National Park), Mr. M.L. Meena (Conservator for Social Forestry, Sawai Madhopur), Mr. D.S. Shaktawat (Range Officer, Ranthambhore), Mr.K.K. Kotia (Principal Chief Conservator of Forests, Rajasthan), Mr. V.D. Sharma (Chief Wildlife Warden, Rajasthan), and Mr. R.L. Singh (Director, Project Tiger).

Special appreciation goes to Dr. H.S. Panwar, Director of the Wildlife Institute who ensured that an already planned visit to Ranthambore by his staff could be carried out in conjunction with our mission. We benefited greatly from this association. We would particularly like to express our sincere gratitude to the many village residents we interviewed in the villages of Amrapur, Bhoyra, Lalavadar, Hingolgadh, Gundala, and Khadkana (in the vicinity of Hingolgadh Sanctuary) and the villages of Mordungri, Gopalpur, Khandoj, Khawa, and Kalonda (in the vicinity of Ranthambore National Park). It is their information, related to us with great patience and forbearance, which has made this report possible, and which can help make sustainable development a practical reality.

Finally, we wish to express our deepest thanks for the arrangements made by our colleagues from the Center for Environment Education (CEE) in Ahmadabad, with whom this assessment was conducted as a joint undertaking. CEE staff have been working in both locations that we visited for a period of roughly two years; indeed, this is the primary reason for selecting these sites. Their familiarity with the people and circumstances of each location, and their interest in evaluating their own development activities, provided insights that we have inserted into this report under our names. In many ways this report reflects their work more than ours, although we must take responsibility for the product. We would like to thank the Director, Dr. Kartikeya Sarabhai, the Deputy Director, Mr. Kiran Desai, Mr. G. Raju, and Ms. Punam Kathuria from the Ahmedabad office; the Hingolgadh field team, Ms. Vandina Joshi, Mr. Attul Pandya, and Mr. Lavji Jhapadia; and the Ranthambore team, Mr. Rajiv Khandelwal, Mr. Sameer Bhatnagar, and Mr. Krishnavatar Sharma. While we cannot blame them for any mis-information this report might contain, we can certainly say that without their help and guidance, this report would not have been possible.

Financial support for this study was provided by the USAID mission in India, through the Biodiversity Support Program mentioned above. The participation of one of the team members, Dr. Janis Alcorn, was made possible through the American Association for the Advancement of Science's "Science, Engineering, and Diplomacy Fellows" program. Acknowledgement is also made to the United States Fish and Wildlife Service and to the Wildlife Institute of India for consenting to the participation of Dr. Stephen Berwick, who was in India on a joint project of the two agencies.

I. OVERVIEW

In the last half decade the development community has become increasingly concerned with ways to ensure the maintenance of wild lands and natural ecosystems as sources of genetic raw materials, as well as critical components of economically vital renewable resources. These resources directly support economic growth in the agricultural and industrial sectors -- and the livelihood of hundreds of millions of people. On a global scale, these scattered refugia of biological diversity and ecological stability constitute the basic support systems for life on earth.

Conserving such biological diversity, and the natural ecosystems which contain those biological resources, implies significant short-term opportunity costs of foregoing extractive use. These considerable "up front" costs are often viewed as an economic sacrifice that resource-poor developing countries can ill afford. Yet from a long-term perspective, the value of biological diversity and the associated natural resources is almost certain to increase dramatically. Investing in biological diversity is sound economics; the challenge is to find ways to make that investment financially feasible.

As biological systems, the resources of wild lands are dynamic and subject to management interventions that can provide sustainable benefit flows in the form of biomass production, clean surface and groundwater, air filtration and humidification, and income generation through high value non-wood forest products and eco-tourism. The biological capital thus preserved continues to be available for unanticipated future demands from biotechnology, agribusiness, forestry, medicine, or other sectors of tomorrow's economy.

Sustained yield management of wildlands depends upon a careful orchestration of policies and practices. On the policy side, renewable benefit flows need to be adequately valuated; under current policies, they are easily discounted in favor of more tangible returns from extractive use. Equally detrimental to maintaining wildlands productivity is the failure of benefits to be equitably distributed among those groups most affected by closing access to the biomass resources on which their livelihood depends. The resulting disenfranchisement of these user groups has given rise to their clandestine (and often costly, due to extortion and fines) encroachment of these resource reserves, forcing an opportunistic and highly exploitative mode of resource use. Exhaustion of vegetative cover and critical wildlife habitat around the inner boundaries of preserves has led to an inevitable retreat of the wilderness core before a widening zone of devastation. It is this interface of human and natural

systems, commonly referred to as the "buffer zone", which has become a focal point for development with a conservation thrust. It is also the context in which the following report is framed.

A. POLICY FRAMEWORK AND OBJECTIVES

In 1985, responding to a Congressional mandate to protect and maintain wildlife habitat, the U.S. Agency for International Development launched the first Wildlands and Human Needs project in collaboration with World Wildlife Fund-U.S. to explore viable strategies for conserving natural ecosystems within a development context. The focus was on preserving the integrity of ecological systems (e.g., high elevation tropical forests, coastal mangrove forests, and coral reefs) while harvesting the productivity of the systems for subsistence and income generation. Ensuring that harvesting was non-damaging and in line with rates of resource renewability opened the way for multiple use management strategies directed towards traditional as well as non-traditional (e.g., eco-tourism) uses.

Further directives from Congress to A.I.D. to specifically address problems of tropical deforestation and declining biodiversity in the preparation of its development strategies for host-countries, resulted in an agency-wide biodiversity initiative. This multi-million dollar program is leveraging private sector funds from a variety of U.S.-based conservation organizations, as well as support from participating host countries in USAID programs around the world.

Biodiversity Conservation in India

The Indian sub-continent, a rich repository of biological and cultural diversity, poses a daunting challenge to the twin goals of sustainable development and preservation of critical biological resources. Representing only 2% of the world's land mass, India supports 5% of the earth's known species and 15% of its human population. Under the best of ecological conditions, this level of biological diversity and human population density would be difficult to maintain. In India, where 50% of the land is degraded and more than 1/3 is considered wasteland (i.e., less than 40% productive), the pressure to convert natural systems into agricultural lands or to mine them for fuelwood and fodder is immense. Without an effective means of transforming vast areas of India's wastelands into productive use, and to sustain that productivity to keep up with rapid population growth, India faces an irreversible loss of her biological resources and future development options.

In response to this threat, the GOI is beginning to implement a specialized development strategy for degraded lands. Eco-development, as it is termed, is an attempt to integrate the restoration of degraded habitat adjoining natural preserves, with

soil and water conservation, range management, livestock breeding programs and fuel conservation. What distinguishes this approach from previous efforts at wasteland rehabilitation is an effort to involve local people more directly in the restoration process.

A central theme of the Government's recently unveiled 8th five year plan in the forestry and environment sector is ecodevelopment in the buffer zones of designated protected areas. This new strategy focuses on the areas around National Parks and sanctuaries, whose stated function was to buffer the interior against the periodic shock of human disturbance, but which now serve as gateways to an increasingly exposed core. The plan seeks to restore the productivity of these areas for maximum sustainable yields of fuelwood, fodder and other essential resources, thus deflecting pressure away from the core.

In consideration of this new development focus on the part of the Indian Government, and in keeping with A.I.D.'s Congressional mandate to enhance the conservation of biological diversity, USAID/New Delhi's Office of Natural Resources Management identified the emerging field of restoration ecology--the science of restoring productivity to damaged ecosystems--as a potentially key element of newly emerging natural resource management strategies. The principles of restoration ecology could prove relevant not only to buffer zone eco-development but also to the wider context of wasteland rehabilitation.

Objectives

The overall objective of the "Ecological Restoration Project," of which this report forms a part, is to evaluate the success of recent efforts in eco-restoration in India and to assess opportunities for future USAID support consistent with the Mission's new project focus on sustainable resource management technologies. The Mission undertook this project through a two-phased study: (1) an overview of the literature plus background data on two representative field cases; and (2) a field assessment of eco-development activities in the two cases identified from phase one. The objective of Phase One was to provide general background, while the objective of Phase Two was to identify generic activities that the USAID Mission could consider in future projects.

Phase I. The Center for Environmental Education (CEE) and its sister organization VIKSAT, were selected to carry out the first phase of the assessment. Under the aegis of the Nehru Foundation for Development, a nationally recognized Center of Excellence based in Ahmedabad, these environmental NGOs are actively involved in creating public awareness about the benefits of participatory natural resource management through education and eco-restoration demonstration programs. This experience, and

their commitment to popular-based conservation efforts, suggested they would be valuable collaborators in the preparation of the assessment for USAID.

The objectives of Phase I called for preparation of a background paper on the nature of eco-restoration efforts in India, with a particular emphasis on buffer zones located in arid and semi-arid regions, thus confronting issues of fuelwood and fodder use by farmers as well as large groups of (essentially) landless herders. Technical aspects of habitat rehabilitation as well as analysis of some of the social, institutional and policy constraints affecting the realization of eco-development objectives, were identified in this phase. A set of case studies, documenting the history of resource degradation and the status of habitat rehabilitation efforts in and around wildlife preserves was prepared by NFD for two contrasting sites: Hingolgadh Nature Education Sanctuary--a small, isolated ecological reserve in central Gujarat, and Ranthambore National Park--an internationally known wildlife park and India's premier Project Tiger reserve. The above information was then compiled and presented to USAID in a separate report.

Phase II. The objectives of the second phase were to examine the case study sites in more detail, to identify the set of ecological and social factors most responsible for the current state of resource degradation around these sites, and to explore options for eco-restoration and sustainable development of buffer zone resources. The anticipated outputs of this phase of the assessment were a systems analysis of the relationships governing resource use in the buffer zone, a set of recommendations for short-term actions at the operational and policy levels to enhance eco-development efforts at these and other sites, and a research agenda of information needs to guide future management decisions consistent with eco-development objectives for these sites. The results of this second phase are presented in this report.

B. METHODOLOGY

The selection of the team was guided by a view of buffer zone eco-development as a mix of problems hinging particularly on ecological and social issues. Thus, the team included a forest ecologist (Flickinger), an economic anthropologist (Groenfeldt), an ethnobotanist (Alcorn), and a systems modeler (Berwick) whose charge was to build a qualitative, and to the extent possible, quantitative model of the ecological and social interactions in the buffer zone "system." A tropical ecologist (Hatziolos), the USAID coordinator for both Phase I and Phase II, served as the fifth member of the team.

A case study approach, focusing on two locations, was viewed as the best utilization of limited time for the Phase Two

assessment. Contrasting locations were important for providing a broad range of circumstances. Within these parameters, selection of Hingolgadh Sanctuary and Ranthambore National Park was prompted by the existence of good baseline data (from CEE) and by the fact that CEE staff have been working in each location and could provide detailed information that would not be available from other sites.

The initial method used in the Phase II assessment reported here was reading the report of Phase I, which provided an excellent introduction to what the team would see on the ground. The second assessment method consisted of interviews and observations with villagers, local field staff of the Forest Department and other relevant agencies, and senior Forestry Department officials in Gandhinagar (Gujarat) and Jaipur (Rajasthan). During village interviews, our colleagues from CEE played the dual role of guides to key features of the buffer zone activities, as well as interpreters. At other times our CEE colleagues became informants, and we interviewed them about their own development activities, and their views about what we had seen.

The team spent one week in each location, of which 5 days were spent in village interviews and field data collection, one day for travel, and one day for debriefing with senior forest officers. Each day of field activity the CEE and USAID team members divided into several groups for field work. Each group generally included one or more USAID team members and one CEE team member. The groups reconvened in the evening for informal debriefing. Both interviews and observations varied in the level of directedness. The ecologist sometimes made formal observations, e.g., along a transect, while the anthropologist and ethnobotanist conducted both semi-structured and open-ended interviews with individuals and small groups. The modeler relied on a mix of secondary data, structured interviews, and a one-day workshop discussed below.

The third method which was used only in Ranthambhore was a small one-day workshop involving the Forest Department and other government agencies and villagers. The workshop was facilitated by Stephen Berwick, along a structured set of topics aimed at eliciting the views of potentially adversarial groups in a way that is non-threatening and productive. The objective is not to mend fences, though this is often a pleasant by-product, but to elicit the categories and variables that a systems model would need information about in order to be useful. The experience in building the model and its utility for planning and monitoring buffer zone eco-development activities is outlined in ANNEX 5. The model will constitute an independent outcome of the team's findings to be submitted to USAID at a later date.

II. MAIN FINDINGS

This section presents the team's major findings in the form of cross-cutting themes that apply to both study locations. Readers unfamiliar with the two locations (Hingolgadh Nature Education Park in Gujarat and Ranthambore National Park in Rajasthan), are advised to turn to the descriptive overviews of each site (the first page of Section III for Hingolgadh and of Section IV for Ranthambhore) in order to have the benefit of a quick briefing.

The themes presented here relate to the particular circumstances of the two study locations, but are also of broad relevance to buffer zone development and wasteland rehabilitation elsewhere in India. In some instances reference is made to the experience from other protected areas in India, but the focus has been kept on the specific cases at hand. In a later section (Section V: General Lessons Learned) an attempt is made to make more sweeping generalizations about buffer areas and eco-restoration overall.

Note on terminology. The term, "buffer zone" in this report normally refers to land adjacent to a park and under the jurisdiction of the Forestry Department, where access is restricted but not closed, and which has been officially designated as an intermediate zone to protect the park, while also providing some fuel and fodder resources to local residents. The term "buffer area" includes the official buffer zone (if any) as well as the adjoining village lands. The buffer area can be viewed as the "sphere of influence" on the protected area; residents in the buffer area tend to use the resources of the protected area. While the buffer zone is a legal category, the buffer area is an empirical category defined by the people who are most likely to exploit the protected resources.

A. THE ROLE OF NGOs IN BUFFER DEVELOPMENT AND PARK PROTECTION

Continuous commitment and presence of NGOs at the community and hamlet level are catalyzing development efforts in the buffer areas of both Hingolgadh Nature Education Park and Ranthambore National Park. Although the process has been slow, the trend is clear: local communities do respond to efforts aimed at assisting them to do more for themselves. In Hingolgadh, the focus has been on fostering the formation of women's mandals (societies) at the sub-village level, initially around issues of planting trees on village common land. Similar organizations at the sub-village and perhaps inter-village level are being initiated for traditional herders. In Ranthambore, the focus has been on helping village communities set aside portions of the buffer zone to permit natural regeneration. The attempts at "social fencing"

have met with mixed results, but the interest of the involved communities has been encouraging.

In the two study sites, as elsewhere in India, NGOs have made progress in establishing partnerships for protection and management of natural resources. In both Hingolgadh and Ranthambore, the CEE has been active in helping villagers avail themselves of government programs, while also helping initiate dialogue between villagers and the Forestry Department.

B. THE ROLE OF LOCAL ORGANIZATIONS IN MANAGING BUFFER RESOURCES

Village panchayats have been poor custodians of village common lands (in both Hingolgadh and Ranthambhore), and have been unwilling or unable to play a role in managing the designated buffer zone (in Ranthambhore). It would be unwise for a buffer zone development strategy to rely entirely on the panchayat system, yet the panchayats have shown some evidence of organizing potential. In Lalavadar village (Hingolgadh), the panchayat has granted a parcel of village common land for use as a tree plantation. The planting and care of the trees is being handled by a women's mandal which CEE helped form for this purpose. By working through the panchayat, the mandal, which is a sub-village organization, can help strengthen the panchayat by providing it with a role to play.

With few exceptions, the examples of successful local organizations in both locations involve sub-groups of a village and are handled outside the panchayat structure. In Hingolgadh, village panchayats have a high potential because they are small (one panchayat per village) and have jurisdiction over sizeable pieces of common land that have considerable economic value. In Ranthambhore, where a single panchayat normally covers several villages, the panchayat could play a useful role in establishing village resource rights within the buffer zone. However, local attempts to actually protect and manage buffer zone resources have so far been carried out only at the village level (Kawa and Kandoj; Uliana).

C. RESTORATION POTENTIAL OF DEGRADED LANDS

Simple, low-cost ecological restoration techniques that provide quick results are available and are being demonstrated by the park management (Forestry Department) in both Hingolgadh and Ranthambore. Buffer areas in both sites are severely degraded and indications are that the process of degradation is continuous and relentless. Degradation includes increasing soil erosion, decreasing capacity of the soil to retain moisture,reduction in native plant and animal populations leading to local extinctions, altered species mixes (tending toward increases in unpalatable weeds and undesirable woody species), decreasing production of biomass, and increasing stress on remaining

vegetation (due to overgrazing and excessive lopping). Present trends are not environmentally sustainable, and pressure on the core of the protected area is likely to increase in proportion to the degradation of the buffer.

The proximate causes of degradation are well known, although they are not well documented. Residents from areas adjoining the buffer exploit the resources of the buffer zone, and the protected areas beyond the buffer, at an increasing rate, as the growing population and economic pressures create an ever increasing demand for fixed supplies of protected resources: fuel wood, grass fodder, grazing land, and (not significantly in the two cases studied) minor forest products. As the economic value of those resources rises, the price that local residents are willing to pay also increases. Stricter park protection that restricts supply will eventually be overwhelmed by the ever increasing demand.

The restorative potential of degraded lands in both study locations is still very good, as demonstrations of exclosures testify. Even with only natural regeneration, the land can indeed "bounce back" to a considerable extent, as it does each year after the monsoon. But each year the species mix changes a bit more, the land erodes further, and the regenerative potential declines. Demonstrations with exclosures also suggest that the total biomass production goes up by allowing the land to rest, and even more so (in the short term at least) through plowing and seeding and/or tree planting. Thus there is both a short-term payoff of increased production, and a long-term pay-off of soil and moisture conservation.

D. POTENTIAL FOR IMPROVED BIOMASS PRODUCTION

There is clear physical and technical potential for substantially increasing biomass-based production in the buffer areas of both study locations through range improvement (as the exclosures cited above demonstrate), afforestation, and (on private land) improved agriculture and livestock. New crops and new approaches to agriculture (agro-forestry and, in particular, high value fruit trees) as well as improved livestock can increase total food and fiber production as well as income. The physical starting point in Hingolgadh has been restoration of the soil through watershed treatments including contour bunding, checkdams, and other well known practices. Protecting the soil from further degradation and trapping more water in the process has had a noticeably beneficial effect on range grasses, trees, and on private lands downstream (e.g., raising the local water table).

Yet, in spite of some examples of land restoration, in both study locations there are indications that productive potential of agriculture and livestock is decreasing in buffer areas. This

is due to soil erosion and consequent loss of soil moisture. Improvements in biomass productivity will be largely dependent upon protecting against on-site and upstream erosion, which currently is adversely affecting the water table through too-rapid run-off.

Agricultural technologies in use include modern inputs (irrigation from diesel pumps, high yielding crop varieties, chemical fertilizers, manure, and pesticides), with very little mechanization, and no reported extension services. Major constraints cited by farmers were lack of water, and lack of manure. Both inputs are being mined non-sustainably, leading to inevitable declines in productivity. The water table is falling in both Hingolgadh and Ranthambhore, as more wells are dug to service increasing numbers of farmers. The present rate of water extraction notwithstanding, it is likely that the water table would drop due to decreased infiltration alone (on degraded buffer lands). In Hingolgadh, patches of relatively fertile black soils are being mined from village common lands and spread on private fields.

E. THE USE AND MANAGEMENT OF BUFFER ZONE RESOURCES

Who is to blame for the degraded status of the buffer area? Our data suggest that responsibility for the degradation lies with at least six groups: (1) forest department staff, (2) farmers in nearby villages, (3) migrant pastoralists, (4) town-dwellers and merchants, (5) representatives of other government agencies, and (6) policy makers. Efforts that focus solely on restoration of buffers/commons will fail to reduce pressure on parks and sanctuaries unless they are part of a broader strategy to alter the existing incentive structure.

Forestry department staff are officially charged with protecting the park or sanctuary. However, despite the efforts of many field staff to maintain strict and impartial enforcement of regulations governing protected area resources, an informal system exists whereby illicit agreements are frequently made by park officials to sell use rights (to headloaders, grazers, timber merchants, etc.). In some villages, one resident is designated as an informal tax collector who passes the funds to the forest guard. Official Forestry Department policy has also contributed in many cases to the degraded condition of the park/sanctuary areas. Past management decisions to sell grazing rights (Hingolgadh) or to clear cut patches of land (Ranthambore), have taken their toll, although such acts are unlikely to be repeated under current management policies.

Village residents collect firewood, mine soil, collect stone, gather medicinal plants and other forest products, and graze their livestock in the buffer areas as well as in the park or sanctuary. Villagers have free access to the village commons unless it has been privately encroached or taken over by government agencies (e.g., for community woodlots under the Social Forestry Wing), thus reinforcing the ill-effects of opportunistic resource use.

Town-dwellers demand fuelwood and timber. Landless villagers "headload" fuelwood out of parks and sanctuaries for sale. The difference between the "fee" paid to forestry officials under the informal system and the price paid by town merchants provides an income for headloaders. No one pays the price of producing the fuelwood on a sustainable basis. Timber is harvested from the parks and sanctuaries, because it can be purchased illicitly for less than it can be purchased in town. There is little incentive for private production of timber.

Migrating pastoralists (maldaris) have historically used farmers' fields, village commons, and parklands to graze their herds. Faced with degraded grasslands, maldaris herd goats as well, that can browse on (and damage) plant species that cattle do not find palatable. Although the traditional role of maldaris in fertilizing the fields of sedentary farmers (in return for grazing post-harvest stubble) continues to be an important part of the local agro-ecology, the maldaris' exploitation of public lands is environmentally damaging.[1] As a clear factor in land degradation, and as a politically marginalized group, the maldaris are in danger of becoming everyone's scapegoat.

Representatives of government agencies such as public works, irrigation, agriculture, public health, and others have overseen numerous development programs which, if properly implemented, could have relieved much of the economic pressure on park and buffer resources. The concerned public servants have not been subject to public accountability, resulting in waste and mismanagement, as in the case of a biogas program in the Ranthambore area. On paper, villages have received cooperatives, canals, loans for biogas units and wells, training in alternative employment, youth clubs, and agricultural extension, but village residents have not seen these things.

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[1] See VIKSAT/CEE, 1990 pp. 19-20 for a discussion of how the Maldharis' fragile ecological equilibrium with grassland systems in Gujarat has been shifted off-balance by ill-conceived development interventions.

Finally, policy makers have enacted a conflicting set of policies and rules regulating common property resources that discourage communities from taking responsibilities for managing common lands, as well as forest lands to which they have traditional use rights. While the policy aspect was not addressed in the field assessment, the encouraging results from experiments in joint Forest Department/community management indicate what can be done with community participation in an enlightened policy environment (see Poffenberger, 1990).

F. THE ROLE OF GOVERNMENT AGENCIES IN MANAGING BUFFER RESOURCES

The management staff of both Hingolgadh and Ranthambhore have had undisputed success in preserving the areas under their protection, and in enhancing the environmental status of the vegetation of Hingolgadh, and the tiger population of Ranthambhore. But even greater accomplishments are being demanded by new government policies, and by the changing needs of the protected areas. The park managers who were trained as foresters and are part of the Forestry Department professional cadre, are being called on to formulate and implement eco-development plans for the buffer zone that require new kinds of expertise. For example, the Ranthambore "integrated development project" that is about to be implemented (and similar efforts are being taken in all 17 of India's Project Tiger parks) hinges to a great extent on "people's participation." Yet Forestry Department staff are given no special training in eliciting that participation, nor are they necessarily predisposed to play the role of community organizers.

That forest department staff can make the transition to a new type of constructive working relationship with local communities is evidenced by examples from other states. In Haryana, West Bengal, and Karnataka, formal contracts are negotiated between the state forest department and local communities to define mutual rights and responsibilities in managing and using forest resources.

The task of mobilizing local participation is just one example of the new challenges with which foresters are being faced. Other tasks, for which they appear to be equally unprepared include: planning and monitoring eco-development initiatives (which would require close interaction with other government departments, and considerable knowledge about rural development options); and conducting research (or coordinating with researchers from outside the Forestry Department) of both a social and ecological nature. Finally, the Forestry Department staff would need to work closely with NGOs, and in some cases might need to stimulate the formation of NGOs to help formulate and implement buffer area developments. Working with NGOs in a productive manner requires yet another set of skills and

knowledge (e.g., helping with fund raising, arranging training for staff, etc.).

Management training for mid- and senior-level park staff appears to be a high priority need for helping the Forestry Department to respond to the new demands of buffer zone development. Other agency needs include structural change in the organization, recruitment of new kinds of staff (e.g., with more development training), and either greater numbers of permanent staff or greater involvement of local communities in park management (as discussed above).

While the Forestry Department is the only agency directly involved in park management, management of the buffer area is the joint responsibility of a large number of government departments concerned with economic and social development. Since the productivity of buffer resources impinges on the viability of the core protected areas, there is an overlap of interests among the Forestry Department, local communities, and other government agencies charged with development activities in the buffer and nearby areas. Public accountability of these agencies, as well as inter-agency accountability, is more the exception than the rule. The lack of built-in procedures for evaluating government programs (e.g., biogas development, tubewell loans, etc.) points to the need for monitoring by outside groups such as NGOs, or some type of oversight committee representing the major interest groups (both public and private) in the buffer area. An advisory panel, overseeing both park policy and buffer area development, is already envisaged under the Ranthambore Integrated Development Project. A similar approach might also be considered for Hingolgadh. In the meantime, a more active role by the Forestry Department in coordinating eco-development efforts involving a range of institutions and sectors in the buffer area is required.

G. ALTERNATIVE LIVELIHOOD OPPORTUNITIES

Villagers residing in the buffer areas of Hingolgadh and Ranthambore do not rely on agriculture exclusively. There are a number of off-farm employment opportunities which have become a critical feature of the local economy. Expanding these opportunities could absorb at least a portion of the growing labor force in the coming years. While the labor absorbed is unlikely to be sufficient to turn back the tide of increasing population pressure, and growing demand for park resources, the contribution of alternative employment will be a critical part of any sustainable solution.

In Hingolgadh, the second most popular occupation after farming is diamond polishing, an industry that has emerged locally only in the last 10 years. Most employees are children between 7 - 15 years old, who earn 2-3 times as much as their

parents could receive in agricultural labor. Employment within the park itself is also an important source of income in Hingolgadh, and to a relatively lesser degree, in Ranthambhore. Employment related to the tourist industry ("eco-tourism") in a high-profile park such as Ranthambhore offers a number of possibilities both for crafts, agricultural markets, and secondary services related to the hotel business.

H. POPULATION GROWTH

The populations of communities in the buffer areas of both Hingolgadh and Ranthambhore appear to be growing at a rate equal to or greater than the national average, thus fueling the demand for the natural resources found in the protected areas. At least some villages have experienced recent in-migration both planned (through government resettlement programs) and spontaneous, thereby adding to the natural increase. We encountered no reports of out-migration, other than isolated individuals and families.

Increasing dependence on park system resources, fueled by local population growth, constitutes the single greatest threat to the continued viability of the Hingolgadh and Ranthambhore ecosystems. The challenge of reversing the present trend of environmental degradation is magnified when the population variable is considered, as it certainly must be. A doubling of the present population over the next 25-30 years appears inevitable. This anticipated population increase for the 60 villages surrounding Ranthambhore National Park is portrayed in Figure 1. Addressing the population issue, through expanded family planning and off-site employment opportunities, will be an essential component of any successful buffer development plan.

I. ENVIRONMENTAL EDUCATION AND PUBLIC AWARENESS

Public awareness about the purposes of protected areas and buffer zones is low. Villagers uniformly felt that the park exists primarily for the benefit of Forestry Department staff, and in a real sense is "owned" by those staff. Social forestry demonstration plots in buffer areas were seen as an assertion of Forestry Department rights over resources that villagers had historically used.

Villagers view the park as wildland (jungli) from which, by definition, wood and other goods could be extracted at no cost. They see the Forestry Department as monopolizing those wildlands for its own benefit (e.g., sale of wood, sale of use rights, tourist dollars for hotels & jeep tours, etc.) while preventing the villagers from exercising their rights to forest resources. One villager described Ranthambhore National Park as "a noose around our necks," citing Forestry Department punishments for villagers who had paid bribes to forest guards, crop damage from

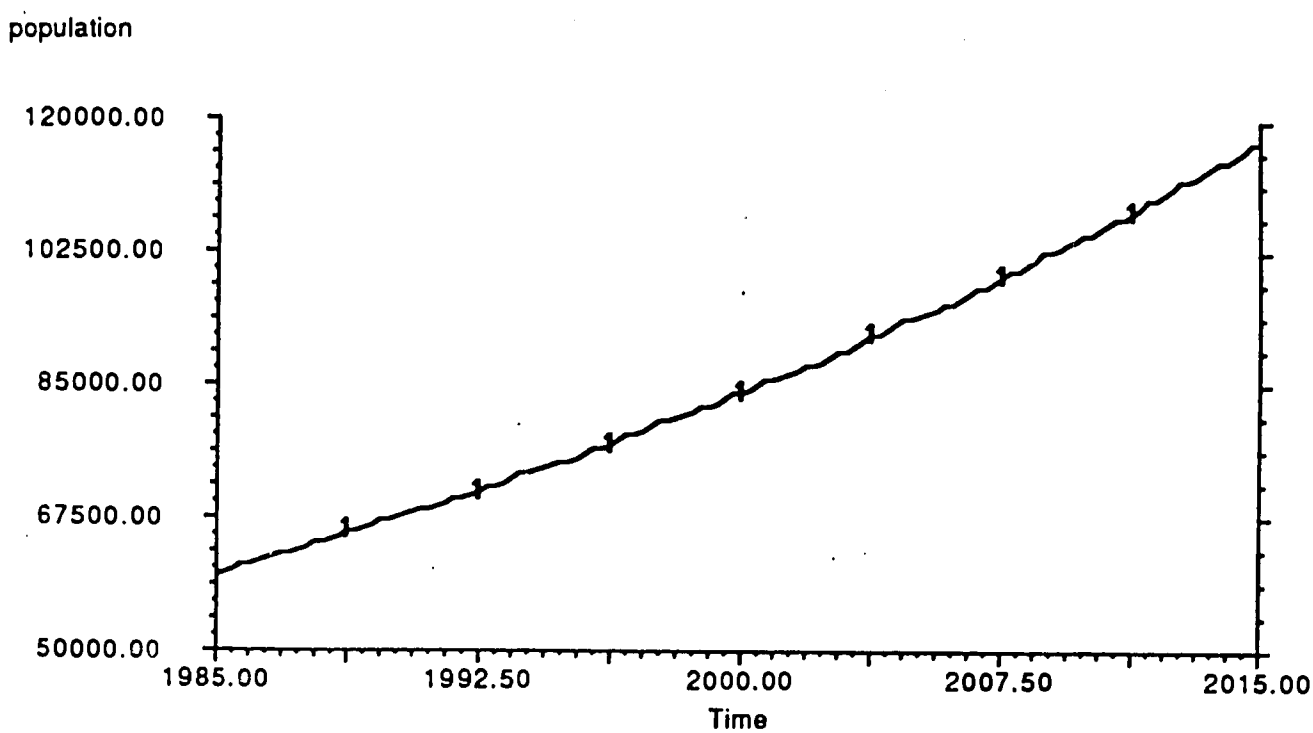

Figure 1. Projected population in Ranthambhore buffer area.

wild animals, and demonstration plots by the Forestry Department's social forestry wing that deprived the village of access to the buffer zone.

In Hingolgadh, relations between local farmers and Forestry Department staff were less strained, and villagers were more apt to cite positive environmental benefits of the sanctuary, which they had learned about from their children who had attended the camps or heard CEE lectures. Relations between Hingolgadh park management and the maldari graziers, however was marked by tension and misunderstanding on both sides, indicating that here too, there is much educational work to be done.

Villagers are aware of their economic dependence on the maintenance of the diverse biological system of the park, and this comprises an important basis for educational efforts. For example, they observe the effects of incorporating organic matter into soil and the effects of tillage and mulch. They understand the principle of spreading risks, and maintain a variety of plant species in temple groves, around wells, and along field borders. These species provide famine food, medicine, dyes, animal food, and many other benefits. The well understood concept of watershed management will be of particular importance for further environmental education leading to community organizing work and practical action.

A public relations campaign to raise awareness about the value of the park and its linked development benefits would contribute toward preserving the integrity of the park by promoting respect for the park as an institution. Public disclosure of the economics of park benefits (e.g., Forestry Department income from park resources) could be an effective part of such a public relations campaign.

J. LINKING RESEARCH, MANAGEMENT, AND OUTREACH

Villagers' natural interest in protecting the resources on which they depend has yet to be addressed by park management. For example, practical, adaptive field research on ecological restoration techniques is a missing element in current buffer zone management in the two study locations. Restoration technologies (e.g., disk plowing and grass seeding) are being demonstrated by the Social Forestry Wing without a research strategy, and with little or no local participation other than labor. An important opportunity is being missed for combining adaptive research with community involvement in monitoring the results and planning new restoration strategies.

Adaptive research should be based on technologies suggested by local villagers, as well as on the experience of Social Forestry staff. Building cooperative relations with local communities through applied research could be an important

outreach function for stimulating local solutions to resource management problems. This could then lead to long-term (sustainable) management strategies involving those communities working hand in hand with the Social Forestry Wing.

Foresters, research institutes, and NGOs could develop research agendas to measure the effects of different restoration techniques under controlled conditions. Farming and grazing castes should be involved in determining what kinds of vegetation and technologies are to be applied in the restoration of sites that they select. These efforts can build on research information already generated but be adapted to local social and environmental conditions. NGO or other extension workers could play a leading role in catalyzing community-based research, and in bridging this work with more formal research efforts.

K. POLICY, PLANNING, AND COORDINATION

Development planning for better management of buffer resources is a recognized need in both study locations, although the implementation of such plans has been problematic. In Hingolgadh, planning for buffer area development is handled through the GEER Foundation. An ambitious plan formulated several years ago was not adopted due to financial constraints. Rather than scale-down and reformulate the plan, it was abandoned. In Ranthambhore, a draft version of an integrated plan for buffer zone development has been devised by the Forestry Department, at the behest of the Project Tiger office.

The chances of successfully implementing a park development plan would be enhanced by addressing some of the following problem areas:

> Defining and mapping land categories on the basis of legal ownership, actual use, and natural resources. Information on all three topics appears to be lacking, and would require specialists in law, socio-economics, and ecology to fill the gaps.

> Reaching consensus on park and buffer zone policies. Is the buffer zone intended for routine use by local residents or only for temporary use during times of drought or other adversity? Under what circumstances and to what degree are resources within the core area to be made available to local residents? Such issues touch on economics as well as ecology, and sociology as well as politics.

> Coordination among government agencies (as well as NGOs) responsible for social and economic development in buffer areas. A local body at the district level might provide the necessary coordination. Another possibility would be a high level "buffer zone development authority" that would have some executive power to direct and orchestrate development efforts.

III. HINGOLGADH NATURE EDUCATION PARK

A. INTRODUCTION

The seven square kilometers of the Hingolgadh Nature Education Park were unremarkable several decades ago when the land was the private hunting grounds of the local ruler, whose fort of Hingolgadh is now a guest house. Then the area was part of a vast area of dry (average annual rainfall of 400mm) deciduous scrub forest and grassland extending over much of Saurashtra in Central Gujarat. Today those grasslands are gone, having become private farms or degraded wastes, and the tiny patch of forest at Hingolgadh is the only biologically significant forest stand remaining. As such both its ecological value, as well as the demand on its fuel and fodder resources, have increased dramatically.[2]

The park was a private forest of the raja of Jasdan (the taluka center) from 1660 until 1974 when the government revoked the power of local rulers and placed the area under the control of the state Forestry Department. The land was open to local use, and was even leased out to the Sheep and Wool Development Corporation for a period of 6 months, before being declared a sanctuary in 1982, under the protection of the Gujarat Ecological Educational Research (GEER) Foundation, a parastatal organization. The GEER Foundation carries out educational and land management activities in Hingolgadh and one other location in the state, and has an arrangement with the Forestry Department to use regular departmental staff. Currently the entire budget of the Foundation comes from the state Forestry Department, but in theory the Foundation could attract separate funding from private sources. Because of this semi-autonomous status, the management policies of the park have greater flexibility for experimentation[3].

The park is a contiguous block bisected by a paved road, and surrounded by six villages (see Fig. 2). The human population is roughly 9,000 and the livestock population is estimated at 7,000,

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[2] For a detailed description of the Park and its socio-agro-ecological setting, see the case study developed in the Phase 1 report by VIKSAT/CEE, 1990, pp. 68 - 101).

[3] The permanent staff (one Range Forest Officer and two permanent guards) at Hingolgadh park are regular employees of the Forest Department, as is the current Director of the foundation who was recently named to the post of Conservator, Ahmadabad Circle.

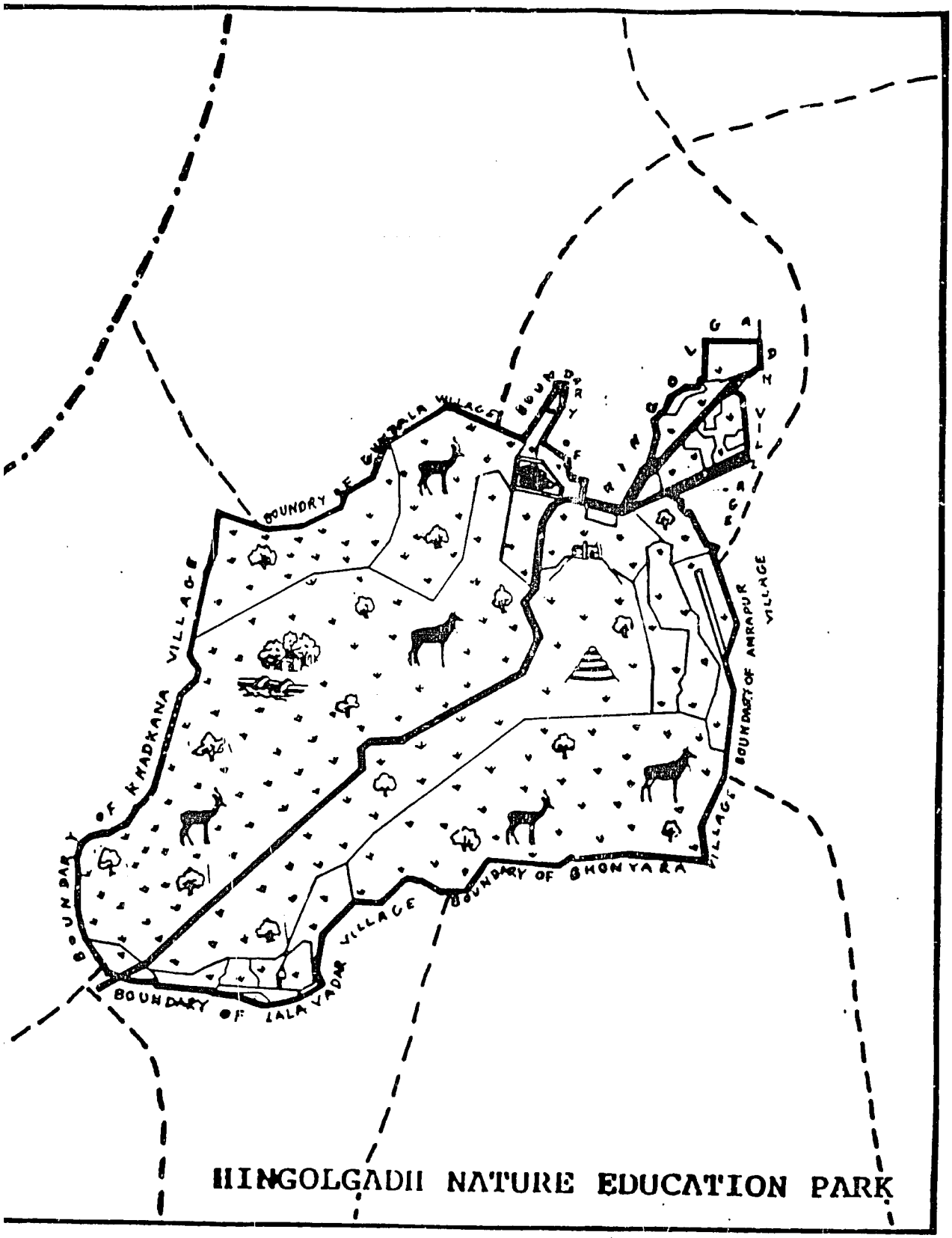

Figure 2 (from VIKSAT/CEE, 1990)

primarily sheep and goats, but with sizeable numbers of cattle and buffalo as well. The total land area of the villages is about 5 square kilometers, divided nearly equally between private agricultural fields and degraded common pasture land. The dominant caste in the villages is Koli, who are primarily farmers, with a sizeable minority of Rabari and Bharward herdsmen. This caste and occupational division poses a considerable challenge to coordinated action for land restoration.

B. THE STATE OF THE ENVIRONMENT: NATURAL RESOURCE STATUS, CURRENT USE AND RESTORATION POTENTIAL

The rolling terrain of the Hingolgadh area consists of patches of limestone several meters thick, overlaying relatively impermeable basalt bedrock (WWF-India Hingolgadh Report, Naik 1985). The region is subject to recurring periods of sustained drought; the most recent, from 1984-87 was the worst in several decades. The elevated, rocky terrain has protected its forests from the brunt of human pressure. This section discusses the land resources of the Hingolgadh area and is divided into three subsections according to land classification: (1) the park proper, (2) the village common lands which serve the function of a buffer and (3) private agricultural lands.

1. The Park

When Hingolgadh Park was used as a hunting reserve for the local raja, it was also used as a source of grass fodder for the family stables. Indeed, the grass resources were so productive that the raja constructed a railway to transport the grass out of the area. Today the railway has been abandoned, and Hingolgadh Park stands alone as a forested island in a patchy sea of eroded wastelands and agricultural fields. But increasing population, concomitant increase in domestic herds, and the destruction of outside range and forestlands in the past three decades threaten the integrity of the park.

Natural Resources.[4] The 3-5 meter high scrub forest canopy is dominated by *Acacia senegal*, *Maytenus emarginata*, *Acacia leucophloea*, *Azadirachta indica*, *Commiphora wightii*, *Euphorbia neriifolia*, *Acacia nilotica*, and *Prosopis juliflora*. Deciduous during the 7 month dry season, tree canopies cover about 50% of the ground surface. Density of mature woody stems ranges from

[4] All botanical names in this report are taken from published sources and were not identified independently. Species names of plants in the Hingolgadh area were take from Forest Flora of Gujarat State, by R.I. Patel, 1984. Forest Department, Gujarat State, Baroda. Printed at the Government Press, Baroda.

200 to 1100 per hectare. Common understory species include: Abutilon indicum, Maerua oblongifolia, Zisyphus mauritiana, and the grasses Aristida adscensionis, Cenchrus ciliaris, Desmodium gangeticum, Hydropogon contortus, Indigofera glandulosa, and Sehima nervosum. ANNEX 1 gives a comprehensive list of species identified during a two-day inventory. Vegetation growth is most vigorous on patches of black cotton soils (vertisols) derived from limestone, whereas the majority of soils are less fertile, rust to brown colored inceptisols derived from Deccan basalt.

Sheet and gully erosion is uniformly severe throughout the park. Pedestalling around tufts of bunch grass varies from 2-10 cm, while sedimentation behind two-year old gully dams is 1 meter or more. Under a thin veneer of topsoil there lies a 20-80 cm thick layer of unstructured loamy sand and basalt-derived saprolite. The exception to this are patches of black cotton soils (vertisols) 400 square meters or more in size, spaced uniformly throughout the park. The sources of at least five streams are found within park boundaries, giving it strategic watershed management importance.

Natural regeneration of woody vegetation (mostly from Acacia senegal seed) is scanty (approximately 75 seedlings per hectare), but improving according to park foresters. Nearly every woody stem has been lopped with varying intensities. However, stem growth over the past three years indicate that this lopping has been recently curtailed, thanks to enforcement of the ban on livewood collection. Annual distal extension of this stem growth varied from 3-20 cm. Commiphora wightii boles show evidence of gum tapping over an extended period. Browse lines 1.50 meters above ground level are distinct on all palatable species. Maintenance of a discontinuous, dense and/or thorny shrub layer, including Abutilon indicum and Zisyphus mauritiana, forms a micro-barrier from grazing that is critical to the protection and propagation of the park's relatively diverse grass community. Highly palatable species such as Cenchrus ciliaris, Dicanthium annulatum, Hydropogon contortus, and Sehima nervosum are now rare outside of the park, where they are not protected by a scrub barrier. Grasses covered about 85% of the soil surface three months (February) into the seven month long dry season.

Park Management. Hingolgadh Park is administered by a staff of two trained foresters and two beat guards, drawn from the ranks of the Gujarat Forestry Department, and four "daily wagers" drawn from local communities. While the GEER Foundation is mandated to carry out a variety of nature education, eco-development outreach and habitat restoration activities, day to day park protection and maintenance exhaust most staff working hours. Since the park was encircled with a 1.5 meter rock wall (in 1988), and policing started to limit park access to people

and domestic animals, there has been substantial natural regeneration of woody plants.[5]

Resource Use. The resources of the park are heavily used by local villagers. Some of this use, such as grass cutting, is sanctioned and (for purposes of public relations) encouraged by park management, but most resource procurement activities (e.g., grazing, collecting wood fuel) is illicit. Cattle dung and goat droppings are encountered four times as often as those of bluebull and hares along the inside of park boundaries, but decrease with respect to wild scat deeper inside the park. The park boundary wall is breached every 30-150 meters, making exclusion of domestic animals impossible. Conversely, crop damage from wild ungulates (bluebull and gazelle) was claimed to be as high as 20% in fields near the park. Permission by park staff for villagers to hand-cut park grasses for their animals after seed set was granted during the 1987 drought and has continued to date. This policy change appears to have had no adverse effects on vegetation (since the practical alternative is illicit grazing) and has helped enormously in building the trust and cooperation of many villagers.

Fodder: Hand cutting of grass is an option for families who own only a few animals (i.e., farming families). In two hours, a group of two adults and two children can cut enough grass to feed two oxen for one day. A Forestry Department officer estimated that the 7 km square park produces enough grass in a normal year to support 500 cattle. Grasslands from the 26 km square village commons areas could theoretically produce several times this amount if managed similarly, although this would still be insufficient to support the local population of 2,360 cattle and 4340 sheep and goats.[6]

Fuel: Local households use an average of 1 kg per person per day (VIKSAT/CEE report, 1990; BSP team interview of Mahila Mandal in Lalavadar). In a typical household, women collect wood from the park three time each week. Euphorbia can be found on village common lands, but it is an inferior fuel. Wood collected from the park can also be purchased for Rs. 20 per 20-25 kg headload.

Building stone: Quarrying of limestone blocks in the park for house construction was widespread before the park was created, and former quarries three to four meters deep and covering large areas are still plainly visible.

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[5] The limited access also coincided with the natural alleviation of the drought, which compounded the beneficial effects.
[6] Data from VIKSAT/CEE, 1990, village census.

Use by villages outside the immediate area: The six villages surrounding Hingolgadh Park are the chief beneficiaries of both park biotic resources and enhanced ground water availability. There was little evidence that significant amounts of park resources are being transported long distances away from its boundaries. There is, however, intense pressure placed on range resources twice each year as external Maldari grazing castes herd their sheep, goats, and some cattle south to the Gir Forest area in the dry season and back to northern Gujarat at the onset of the monsoon. Since the state highway thoroughfare unfortunately bisects Hingolgadh Park, these herds consume park forage and browse as they pass through. Short of relocating the highway, little can be done to control this outflow of fodder resources. As discussed in the (Phase I) VIKSAT report (pp. 19-20) this external pressure has come about partly as a result of earlier development efforts to increase Maldhari incomes by introducing higher yielding, though less hardy, livestock varieties. Recurring, harsh drought conditions invalidated this approach, forcing even longer migrations to areas where adequate fodder and browse could be obtained for these herds.

Habitat Restoration Techniques and Options. Current habitat restoration techniques used in Hingolgadh Park are of three kinds: 1) soil and water conservation measures employing man-made structures, 2) revegetation measures, and 3) combinations of both of these. The first category represents a "curative" approach to habitat restoration, while the latter two are primarily "preventive" in nature.

Rockwork gully dams (nalla bunds) and hillside checkdams 1 meter high and 1.5 meters wide are normally constructed in drought relief public works employment programs. Since the primary goal is to employ local people when prolonged droughts occur, these labor intensive projects may, on this basis, be justified. The placement of these structures, however, often fails to maximize their soil and water capturing potential. A combination of *Cenchrus setigerus* and *Commiphora wightii* planting is presently being tried along gradony contours. This holds much promise, since both of these species are utilized by domestic livestock and wildlife.

Demonstration exclosures inside the park include trenching, stone fences, and noxious living fences (e.g., *Euphorbia neriifolia*). Several forage production plots and watering holes have been created for the use of park wildlife, and could be expanded to more park areas. There is apparently a need for a wider physical distribution of watering sites than presently exists. These activities will reduce crop damage caused by wildlife (esp. bluebulls) in surrounding village agricultural fields, while maintaining the health of wild park animals.

Recurrent inventories of park wildlife populations based on transect sampling of scat, intensity of browsing/foraging on selected vegetation, actual counts, etc., would indicate how populations were responding to increased availability of food and water. The quantitative effects of GEER Foundation's soil working techniques (i.e., cultivation around stems and mulching) around naturally regenerating woody plants needs to be systematically compared to untreated naturally regenerating plants of the same species.

2. The Buffer Area

Although there is no formal buffer zone around Hingolgadh Park, the common lands of the six surrounding villages continue right up to the rock wall boundary of the park and provide the functional equivalent of a designated "buffer" zone. Official estimates of the extent of village common lands in the six villages surrounding Hingolgadh Park are 2,168 hectares (VIKSAT/CEE, 1990). While private encroachment has reduced this number substantially (but to an unknown extent), these lands constitute an greater area than the park itself. All the common lands observed were severely degraded. The precise breakdown of land categories was not clear to our informants, but includes the following types:

> land under the Revenue Department;
> cultivable land under the management of the village panchayat;
> non-cultivable land under panchayat management;
> land owned by Indian Railways and other government agencies.

The ecological condition of village common lands contrasts sharply with the condition of parklands. Grazed heavily during and immediately after the summer monsoon, these areas sustain only a limited number of extremely hardy plants growing at very low densities. Species include: Abutilon indicum, Acacia nilotica, Acacia leucophloea, Bauhinia racemosa, Cassia auriculata, Cassia fistula, Euphorbia neriifolia, Euphorbia tirucalli, Ficus racemosa, Ficus religiosa, Opuntia elatior, Phoenix sylvestris, Prosopis juliflora, and Zisyphus mauritiana. Little grass cover was visible three months (February) into the dry season. Borrow pits on these commons, where villagers "mine" deposits of black cotton soils (vertisols) to fertilize agricultural land and remove saprolitic basalt for building material, made soil profiles easily visible. The rare deposits of soil, covering perhaps 10% of common lands, derived from limestone parent material. The soil lenses are more than a meter thick, having uniform dark color and texture. But the vast majority of village common lands (up to 90%) were covered not by soil but only by particulate sands, loamy sand, and hard gravel associated with the underlying basalt formations. Dust devils

often form in stiff 20 km/hour breezes that blow 250 or more days per year (VIKSAT/CEE, 1990), atomizing precious bits of soil into aeolian dust. As a result, soil fertility on these commons is steadily decreasing.

Resource Use and Management. Village common lands are under the legal management control of the concerned village panchayat. Since there is a separate panchayat for each village (in contrast to the situation in Ranthambhore where there are several villages per panchayat), one might imagine that land management would be possible. Caste differences and unequal access to resources within the village, however, make management structures analogous to the Van Panchayats in U.P. (VIKSAT/CEE, 1990, pp. 43-47) an unlikely prospect. In practice, it appears that the only management interventions have been induced through outside agencies (e.g., under National Rural Employment Programs, and with NGO support), and that the panchayats in Jasdan taluka have been ineffective in protecting the common lands.

The primary use of common lands is for grazing during and after the monsoon, when the grass grows, and continuing until it is completely grazed. The primary users of these grazing areas are the maldari herdsmen, a generic term including two caste groups: rabari and bharward. Traditionally, the rabari tend to keep more cattle and the bharward more sheep and goats, but today the lines are not clear cut. Goats are more resiliant, and also more destructive. Until 1974, when ownership of the area was transferred from the local raja, goats were banned from the six villages for this reason.

Farming families also rely on the common lands for pasture during the monsoon, but the number of animals they possess is much smaller (generally 3-4 animal units) than is the case of rabari and bharward families, who normally have 20-80 animal units. Not only village residents, but outsiders as well use the common lands. When herdsmen take their animals through the area on migrations, they also use the common lands. After the harvest, they graze in private fields after receiving permission from the owner; indeed, farmers often pay for the service of having their fields fertilized by passing herds.

Farmers also use soil resources from common lands. As noted above, the practice of "mining" black cotton soils from village common lands was observed in several villages. In at least one case, a tractor was used to till the soil so it could be more easily removed. The soil is then mixed with manure (often purchased from the maldari herders) and spread on private fields. Thus, the common lands are being degraded not only through neglect, but also intentionally for individual gain.

Restoring Village Common Lands. Degraded lands can be improved through land-leveling, by constructing physical barriers to contain runoff, and by the importation of organic matter and topsoil. Physical barriers range in size from checkdams, normally on private land, to percolation tanks, which are more often found on common land. The benefits of percolation tanks are primarily to increase groundwater, where it is captured by those farmers fortunate enough to have wells in the vicinity. Percolation tanks also serve to trap silt that would otherwise escape from the system altogether.

Land restoration activities appear to be the exclusive domain of the state government, and not the panchayat. All earthwork observed on common lands was the direct result of state-level programs. Some individuals are also restoring common lands but not for the common good; rather they are encroaching on and illegally converting common land into their own agricultural land. This practice impacts directly on the area available for grazing, which is typically the mainstay of the rabari and bharward castes, particularly during the period following the summer monsoon (July through September) in this area.

Constraints expressed regarding common land (buffer area) rehabilitation include the fear, on the part of the grazing community, that if commons are planted in improved grass, they will no longer be allowed to graze there (i.e., it might be for hand cutting only, as is the case in the park. If trees are planted on commons, the grazing community fears they might be kept off in order to protect the trees (since goats can do considerable damage to trees). These fears are compounded by a confusion as to who has authority over the common lands. Women interviewed had no idea who manages the commons, though some guessed that perhaps the sarpanch was in charge. The idea of managing village common lands in a manner similar to that of the park itself has not been widely considered, although CEE staff are encouraging thinking along these lines.

3. Private Lands

Private agricultural land holdings are small (generally between 0.5 - 3.5 hectares per family), and intensively cultivated where irrigation is available. The primary constraint to increased agricultural production is water. During the dry winter season, only 29% of the total cultivated land is irrigated. During the monsoon season, this figure rises only to 31%. The constraint is the groundwater itself, which is already insufficient to meet the demands of existing wells. Many wells can store only enough water to operate for a few hours.

Major crops are wheat, cumin (jeera), and mustard during the winter season, and cotton, peanut, millet, and sorghum during the monsoon season. Cotton is planted in May and matures slowly, remaining in the fields until February, when the stalks are cut and stored for fuel. The preferred variety is Shankar-4 which is always irrigated, and gives a yield roughly 5 times that of unirrigated varieties. Nearly all farmers grow at least some cotton, though only the largest farmers have surplus cotton sticks. These are not sold, but are given to landless households or service castes (e.g., the barber and the priest) with whom the farmer has an established relationship.

The relationship between farmers and grazers can be symbiotic, as well as competitive. Grazers rely on access to harvested fields to feed their livestock during various times of the year, while farmers rely on the manure the animals provide. Manure may be particularly important to improve the structure as well as the fertility of the eroded basaltic soils prevalent in the area. The links between agriculture and animal husbandry also take the form of fodder production. Most farmers grow either sorghum or lucerne as a fodder crop, and also use the crop residues (particularly millet) as fodder. Rabari farmers, who are also herdsmen, tend to devote a substantial portion of their land to fodder crops. The usual pattern is that they give the land on a 50% share to a Koli caste farmer to cultivate.

All irrigation water comes from dug wells equipped with diesel pumps. The number of wells has increased sharply in recent years as families have fissioned (farmers prefer to have an individual well, although many are shared among 2-7 relations), and as the water supply per well has dropped. The investment is considerable, as a well and pump cost about Rs. 20,000. There are no surface storage systems used directly for irrigation, although there are many percolation tanks that recharge the groundwater. The effects of percolation tanks are very localized, often benefiting a single well adjacent to the tank, and in some cases in the tank itself. The depth of groundwater varies from 30-50 feet, at which level bedrock is encountered. Wells typically give water for only a few hours during the non-monsoon months, and during droughts will dry up altogether. Deep water is available at depths of 150 to 250 feet. There are at least two bore wells in the six villages which the government drilled for drinking water during the recent drought.

In addition to agriculture and grazing, private fields also support trees. This is a recent development, the result of social forestry programs orchestrated by CEE staff (as discussed below). The trees are grown on field bunds, and in a very few cases, as small orchards. Species include *Zisyphus mauritiana* (ber), *Syzygium jambos*, *Tamarindus indica*, *Citrus* sp., *Carica*

papaya, Sesbania sp., Aegle marmelos, Azadirachta indica, Leucaena leucocephala, and Eucalyptus camaldulensis. Musa sepiantum (banana) was also widely cultivated. The incorporation of significant numbers of trees into the farming system is a very recent phenomenon, which holds much promise for nutrition, income (from fruit sales), fodder (from leaves), and fuel.

C. SOCIAL/INSTITUTIONAL CONTEXT

1. The Levels of Organization

The six villages surrounding Hingolgadh are well defined social entities both spatially and in terms of personal identity. In spite of universally weak panchayats, the concept of "village" constitutes an important resource for restoring and managing the common lands. There is considerable diversity of size, caste composition, and economic base. Sizes range from 55 households (Khadkana) to 605 households (Amrapur); four of the six have large minorities of grazing castes; all villages are based primarily on agriculture and livestock, but to varying degrees.

Formal organizations within villages or cross-cutting villages appear to be almost non-existent. Several villages have dairy cooperatives but these are village-specific, and in Amrapur village, caste-specific (Rabaris have formed one cooperative and Kolis another). Although caste can certainly be divisive, it can also provide a basis for intra-village groups to act for the common good. In Lalavadar, a group of Koli women have, with the help of CEE staff, created an informal society and have planted some 3000 trees on 4 ha of common lands. In Amrapur, a group of 90 Rabari households have for the past decade rented land from the panchayat of an adjacent village where they cultivate 1.5 ha of land in common, and grow sorghum for fodder.

The civil administration of the park area comes under Jasdan taluka within the Rajkot district. There are a great number of government programs that are in effect in the area, most of which are managed through district-level offices.

2. Key Linkages in the Institutional Structure

Park Management -- Villagers. Relations between the Forestry Department (GEER Foundation) officers who set and enforce policies of park access, and the villagers who routinely transgress the official rules, is strained. By far the most strongly felt emotions pertain to interactions between the GEER Foundation and the maldari grazers. There have been many cases

of maldari livestock grazing in the park, even under the new policy that grass may be hand cut legally. They have too many animals to ever hope to gather enough by hand, and the alternative would be to hire labor. Though this option would be both legal and (probably) profitable, they would have to pay for what is now free. Thus, while the grass cutting policy appears to have improved relations between the Park management and farmers, it has done little to relieve the tension with the maldaris. There are elements of casteism and "occupationism" against the maldaris, while the latter bring attitudes of suspicion and disdain for authority that has threatened their cultural integrity to date.

CEE -- Forestry Department. The park management, which can be viewed as either GEER Foundation or the Forestry Department (the people are the same, but the lines of authority are slightly different) and the staff of CEE have developed a productive relationship in social forestry activities and educational camps. CEE views the Forestry Department RFO as a part of the target group to work with, and the RFO has come to view CEE as a useful mediator in dealing with villagers.

Government Agencies/Programs -- Villagers. Programs such as the agricultural T&V system are largely defunct in the area. Information about agricultural technologies comes from other farmers, and not through the gram sevak. The cooperative banking system also appears to be non-functional for most farmers because of unpaid debts. As a result, private money lenders are able to charge rates as high as 10% per month, according to our interview data.

D. CURRENT DEVELOPMENT ACTIVITIES

The Government of India and the state government have offered numerous social welfare and rural development programs for many years in the Hingolgadh area. There are pan-India loan programs to stimulate progress and provide capital for meeting a wide variety of rural needs (wells, agricultural inputs, upgraded livestock, etc.) as well as loans for development of small industry. Although many of these programs exist more on paper than on the ground, they nonetheless provide an existing framework for development if coordination and accountability could be attained.

Among the ongoing programs that involve restoration work are the Drought Prone Area Development Program, the Integrated Rural Development Program, and programs of the Gujarat Land Development Corporation. Forestry Department activities in the area are focused on protection and rehabilitation of the Hingolgadh park, while the GEER Foundation supports outreach and educational activities. Currently, there are no explicit efforts to transfer rehabilitation technology from the Forestry Department to the six

surrounding villages either through extension to village or through education camps on the park itself.

The only NGO activity in the immediate vicinity of Hingolgadh Park is being undertaken by the Nehru Foundation's Center for Environmental Education (CEE) through its Hingolgadh Eco-Development Project (HEDPRO). The HEDPRO program of CEE has maintained a team of 3 people for two years with an office in the taluka center of Jasdan. The goals of HEDPRO include:

> strengthening villagers' capacity for community action;
> facilitating villagers' access to government and non-government development programs,
> promoting land restoration on village commons and private lands; and
> coordinating interaction between the park management and the villages around the park.

The HEDPRO team has worked most intensively in the village of Lalavadar, but has also initiated activities in several other villages around the park. Beginning with educational and technology-related services, the HEDPRO team has gradually moved into the realm of building organizational capacity in the communities, as a basis for sustainable local development. Activities have included facilitating a government program to introduce smokeless chullas (a variant on the traditional mud cooking stove), assisting with the curriculum of GEER Foundation nature camps, and a variety of workshops for local villagers to increase awareness about the environment and build trust within the group.

The workshops focus on particular social groups (caste and gender specific), e.g., a group of women from one village, and a group of maldari men from several villages are two examples. In both cases, the expectation is that the groups attending the one or two day workshops will form the core of a formal society that can undertake productive tasks to utilize village common lands that are currently degraded. The presence of significant village common lands in all six villages has offered an opportunity for HEDPRO action at the village level. [See Box 1 for a more comprehensive list of HEDPRO activities.]

Perhaps the most significant role that the HEDPRO team has played comes as a byproduct of its organizing activities. The team has functioned as an informal mediator between the local communities and government programs. Several programs that might not otherwise have reached these six villages, such as the smokeless chulla program, or land development activities, have been encouraged to work in the buffer villages. As the community groups that HEDPRO is helping get established gradually take

shape, they can continue this lobbying function to take advantage of government services.

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BOX 1 A LIST OF ACTIVITIES UNDERTAKEN BY THE HINGOLGADH ECO-DEVELOPMENT PROJECT (HEDPRO) DURING THE PAST TWO YEARS

Note: This list is not intended to be exhaustive, but provides insight into the type of activities the HEDPRO team has been engaged in, and points to the ways in which an NGO can complement ongoing government programs.

- >> introduced smokeless chulla technology and training chulla masons through a government program;
- >> promoted inclusion of village children in GEER Foundation nature camps;
- >> developed women's clubs (mandal) in three villages; one mandal has planted a village woodlot through a government program;
- >> encouraged a national NGO to open an office nearby;
- >> conducted women's awareness camps;
- >> conducted a workshop for grazier castes on common land management options;
- >> creation of nurseries and private tree planting through the Forestry Department's social forestry wing;
- >> sponsored tours for local villagers to see livestock management demonstrations, community woodlots, dairy demonstration, drip irrigation demonstration, etc.;
- >> worked with the Gujarat Land Development Corporation on land leveling and shaping of private and village common lands.
- >> held informal negotiations with GEER Foundation concerning villagers' access to park grass;
- >> conducted local workshop on land and water conservation opportunities;
- >> sponsored local woman to attend a handpump repair workshop put on by a government agency;
- >> demonstrated grass production on private lands.

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[END OF BOX 1]

E. KEY ISSUES AND SUGGESTIONS FOR ECO-DEVELOPMENT

The 1984-87 drought necessitated the employment of thousands of local villagers in government drought relief public works employment programs, involving soil and water conservation projects in the park. Hillside contour ditches, checkdams, and

gully dams scattered throughout the park attest to the magnitude of this work. Yet, due to short notice and lack of a comprehensive park-wide management plan, much of this work was done inappropriately or haphazardly. These recurring employment programs could be better used to achieve long-term park habitat restoration goals, once such goals are defined and methods to achieve them undertaken. The GEER Foundation should assume and expect that drought conditions will, sooner or later, arise again, forcing park staff to create mass employment for village people. If a park management plan is in place, such labor can be used rationally, in line with long-term park management objectives.

1. Ecological Restoration

Drought area relief works within the park (e.g., rock work check dam construction) are an ideal opportunity to employ soil and water conservation techniques that villagers can adapt and use on their own lands after returning home. Learning indirect contour terracing, box trenching, tree nursery, and tree transplantation techniques can all be easily transferred from park lands to village lands by trained villagers themselves.

A few motivated village volunteers could be provided with a daily wage from GEER Foundation as extensionists, to insure that techniques learned in the park are being applied correctly in the villages outside. These extensionists could be involved in identifying village common lands (gaucher) that are socially and ecologically the best candidates for successful demonstrations of restoration techniques. They would also serve as a bridge of sustained communication and exchange between park staff and the six surrounding villages.

Monitoring Habitat Recovery. Every restoration site visited, whether managed by government agencies or private organizations, lacked a well-conceived, structured, and rigorous applied research orientation. For example, foresters in the Social Forestry Wing, research institutes, or NGOs could develop research agendas to measure the effects of a variety of restoration techniques on a variety of different sites representative of the project area. These experiments should be as controlled as possible (i.e. the confounding effects of roaming people, domestic animals, wildlife, and fire should be minimized). Exclosures should be sound, and personnel should be constantly and vigilantly on site. Farming and grazing castes should be involved in determining what kinds of vegetation and technologies are to be applied in the restoration of sites they help select. Simultaneously, these same villagers should undertake their own community-based habitat restoration research, receiving guidance from a supportive NGO or government agency.

This village science could build on research information being generated in more formal experiments, while being truly assimilated to local social and environmental conditions. NGO or other extension workers can play a leading role in catalyzing community-based habitat restoration research, and in bridging this work with the activities of government development agencies.

Villagers inevitably develop their own, quite accurate criteria to measure and monitor habitat recovery rates and bio-diversity indices, since their welfare depends on habitat productivity. Some of the ways villagers monitor vegetation condition in Hingolgadh are: counts of live seedlings in a plot, counts of sprouting leaf buds per seedling, water status of twigs (done by carefully bending stems), number of species of grasses and/or trees in an area, forage quality of grass species in terms of milk yield per buffalo, time required to collect one headload of hand-cut grass or one headload of fuelwood, and weight of gum collected from individual gugal (Commiphora wightii) trees. Habitat recovery is locally measured by: the period of time before a well goes dry, or a tree loses its foliage, thickness of litter layer, soil moisture, soil texture, soil structure, thickness of topsoil, frequency of encountering wildlife scat, and number of bird species encountered in the fields. All these measures are valid indices of habitat recovery and could be incorporated into structured research programs at the community or agency level.

Linking Activities in Public and Private Lands. Villagers presently visit the park to hand-cut grasses, as participants in organized nature education camps, as paid laborers in drought relief public works programs, and to illegally remove park resources. Each of these occasions represents an opportunity for ideas and information to flow into and out of the park. The long-term measure of extension success should be to observe villagers reproducing habitat restoration techniques on their own agricultural lands, and collectively on village common lands. NGOs such as CEE can help foster a sense of shared involvement in eco-development and conservation throughout the Hingolgadh area. CEE can help bring villagers into the park as participants in park management decisions, and park personnel into villages as welcome resources in community eco-development.

The park is already playing a valuable role as a multiple demonstration site of many habitat restoration techniques on a variety of sites. Restoration technologies should be selected in consultation with local villagers, and should be adaptable to the economic level, technological sophistication, and basic needs of local people. Species chosen for range and forest restoration programs, whether at the trial or dissemination stage, should fulfill a variety of local fuel, fiber, and health needs. Experimental restoration exclosures should be of modest size (no

greater than 10-15 hectares in size), highly visible to passers-by, easy to patrol, and representative of local site conditions throughout the area. Once examples show tangible ameliorative effects of a particular restoration technique on site productivity, the time will ripen for extension of the technique onto village lands, private and public, selected by local people.

Monitoring Restoration Activities. Monitoring both the ecological and economic impacts of habitat restoration is a key element of good management. The former involves quantitative measurement of wildlife population densities, reproduction, and health, as well as systematic sampling of vegetation productivity and diversity. Assistance in using these techniques could be obtained from staff of the Wildlife Institute of India, Dehra Dun, or perhaps from other research institutions closer to Gujarat (e.g., The Grasslands Research Institute, Jhansi).

Economic impacts of habitat restoration efforts could be assessed visually by recurrent tallying of the number of headloads of fuelwood/fodder coming out of the treatment area over a specific time interval; the time it takes to collect headloads; the variety, quantity, and value of minor forest products removed from the area; and the changing variety and number of small industries that can be sustained by biomass produced within a treatment area. Several NGOs within Gujarat, including CEE, have experience in conducting the socio-economic surveys that could provide this information.

2. Institutional Strengthening

Much of the ecological restoration activities depend, in the long term, upon institutional capacity that does not currently exist. Stronger village-level organizations, as well as park management institutions will be a critical part of the ecological recovery and sustained health of Hingolgadh Park and surrounding buffer area.

Village level institutions. Although there are village level panchayats in all six villages in the buffer area, they are weak and in a few cases non-functional. The work that CEE is doing in building capacity of sub-village groups (e.g., women's mandals) and inter-village awareness (e.g., the maldari workshop) is of vital importance both for the immediate aims of local resource management and the longer-term aims of revitalizing local organizational capacity. Viable sub-village groups, and possibly inter-village caste-specific groups, will have to work through the legally recognized panchayat system, and thereby may stimulate the panchayat to take on a new role in managing village common lands.

Park management. The management of the park needs to be more explicitly linked to the management of village common lands.

As discussed above, there are clear opportunities for outreach and extension to build upon restoration activities in the park. At the institutional level, the GEER staff need to become involved in fostering the development of resource management groups that are emerging in the buffer villages (with the help of CEE). For example, the women's mandal in the village of Lalavadar has no official status as a society, but has already planted 12,000 trees on 4 ha of common land. This would be an excellent opportunity for the GEER staff to become involved in community outreach to provide technical advice and material assistance (e.g., in irrigating the trees until they become established). The park management staff need to give explicit recognition to the links between what happens outside the park and the pressures on the park itself. Community outreach is really in the self-interest of the GEER staff, and is certainly in the best interest of the park.

An advisory panel of village representatives and GEER staff could help institutionalize the links between the park and the surrounding communities. Such a panel could take many forms, and might take representation through the panchayat structure, or through a separately elected post. Whatever the form, the function would be to ensure information flow between the park and the communities, and to provide park management with feedback about park policies. It will be essential that the views of the maldari graziers are well represented on any panel; indeed, an additional function of the panel would be to ensure communication between the farming community and the graziers, who are under-represented in the existing panchayats.

3. Options for Development

Economic growth in the six villages of the buffer area is an absolute requirement to keep up with the growing population. The introduction of the diamond polishing industry has met with mixed feelings because of health concerns and the tendency to pull children out of school. Yet without that industry, the pressures on park resources would be even greater. The diamond industry should be encouraged, but also should be regulated by the local communities. Villagers were unaware of basic information about this industry: where the diamonds come from, where they are sold, and at what price. This absence of knowledge is conducive to economic exploitation. Until the communities develop the institutional capacity to take on a regulatory function, the diamond industry would be a high priority area for an NGO to become involved with. Village diamond cooperatives would be one possibility, with attention to health and lighting conditions, and provision for part-time work and school attendance.

Improvement of the traditional employment activities of agriculture and livestock also has significant, though limited potential. Improved breeds of animals, reduction of the number

of sheep and goats, and stall feeding wherever possible are some of the suggestions that we encountered in relation to the maldari livestock situation. While these measures would be helpful, it is unrealistic to anticipate progress along these lines unless a new process is initiated. The maldari themselves are acutely aware of the difficulties of grazing their herds, and they need to define the steps to be taken towards any solution. Since their herds are viewed as the primary threat to the integrity of the park, there is a good opportunity for GEER staff to work with maldari groups towards defining what steps can be taken. The role of CEE would be critical as a third party, both because there are no clear spokesmen for the maldari, and because current relations between GEER management and local maldari are strained.

The agricultural potential of the buffer villages depends upon water, and the current demand on water resources is already causing the water table to drop. Greater efforts need to be made to harvest surface water in situ, before it flows away causing erosion in the process. While many percolation tanks have been constructed, some need repairs. In at least one case, an inter-village dispute over land and water rights (the tank is located in one village but the slope of the land gives the benefit to another village) is preventing needed repairs. Again, stronger village level organizations are needed, but will only come about through the kind of gradual organizing work that CEE is doing, and that GEER Foundation could also help support through outreach programs.

New technologies for using water more efficiently (e.g., drip irrigation) should be explored. Intensive cultivation using such technologies, or existing open channel technologies, could be carried out on village common land through a cooperative enterprise. The rabari residents of Amrapur are already cultivating land in common (renting common lands in an adjacent village), pointing to the social feasibility of such an approach.

The technologies to transform village common lands into productive resources, or to restore the habitat of the park, or to improve crop production on private lands, can be seen already in place and working somewhere in the Hingolgadh area. Yet, in spite of this progress, the future of Hingolgadh Park is still in doubt. As population grows, the pressures on park resources will only increase. A new strategy is needed for applying known technologies and for integrating the management of the park with the management of buffer areas (village common lands), protecting the former through the productivity of the latter. The solution, if one is to be found, will be institutional in nature, and will emerge from grass roots development efforts combined with responsive park management.

IV. RANTHAMBHORE NATIONAL PARK

A. INTRODUCTION

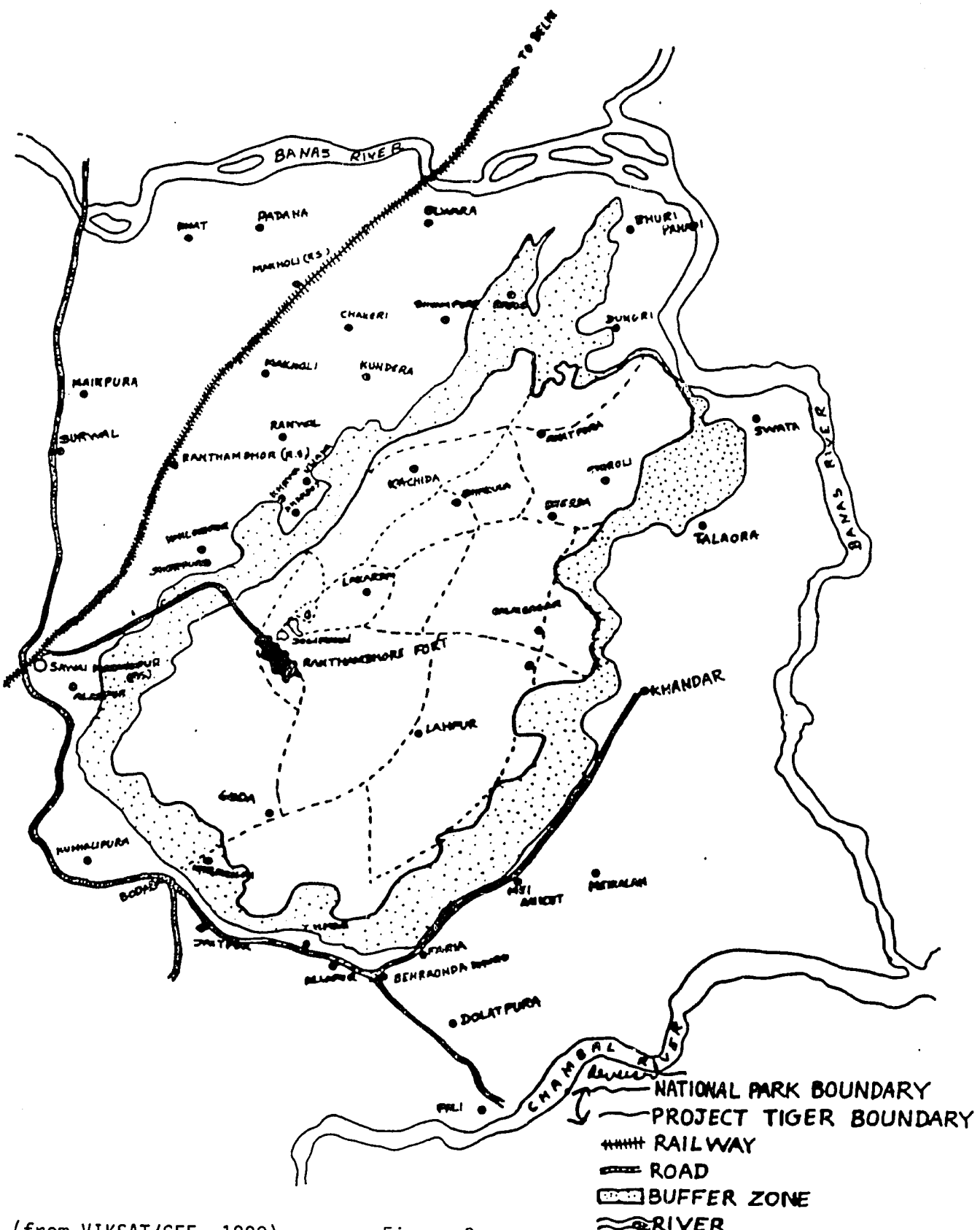
Ranthambhore National Park sits atop an imposing escarpment rising some 200 meters above the dry plains of eastern Rajasthan, its core area of nearly 400 km^2 defined by the slopes of the escarpment. The dry deciduous forest, the most extensive relict forest in eastern Rajasthan, is dominated by Anogueissus pendula. Until quite recently, this area was a hunting reserve for the Maharaja of Jaipur. An ancient fort, initially constructed, according to legend, in 944 AD, dominates the southeastern side of the escarpment. The fort was rebuilt many times, and used nearly continuously. Today its temples are the object of pilgrimage, and attract tens of thousands of visitors each year.

When the national park was declared a Project Tiger Reserve in 1973, a buffer zone surrounding the core like a ribbon was created from existing park and adjacent Forestry Department lands (see Fig. 3). The addition of the 115 km^2 buffer increased the park to nearly 500 km^2. More recently, the addition of nearby patches of Forest Department land to the north and south of the main park have also come under the park (Project Tiger) management, bringing the total land area to roughly 900 km^2, of which roughly 400 km^2 is a contiguous piece. A population of 45 tigers resides in the core area.

The twelve villages within the park are slated for relocation; eight of them have already been moved to nearby locations. Four, including one in the buffer zone, will be relocated in the next few years. There are 60 villages immediately surrounding the park, comprising a population of roughly 250,000 people and 100,000 cattle (VIKSAT/CEE 1990). It is estimated that about half of these people depend almost exclusively upon the park and buffer zone for fuel and fodder.

In light of this population pressure, it is hardly surprising that the buffer zone is severely degraded, both from tree cutting, lopping of branches, and grazing. In addition to official buffer, there are also some small areas of village common lands; however, most villagers depend upon the buffer zone to serve as a common grazing area, and many villagers use the park itself as a type of common area. Patrols by park guards that have clashed with villagers have led to several violent confrontations. It has been the news reports of these incidents, as much as the success of the tiger population, that has brought Ranthambhore Park into national prominence.

RANTHAMBHOR NATIONAL PARK



(from VIKSAT/CEE, 1990)

Figure 3

B. THE STATE OF THE ENVIRONMENT: NATURAL RESOURCE STATUS, CURRENT USE AND RESTORATION POTENTIAL

1. The Park

The preservation of Ranthambhore's natural environment owes much to its natural geological defensive location atop the escarpment. As a hunting ground for the Jaipur royal family, the area was not considered to be a particularly good forest, but today its importance as a reservoir of biological diversity is undisputed. The natural resources of Ranthambhore Park are documented in existing reports, and the study team did not systematically assess the park's resources. The largely illicit use of park resources by nearby villagers, as well as the licit use of those resource by villages yet to be relocated, did fall within our purview, and are discussed below under "resource use."

Park Management. Ranthambore Park falls under the jurisdiction of the Rajasthan State Forestry Department, and is managed by a Field Director who is responsible to the Chief Conservation Officer in Jaipur. The Field Director has a staff of a Deputy, two Range Officers, six Foresters, 24 Beat Guards, and varying numbers of Cattle Guards. The Social Forestry Wing of the Forestry Department overlaps with the Field Director in managing the buffer zone, which technically falls under the parallel jurisdiction of both parties.

Resource Use. The human pressure on the core area of the park has been documented by Berkmuller et al. (1988) who found an "effective" core of only 70 km^2 where "cutting and grazing appears [sic] to be minimal but not entirely eliminated." Most residents of the 60 villages surrounding the park enter the official core area during certain times of the year to collect grass fodder and wood fuel. For most residents, gathering grass is more of a problem than fuel, as some bits of wood can usually be found in the buffer, but during much of the year, the buffer is completely denuded of grass, while the park always contains a good supply. The pressure comes not only from the villages directly adjoining the park. People of villages 25-45 km. away visit the Padli, Khandoj, Khawa area (a small section of the buffer zone) to collect or buy an estimated 60 camel cartloads of wood every year.

Habitat Restoration. The primary approach being taken to restoring the park habitat is relocation of villages inside the park and exclusion of all humans except for tourists, tour operators, and park staff. The relocation process has fallen behind schedule because of problems with locating suitable lands

and meeting legal requirements. The team did not assess the relocation policy nor the "full protection" policy adopted by Project Tiger.

2. The Buffer Zone

The dependence of resource poor villagers on the buffer zone is acute and continuous. The combination of heavy use and almost total absence of resource management has resulted in a severely degraded environment operating far below its productive potential. The most striking sight looking down from the buffer scarp towards perimeter village lands below is the dendritic system of erosive gullies swelling into precious agricultural land. These gullies are 1-4 meters deep and sometimes more than 10 meters wide. Devegetation of the buffer scarp is the direct cause of this erosion. This process has continued for many years as the absence of all topsoil on the scarp above attests. Soils on the more level parts of the buffer zone are 20-130cm thick, and consist of sandy clays and loamy clays.

In February, three months into the seven month dry season the buffer zone was devoid of herbaceous vegetation. Mature trees from three to seven meters tall dotted the landscape. Stem density was variable, but never exceeded 60 stems per hectare. All stems had been lopped, and there was a visible browse line 1.75 meters above the ground. The most common species included: Anogueissus pendula, Acacia leucophloea, Acacia nilotica, Balanites aegyptica, Bauhinia racemosa, Dichrostachys cinerea, Diospyros cordifolia, Prosopis juliflora, and Zisyphus mauritiana (see ANNEX 2 for a more complete species list). In some sections of the buffer zone, Prosopis is becoming the dominant species to the exclusion of nearly all other trees (whereas on private lands its spread is controlled).

Resource Use and Management. The buffer zone provides valuable grazing area during the summer monsoon and for several months afterwards, and it provides fuel and leaf fodder throughout the year. But the single most remarkable feature of the buffer area is not resource use, but resource depletion. The intensity of resource use is not sustainable. Evidence from soil erosion patterns and observations of vegetation patterns support the consensus of interview data that land degradation is indeed taking place.

During a two hour walk across the buffer zone from the western perimeter of the park and into Ranthambore's core area the following activities were noted:

> herds of 35 goats and 30 cattle;
> collection of 4 headloads of living and dead fuelwood;

> four people levering 300 kg. gneiss rocks out of the scarp and down to the plain below;
> two others heating these rocks with Anogueissus pendula fuel and sledging them;
> the export of four camel carts of this broken rock for well lining;
> removal of straight stems of Anogueissus to make walking sticks and poles;
> collection of headloads of grass from the park core; and
> the collection of medicinal leaves and other plant parts for ayurvedic purposes.

Other demands on the buffer zone (and/or the core area of the park) derive from ceramic manufacture in the region. The kumhar (potter) caste appears to be disproportionately represented in several villages close to the park because of the accessibility of wood that is required for their industry. Fired clay roof tiles as well as ceramic vessels are manufactured. In one case that was observed, 200 ceramic water jugs were fired using 120 kgs of Anogueissus fuelwood. In this particular village, 45 families are engaged in this occupation, and a rough estimate (based on one firing per family every 10 days during the 8 months of dry weather) suggests an annual consumption of 129,600 kgs of wood from the park and buffer area.

People from villages 25-45 km away from the park boundary, such as Devpura, come to the Padli-Khandoj-Khawa area to collect or purchase an estimated 60 camel cartloads of wood every year. Allowing such outsiders access to buffer resources was effectively stopped by a "Khawa-Khandoj Buffer Community Management Agreement," but this has recently fallen apart (see below, and Ranthambore Case Study in the VIKSAT/CEE report, 1990). It will be critical to reinstate some type of inter-village agreement to protect the buffer zone resources from this long distance drain. Some feeling of limited control over natural resources or usufruct rights seem to be the key to responsible community management of buffer lands.

Management of the buffer zone is under the legal jurisdiction of the park Field Director, but in practice, the park management has retreated to the boundary between the park and the buffer and has concentrated on protection of the core. Recent efforts to restore patches of buffer land point to a new interest on the part of both park management and the Social Forestry Wing of the Forestry Department to "upgrade" the buffer, as is discussed below under "Habitat Restoration."

An "integrated development programme" for Ranthambhore Tiger Reserve has recently been prepared by the Chief Wildlife Warden for Rajasthan, at the behest of the Project Tiger central office. Each of the 17 Project Tiger Reserves has been asked to

formulate such a plan that gives particular focus to the development of the buffer zone in an effort to relieve pressure on the park core. The plan, which is a first draft still to be revised, calls for pasture development and tree plantations as key elements of improved productivity of the buffer zone. However, aside from increased patrolling by park guards, it does not address the problem of how to manage the buffer zone.

Management of parts of the buffer zone by the villages immediately adjoining the area has met with very limited success. Such management control is not legally sanctioned, and requires a high degree of village cooperation. The degraded state of village common lands that are within the clear management jurisdiction of individual villages is testimony to the difficulty of managing access to community resources. Nonetheless, two cases of villages claiming parts of the buffer for their exclusive use have been documented in the Ranthambore Case Study (see VIKSAT/CEE, 1990, pp. 129 - 136) and hold valuable lessons for the restoration of these lands.

The village of Uliana is a single caste (meena) settlement on the northeastern fringe of the buffer zone. Following severe clashes with the Forestry Department in 1981, and ensuing legal battles that left many villagers in debt, the village took a group decision to avoid any further interaction with the forest authorities. They let it be known that they would not allow cutting in their adjoining portion of buffer, a decision that surrounding villages have respected.

A second case of village management of buffer zone resources took place, briefly, among the three villages of Khawa, Khandoj, and Jagna ke Tapre located just a few kilometers south of Uliana, also on the edge of the buffer zone. The decision of this group, which included gujar graziers as well as meena farmers, was the result of environmental educational training on the part of CEE staff. For more than two months the three villages cooperated in closing off their portion of buffer zone to outsiders, and limited all tree cutting and lopping. An unfortunate decision by the Forestry Department to construct an experimental exclosure to promote grass regeneration, however, created a fear among the villagers that they would lose access to part of the buffer. The result was the collapse of the group decision and a resumption of cutting by both local and outside residents.

Habitat Restoration in the Buffer Zone. The Social Forestry Wing is establishing exclosures for natural regeneration of dhok (*Anogueissus pendula*) forests along the scarp that surrounds the park. Regeneration after even one year of protection is encouraging, although it has yet to be quantified. Box trenching is another technique that has proven effective in other

parts of Rajasthan, although it too needs to be quantitatively compared in economic and ecological terms to other soil and water conservation techniques on an site by site basis.

Social Forestry habitat restoration demonstration plots are 100 hectares in size and are planted at a density of 1100 trees/ha for forest plots and 100 trees/ha, plus seeded grasses, for range improvement plots. The former costs approximately Rs. 6,000 ($ US 330.00) to implement, while the latter costs Rs. 2,000 ($ US 112.00). The Social Forestry Wing is focusing on the demonstration value of these plots, trying to maximize increases in biomass productivity, but has not tried to adapt restoration concepts to the level of individual villagers or even village conditions (e.g., using 5-20 hectare plots and avoiding the use of tractors and mechanical cultivators).

Some interior portions of the buffer zone (e.g., 500 meters from the outside perimeter) still support lopped Acacia leucophloea trees up to 3 meters in height at roughly 3 X 3 meter spacing. Much more bunch grass grows under the protection of these trees. Pedestalling around tufts of grass averages 10-18 cm, indicating the loss of perhaps several centimeters of surface soil every year. Using Acacia and Zisyphus trees as a way to protect and propagate native bunch grasses would be one useful strategy to restore range productivity in natural regeneration exclosures.

3. Village Common Lands

Most of the 60 villages adjoining the buffer zone also possess some common lands within their borders, but the extents are so small as to be almost insignificant. The total area of common land for all 64 villages[7] is 2,590 ha (Rathore n.d.), just 3 ha more than is available to only six villages surrounding Hingolgadh park in Gujarat. Thus, while there are individual cases where the common lands resources will be an important part of a land strategy, for the most part, a discussion of village common lands merely confuses the more critical issue of village access to buffer area resources.

[7] The number of villages surrounding Ranthambhore National Park is variously given as 57 - 64 in the park management plan (Rathore, n.d.); the figure of 60 is used in this report except where a particular number is given in the source cited.

4. Private Land

The private holdings of the 60-odd villages surrounding the park amount to a sizeable area, but the team did not attempt to calculate the size, and no figures were readily at hand. [The calculations could be made from census reports available in Sawai Madhopur or in Jaipur.] Average landholding sizes are also not available, but the team compiled "snapshot" indications from the villages we visited. In one small single-caste meena village, all 15 families are landholders, having inherited portions of the 50 ha farm owned by the great-grandfather who moved here from an adjoining village. In another village where the gujar caste predominates, land holdings are slightly smaller; the 20 landed families own an average of 3 ha, while the 15 landless or near-landless families depend on livestock and wage labor.

The major winter crops are wheat, mustard, gram and (depending on the area) small amounts of chili and vegetables. Very small plots of lucerne (green fodder) are also making an appearance. Major summer crops are sorghum, millet, and peanuts plus small amounts of lentils and maize. Cotton is not grown, apparently because of animal damage (nilgai eat the buds). Planting of multiple use trees is beginning on agricultural field bunds, around house compounds, and there are a few cases of fruit tree planting within agricultural fields.

As in Hingolgadh, the major constraint to increased production is water. The water table is around 50-60 feet and, according to most informants, is dropping little by little. An equally ominous and related problem is soil erosion. Run-off from the denuded buffer zone, which comprises the steep flank of the Ranthambore escarpment, washes down with considerable force during intense summer rains, resulting in gullies that are removing substantial quantities of soil from private lands downstream. In one private field the channel depth was more than 2.5 meters, and the channel width nearly 6 meters, within 200 meters from the edge of the buffer zone.

Two other factors that may constrain agricultural intensification are animal damage (cited by nearly every informant as a problem), and land fragmentation. Most farmers estimated damage at 20% of total production, but the pervasiveness of this figure suggests it is more a figure of speech than a calculated estimate. But in terms of farmers' assessment of the pay-off of cultivating vs. leaving the land fallow, this figure may have practical validity. The effects of land fragmentation are more difficult to evaluate. Farmers are reluctant to invest in an irrigation well if their plot is too small to use all the water. The option of selling water to neighboring farmers does not appear to be an accepted tradition. Instead, farmers pay for the operating costs of the pump during their water turn (Rs. 14/hour) but not for the water itself, nor

for capital costs of the well and equipment.

A rough estimate is that about half the total cultivated area is irrigated. This figure does not include the significant areas of fallow land (perhaps a third of the total cultivable area), which are kept fallow largely for want of water. In the absence of watershed rehabilitation in the buffer zone, the constraints to irrigation investments are probably fortuitous, as the groundwater level would drop even more rapidly. However, increased agricultural production, and cultivation of green fodder, will very much depend on increasing the irrigated area.

C. SOCIAL/INSTITUTIONAL CONTEXT

1. The Levels of Organization

As one of 17 Project Tiger locations, and since 1982 a National Park as well, Ranthambore Park is affected by management decisions made in New Delhi, as well as the state level decisions that flow through the Rajasthan Forestry Department. While the status of National Park has more effect on the level of enforcement than on the policies themselves, the park's role within Project Tiger does have important implications for policies and practical management.

Project Tiger policies are formulated through the project office that is attached to the Ministry of Environment. Funding comes directly from the Centre, and is dispersed through the project to the individual Project Tiger locations. Although executive control comes through the state-level Forestry Department, budgetary control is through Project Tiger, which currently funds all of Ranthambore Park's operating expenses. Perhaps the most significant intervention of Project Tiger, aside from finances, has been in requiring an "integrated development" plan for all Project Tiger parks, including Ranthambore. The Rajasthan State Forestry Department has prepared such a plan, which attempts to lay the basis for buffer zone development activities in social forestry and livestock improvement.

In addition to the Field Director, whose duties were mentioned earlier in relation to park management, the Director for Social Forestry (Social Forestry Wing) has responsibility for the district of Sawai Madhopur, including the park area. He and a small staff are responsible for promoting (on private and common lands) and implementing (on Forestry Department lands) tree planting and improved grass areas.

Other relevant government agencies based in Sawai Madhopur include the Animal Husbandry Department, Agriculture Department, [Soil Conservation Office], and the District Rural Development Agency. The activities of these agencies were not explored in detail, but would certainly need to be included in buffer zone development initiatives.

The civil administration of the park area comes under the district of Sawai Madhopur, and is divided into two Tehsil divisions, Sawai Madhopur Tehsil covering the north and western portion of the buffer zone, and Khandar Tehsil along the southeast portion. The 60 villages within 5 kms of the park come under 13 panchayat organizations within these two tehsils, and comprise roughly a quarter of the total number of panchayat divisions. Thus, the problems of the front-line buffer villages are not shared by the majority of panchayats in the tehsil. And within most panchayats, there are a number of villages (an average of 4.6) with competing claims and differential proximity to buffer zone resources.

The organizational structure of the Ranthambore area can also be viewed culturally and geographically as a division between predominantly agricultural villages of Meenas and some Mallis (vegetable growers) and other castes, along the west and north sides of the escarpment, and a region to the south and east where Gujars are the dominant caste and livestock provides the economic base. Agriculture is everywhere important, but especially so to the Jat minority in this region. This division is also reflected in the tehsil divisions, the Meenas under the Sawai Madhopur tehsil and the Gujars and Jats coming under the tehsil administration of Khandar.

Even within these areas, there is considerable diversity of size, caste composition, and economic base at the village level. Village size ranges from 13 households to several hundred. Most villages are represented on the panchayat through an elected <u>member</u> who plays a leadership role but rarely represents the interests of all the village residents, because of intra-village differences of caste, kinship, political affiliation, or other reason. In one single-caste village of 18 households, for example, there are three acknowledged factions. Because of its small size, there is no panchayat member, nor is there any other acknowledged leader.

Formal organizations within villages or cross-cutting villages appear to be almost non-existent. In one village, a skeletal structure of a defunct <u>mandal</u> (a registered society) was found, a relic of a government program some ten years ago that has been inactive since then. In another village, there is a savings society but this may be a unique case.

2. Key Linkages in the Institutional Structure

Park Management -- Villagers. The most important, and the most problematic set of relations within the "institutional environment" of the buffer zone is that of the park management's dealings with the villages and villagers along the buffer zone periphery. The tone of these relations at present is one of hostility, with park management adopting a strong defensive orientation, and villagers exercising any means possible to capture fuel and fodder from the park.[8] Several institutional elements which contribute to these dangerous relations are (1) lack of information flow in both directions, (2) ineffective management of park guards and other Forestry Department staff, and (3) lack of village-level organizations or legally defined use rights to control access to buffer zone resources. The result is widespread legal violations of property rights (on the part of villagers) and exploitation for private benefit (on the part of some Forestry Department staff).

Project Tiger -- Forestry Department. There appears to be a smooth flow of information between Project Tiger and the Forestry Department. Where one could expect a divergence of perspective, however, would be the extent to which Project Tiger reflects the concerns of the Centre, while the Forestry Department Field Director is directly responsible to the state of Rajasthan. Particularly as new thinking about buffer zone management is infused into the parks through the conduit of Project Tiger, it will be important to ensure that the "perestroika"-like concepts already familiar to central government planners be fully aired and discussed with forestry professionals.

Government Agencies/Programs -- Villagers. Local involvement in government programs appears to be ineffective. Social forestry experimental plots in the buffer zone are introduced to villagers in a meeting, but those interviewed expressed little understanding of what the Forestry Department is trying to do. Communication through the over-extended panchayat system is not adequate to reach the majority of villagers, nor does such an approach of "top-down" communication take advantage of the intrinsic potential of the social forestry approach.

[8] This crisis of confidence is graphically illustrated in the various accounts of villager/forestry official interactions recounted in the Ranthambore Case Study prepared by VIKSAT/CEE in their report (1990, pp. 114 - 127).

The work of the social forestry wing, however, needs to be seen in the context of other government programs to be better appreciated. Not a single farmer interviewed had any idea of the name of the agricultural extension agent (T&V system), or had seen him recently. Other government programs such as IRDP loans were better known but more for their reputation of benefiting the middlemen than for the productive value of the loans. Farmers estimated that they received 50% of the nominal value of an IRDP loan, with the other half "eaten" by intermediaries. Even if this is the case, farmers still receive economic benefit from such loans, but these experiences set the tone of interaction with government in a direction that makes idealistic plans for buffer zone development more difficult to implement.

Sawai Madhopur City. The role of an urban center on the periphery of the park is of tremendous significance as a locus of employment, a center of government and private sector services, and as a market for park resources (e.g., fuel wood and minor forest products). While the team did not attempt to assess the character of these interactions the role of Sawai Madhopur as a fuel wood market is discussed in Viksat/CEE 1990.

D. CURRENT DEVELOPMENT ACTIVITIES

The Government of India and the State of Rajasthan offer numerous social welfare and rural development programs in Sawai Madhopur and around Ranthambhore National Park. Because the area has a high percentage of Meena and Gujars, there are particular programs targeted for these designated "backward" castes, including training programs, scholarships, health camps, etc. In addition, there loan programs (e.g., IRDP) to provide capital for a wide variety of rural needs (wells, agricultural inputs, upgraded livestock, etc.) and small industry. While similar government investments for over twenty years have not yielded the benefits anticipated, the programs offer an existing framework for development if coordination and accountability could be attained.

NGO activities in the area surrounding Ranthambhore National Park include the Nehru Foundations' Center for Environmental Education (CEE) program: the Ranthambhore Eco-Development Project (REDPRO) which has in turn stimulated development of a local NGO, a chapter of Jan Kalyan Samiti. The only other NGO presence the team encountered is that of Ranthambhore Foundation working through a local chapter of Parivar Seva Sanstha.

In 1989, the Ranthambhore Society was established in London to support the Ranthambhore Foundation (RF) in India to meet its stated objective of promoting the welfare of local people to

reduce pressure on the RNP (Cat News, Jan 90). Ranthambhore Foundation (RF) is new and their activities have had minimal impact to date. There is no on-ground RF team in the RNP area; presence is maintained by visits from a Delhi-based program supervisor. Accomplishments and "considerable activity" reported in Cat News were not confirmed on the ground by interview and observation.

The major activity of RF has been to fund the establishment of a Sawai Madhopur branch office (known as Ranthambhore Sevika) of Marie Stopes/London ("innovators in family planning programmes") India branch, Parivar Seva Sanstha (PSS). PSS operates a mobile clinic (a van). Its team includes a woman doctor, a nurse, and two rural health care educators. The van travels a regular weekly schedule to visit 11 villages in a 29 km strip along the west side of RNP. The team offers prenatal care, mothers' education, OB/GYN, and family planning as well as immunizations and treatment of minor ailments. The team performed in a professional manner and villagers interviewed indicated that the van complemented the good general hospital in Sawai Madhopur in providing immunizations and treating minor problems.

The REDPRO program of Jan Kalyan Shikshan Samiti and CEE has maintained a team of 3-5 people for two years with offices in Sawai Madhopur and one village on the western side of RNP. The goals of REDPRO are 1) develop villagers' capacity for community action, 2) coordinate villagers' access to government and non-government development programs, 3) environmental education, 4) promote development of sufficient fuel and fodder in the buffer zone to take pressure off the core area, 5) forge intervillage contacts in order that coordination of village use of buffer zone can be regulated by mutual respect for agreements, and 6) coordinate interaction between the Forestry Department and the villages around the park. The team has selected six villages for intensive focus, but maintains contacts with other villages around the park perimeter.

REDPRO activities to date include establishing men's groups (mandals) in several villages, a survey of a government biogas program, and developing and distributing a directory of locally available government programs with names of contacts in government offices and a summary of application procedures and benefits. The team has focused on environmental education for both children and adults, using folk tales and pictures. Work has included literacy programs; a nature club for school children in Sawai Madhopur; establishing a village tree nursery, and educational tours for villagers to see health programs, wasteland development efforts, and other community activities in other areas.

E. KEY ISSUES AND SUGGESTIONS FOR ECO-DEVELOPMENT

The Integrated Development Plan for Ranthambhore National Park provides an invaluable tool for discussing options and strategies, and for involving local communities in that discussion. The Director of Project Tiger noted that the plan is imperfect and needs to be revamped. This is precisely the time that input from a broad set of actors will be most useful: before the plan becomes "set" and fixed in people's minds. Perhaps the highest priority for action in the short term is to take this plan to the people who are assumed to be its beneficiaries, and to use the plan as a sounding board for their ideas and suggestions. Dialogue with 60-odd villages is not an easy task, but the problems posed simply by trying to define the set of potential actors would be a rewarding process in and of itself.

Interaction between the Forestry Department and the village communities is charged with hostility and suspicion on both sides, and a third party to serve as intermediary is probably a prerequisite for meaningful dialogue. A mutually acceptable NGO would be the ideal solution. The CEE/Jan Kalyan team would be well placed to fill this role, or an outside group could be brought in.

1. Ecological Restoration

The assessment team identified a number of activities that could be explored further for possible implementation in restoring the degraded buffer zone areas. In many cases the suggestions are variants of work that the Social Forestry Wing is already undertaking.

Ecological restoration technologies should be adaptable to the economic level, technological sophistication, and basic needs of local people. Species chosen for range and forest restoration programs, whether at the trial or dissemination stage, should fulfill a variety of local fuel, fiber, and health needs. Afforestation exclosures should be small enough to enable local people to easily monitor and protect them. Current approaches to demonstration plots should be re-considered; particularly seeding sites in an intensive manner and applying high inputs in order to achieve a quick growth response. Growth response under natural regeneration regimes has been proven to be surprisingly fast, while being inexpensive and easily adopted by local people.

Community-based afforestation research that stresses simple tree planting treatments in modest-sized plot exclosures should be encouraged. Productivity improvements on private lands, i.e. tree planting on agricultural field bunds, and even fruit tree planting within agricultural fields should be encouraged and monitored. The Social Forestry Wing will have to make a strong

commitment to "on-farm," or "in village" visits and create a sustained dialogue with villagers on social forestry activities to be undertaken. Without this, villagers will continue to suspect and mistrust any Forestry Department field activity, particularly if it involves exclosures on buffer zone lands. Reorienting social forestry programs toward a community participation focus would require significant institutional changes and in-service training of existing extension staff. Local NGOs could play an important role in fostering that dialogue, and in working with extension staff.

Special attention will need to be given to the needs of the grazing community, both those families resident in the area and the summer migrants who come during the monsoon. Understanding their economic system and the role that park/buffer resources currently play is a critical first step in bringing them into the dialogue of land restoration. Without pre-judging the issue of resource rights, the first step has to be a better understanding of resource use.

Research Needs for Restoration Activities.[9] A genuine scientific approach is needed at the practical field level, to search for location-specific solutions. Without a grassroots notion of practical research, the social forestry experiments run the risk of mindless repetition of proven demonstrations. The real value of a demonstration comes from involving local people in designing the experiment and giving them a stake in "owning" the result; it will become their experiment and they will learn far more from it than from a demonstration they passively observe and never understand.

Forestry Department efforts have been primarily located in park buffer areas. Community-based efforts, while presently non-existent, would be more appropriately based on village common lands or private holdings. Experimental restoration exclosures established on any of these three types of land should: 1) be of modest size (10-15 hectares, except with the agreement of truly representative village forums), 2) highly visible to passers-by, 3) easy to patrol/protect, and 4) representative of local site conditions throughout the area. Restoration techniques employed should: 1) stress the use of native species and ecological concepts of succession, 2) use locally available technologies that are modest in cost, 3) produce substantial yields of useful

[9] Additional suggestions are given in ANNEX 4, "A Preliminary List of Suggestions for Future Jan Kalyan Shikshan Samiti Development Activities in the Ranthambore Area."

products in a short time, and 4) be easily adapted to a variety of site conditions. Existing Forestry Department restoration plots have tremendous demonstration value, but are too large and often use machinery too costly for villagers to replicate.

Future research should build on past restoration activities. An example of this is the huge forested tract (ca. 7 x 20 km) of exotic Prosopis juliflora that stretches down the eastern flank of Ranthambore Park. This species was introduced at least 10 years ago. Mature stands have 5 X 5 meter spacing (or less) and create 60-80% canopy closure. Soil is stabilized while understory productivity is reduced to a few scattered bunch grasses. Local opinion in the Khandar Village/City area is mixed concerning the impact of this run-away stand of Prosopis. Grazing castes are obviously threatened by further loss of range areas, while fuelwood and charcoal producers have theoretically benefitted. The effects of this afforestation effort should be quantitatively evaluated before other large-scale afforestation schemes are undertaken.

In addition to local field studies, there is also a need for tapping the results of basic research conducted in national and international research institutes. The Central Arid Zone Research Institute (CAZRI) in Jodhpur, the range management institute in Jhansi, and the International Centre for Research on the Semi-Arid Tropics (ICRISAT) in Hyderabad should be contacted and invited to use the Ranthambore area for one of their research locations. Similarly, the agricultural university at Udaipur, or other organizations that have an interest in land-based production in dry areas should be contacted for ideas and support.

Community Outreach and Dissemination Strategies. The Social Forestry Wing will have to make a strong commitment to "on-farm," or rather "in village" visits, to create a sustained dialogue with villagers concerning social forestry activities to be undertaken there. Without this, villagers will continue to suspect and mistrust any Forestry Department field activity (especially the erection of exclosures on buffer zone lands), however high-minded the intent of government foresters. Making social forestry programs truly community-oriented would require significant institutional changes and in-service training of Forestry Department extension staff. Local NGOs may have an important bridging role to play in fostering sustained dialogue between local communities and the Forestry Department Social Forestry Wing.

2. Institutional Strengthening

The inability of the three villages (Khawa, Khandoj, and Jagna ke Tapre) to sustain solidarity of purpose in protecting their section of buffer zone (see above) points to the urgent

need for organizational strengthening at the village level as a prerequisite to sustainable resource management. The role of the Forestry Department in unwittingly adding to the tensions of that case also points to the need for staff training in community development skills. While training and institutional strengthening alone will not be sufficient, it is necessary to any successful program of sustainable ecological restoration.

Village Level Institutions. The panchayat system in this area is so extensive (covering an average of more than 4 villages per panchayat) that village and sub-village organizations take on a particularly great need. But how are these organizations to be formed? In some cases, the skeletons of now defunct societies are encountered, the remnants of past development efforts. These may offer a starting point for new organizations. But in most cases, the process of building a sense of community must begin from nothing, a daunting task, and one which is possible only if the community organizations have something to grow towards, a raison d'être.

The immediate interest of local communities adjoining the buffer zone is, or could easily become, the productive utilization of the natural resources found in the buffer zone. Most, if not all, of the 60 villages that adjoin the buffer zone have this same incentive, which could be realized through education and community capacity-building efforts, and through supportive policies on the part of the Forestry Department (see below). The task of building the capacity of local communities to organize themselves will fall partly on NGOs such as CEE, and partly on the Forestry Department itself.

The Forestry Department. Already over-stretched and under-staffed, the Forestry Department will have to do even more to respond to the needs of eco-development and the preservation of the biodiversity within the park. But it is not simply a matter of bigger budgets and more staff, but a reorientation of the mission of the Forestry Department and, in particular, its relations with local communities. Much will depend upon in-service training for existing staff, to impart the skills they need to work constructively with suspicious villagers. New cadres of staff with experience in community development will probably be needed. For mid- and upper level forestry officers, in-service training and professional development (workshops, study tours) will be needed in the new discipline of "buffer-zone management."

Learning how to work with local villagers on common problems (the management of the buffer zone) can relieve some of the burden from the Forestry Department by transferring some of their management responsibilities to the villagers they (used to) mistrust. Greater control over the buffer zone resources they view as rightly "theirs" is also what local community

organizations need to justify the work of sustaining that organization. Formal contracts delineating the resource rights of the local community vis à vis the Forestry Department (similar to the approach used in Haryana) could be an important element in reaching a mutual agreement.

Many elements would need to be in place before a contract drawn up between the Forestry Department and local communities can work. In addition to organizations that can speak on behalf of the community, and a legal framework within which to negotiate, there have to be open channels of communication between the communities and the Forest Department. At the moment, buffer zones as well as the core area of the park represent disputed territory between local people and park authorities. Park staff carry weapons not only to facilitate enforcement of park regulations, but for self-defense in case of attack. When villagers enter the core protected area, they move in groups for similar reasons of defense. The level of antagonism on both sides needs to be addressed before anything like management contracts could be implemented. Yet the idea of a contract could also serve as a discussion point to help bridge the current communication gap. Third party mediation through an NGO or a professional mediation service could be considered once an agenda (contracts for use rights) is on the table.

Non-Governmental Organizations. The few NGOs already working in the Ranthambhore area will be inadequate to meet the demand that a re-oriented Forestry Department would place on them. New NGOs, or the expansion of existing NGOs will be needed. The rich tradition of NGOs in India suggests that to some extent, their formation is dependent upon a clear role for them to play. Thus, the first move needs to be made by the Forestry Department to show a willingness to work with NGOs and directly with community groups.

3. Options for Development

The buffer area (including just beyond the designated buffer zone) of Ranthambhore National Park includes a city (Sawai Madhopur) and a good sized town (Khandar). A major rail line runs through Sawai Madhopur, and the park itself attracts vast numbers of religious pilgrims (to worship in the ancient temples in the fort) and large numbers of international tourists (to see the tigers). Cottage industries for local crafts could be built up around the inflow of both local and international pilgrims and tourists.

Eco-tourism. The opportunities for eco-tourism are considerable, either as guides, drivers, or in the service sector attached to tourist hotels. A tax on entering visitors could be used for community development and/or ecological restoration efforts, particularly if the use were clearly stated. Indeed,

visits to local reforestation projects (for example) could become part of an eco-development visit to Ranthambhore.

Alternative Employment. The transportation links and diversity of small-scale enterprises in Sawai Madhopur offer a range of off-farm employment opportunities, as well as a diversity of agricultural markets. New agricultural crops (e.g., fruit) should be investigated that would capitalize on the relatively convenient transport, and would give high value for low inputs of water, the limiting agricultural resource.

Agricultural Productivity. The potential for improved biomass productivity is very high, but hinges on the ecological rehabilitation of upstream areas where both soil and moisture are currently being lost. Most of the watershed for the buffer area is within the boundaries of the park itself, and much of the immediate watershed consists of the designated buffer zone. Thus, better management of the buffer zone, in addition to the direct returns of fuel and fodder, would contribute significantly to groundwater resources and would protect against the currently high level of soil erosion.

The problems of Ranthambhore are severe, and are likely to become more so as population levels increase and pressure on the park increases with it. The problems are not only local ones; maldari herders from as far away as Jaisalmer District (Western Rajasthan) bring their herds into the park area, and at times into the park itself. Commodity markets in Delhi (as well as internationally) and policy decisions in Jaipur all affect the ability of local people to manage the resources of the buffer zone. The inter-connected problems require an integrated response. The Forestry Department needs to become more actively involved with local villagers, and with local government agencies that carry out development programs affecting resource management.

V. GENERAL LESSONS LEARNED: Eight Strategies for Buffer Area Improvement

India's forest departments are losing the battle to save the country's biological heritage. The final remnants of an environmental inheritance that have been preserved during more than four millennia of civilization are slowly but inexorably being chipped away. The state forest departments, charged with managing the forests and protecting the wildlife, find their task to be nearly impossible. In the words of one exasperated senior forestry official, "It's hopeless!" There are limits to what parks and buffers can support; access must be controlled if those limits are not to be exceeded.

Perhaps the most important conclusion of this assessment report is that there is hope; there are a growing number of success stories to learn from, both within India and abroad. The solutions vary, but a common element emerges: the people who live around the park are the most effective guardians of the park's resources. Forestry Departments must share the resource rights and the management responsibilities with them, and work together to conserve the park ecosystem.

One of the most pressing needs is training for park staff, as well as restructuring of the administrative apparatus for a new management role. At the village level, the lack of effective organizations needs to be addressed so that villagers are able to enter into constructive dialogue with the Forest Department or park management. At the local level in particular, NGOs can provide a key service both in catalyzing village-level organizations and in helping mediate between village groups and the concerned government agencies. Below are eight key steps that could significantly enhance prospects for preserving India's endangered biological resources--not at the cost of social and economic growth--but in concert with it:

1. **Strengthen the Management Capacity of the Forestry Department.** Park managers need to work more closely with local communities, NGOs, and other government agencies in searching for solutions to buffer zone management problems. The goal of protecting park resources cannot be met by continuing the current approach to park management; the orientation of the Forestry Department must change from that of a paramilitary unit to that of eco-development facilitator. This bureaucratic reorientation will require in-service training in community development and management skills, and the adoption of new policies recognizing cooperative management of buffer areas (see below).

2. **Establish Cooperative Management Rights and Obligations.** Formal contracts between local communities and the Forestry Department can serve as important mechanisms for establishing

ghts to buffer zone resources and responsibilities for managing a d protecting those resources. The examples of Haryana and West F ngal point to the utility of this approach. But before such a ntract can be negotiated, a great deal of institutional s rengthening needs to be accomplished at the village and sub- llage levels. This work will involve environmental education d training in organizing skills, as well as range and forest nagement. Existing organizations could be strengthened or tirely new groups formed (e.g., women's societies, men's cieties, dairy cooperatives) to play a role in managing common nds. The panchayat system will be an important factor in all ganizational efforts, but in most villages, organizing work ist first begin at the sub-village level, where groups can form ound clear and immediate common interests.

3. Strengthen the Capacity of NGOs in Buffer Area Eco-evelopment. NGOs can play a unique and critical role both in orking with local villagers, in mediating between the villagers nd outside agencies, particularly the Forestry Department, and n working directly with Forestry Department staff, e.g., in raining and participatory field research. In addition, NGOs can elp coordinate disparate government services and serve as public nterest "watch dogs" to increase the accountability of overnment agencies, programs, and projects in the buffer area.

4. Involve Local Communities in Practical Field Research on estoration Technologies. A new approach to applied field esearch would bring forestry professionals into constructive orking relationships with local farmers and herders. What is eeded is better understanding of how to adapt known echnologies, including local indigenous technologies, to articular settings. This process needs to involve local people s full participants in the search for solutions, and in the mplementation of those solutions.

5. Improve Biomass Production in Buffer Areas and Private Lands. Much can be done using existing knowledge, and often through existing government programs, to restore degraded lands, develop water harvesting and local irrigation, improve agricultural production, and improve livestock quality. The best short-term strategy is to work through existing programs by using public pressure (NGO activism), political pressure (governmental channels), and direct interaction with the local staff of programs such as T&V (agricultural extension), Wasteland Development, Dairy Board, etc. The Forestry Department needs to view the eco-development needs of buffer communities as a forestry concern, and become involved either directly, or with the help of NGOs, in raising the level of development activities in the buffer. As a medium- and long-term strategy, the Forestry Department needs to work with research institutes in defining priority needs for future development work. New varieties of range grass, multi-purpose trees, soil conservation techniques,

or small scale irrigation are just some of the areas that the Forestry Department should be concerned about.

6. Develop and Implement a Livestock Management Plan for the Buffer Area. Grazing of livestock in the buffer area and within the park, as well as unauthorized grass cutting and lopping of tree branches for fodder pose a serious threat to the park ecosystem that needs to be addressed comprehensively. Seasonal migrations of herds from outside the area add to the problem. The Forestry Department should initiate a dialogue with the concerned parties and develop a management plan with the involvement of representatives from local as well as outside grazier communities. NGOs could serve a valuable mediating role in this effort, and other concerned government agencies might also be involved. Issues such as herd size and composition (e.g., the number of sheep and goats), veterinary health care, alternative fodder availability, scheduling of migratory visits, and grazing rotations could be some of the topics for discussion; but the most critical feature of the plan would be the participatory process of formulating it.

7. Develop New Livelihood Opportunities within the Buffer Region. Economic opportunities in the buffer area need to be viewed in a regional perspective, taking into account the resources that residents of buffer villages can draw upon. Ecotourism is the most obvious opportunity, but requires coordinated planning (e.g., hotel development, craft industries) and policies (e.g., an eco-development tax on park visitors). Value-added industries such as food, fiber, or medicinal processing, and extractive enterprises based on honey, gum, leaves, and other minor forest products need to be explored and developed. Other small-scale enterprises that are environmentally benign (e.g., diamond polishing) could also be developed. Finally, alternative energy sources to power new industries should be explored. Wind generation in Hingolgadh, and solar technologies in both areas could be economically viable for certain purposes, given appropriate policies and incentives.[10]

8. Promote Family Planning and Health Care in the Buffer Area. The long-term viability of park ecosystems is dependent upon the human pressures that are placed on them. While those pressures can be relaxed significantly through better management

[10] The hotel where the team stayed in Sawai Madhopur heated its water by burning wood from the park, rather than making a small investment for a passive solar water heater.

and improved production from the surrounding buffer area, there are limits to this "supply-side" strategy. Eco-development aimed at enhancing the supply of natural resources provides a context for promoting family planning measures to enable local communities to attain a sustainable ecological balance with their environment. Such measures could be introduced as part of a package of primary health care and other services (e.g., animal husbandry, small-scale industries) planned for buffer zone eco-development. An alternative might be to target buffer zone areas for the government's expanding ICDS (Integrated Child Development Strategies) program, with a particular emphasis on the maternal education and family planning components of this national program.

VI. RECOMMENDATIONS FOR USAID

USAID/New Delhi's natural resources management program is at a critical juncture. Many of the Mission's large scale forestry and irrigation projects are coming to an end at a time when the tenor of debate on sustainable natural resources management is shifting from technical issues to questions of policy, equity, and broader social participation in the management process. The issues raised in this assessment are symptomatic of this debate and underscore the need for new initiatives in developing approaches to sustainable natural resource management.

The recommendations listed below are designed to respond to some of the outstanding needs identified in this report, while simultaneously addressing issues highlighted in the Draft Strategy on Environment and Natural Resources prepared by the (former) Asia/Near East/Europe Bureau. Some of the follow-up actions proposed (e.g., those dealing with management technologies and policy analysis) could be funded under the Mission's Technical Assistance Support Project (TASP). Others, dealing with social organizational constraints, might be supported under the Mission's proposed new Natural Resources Management Initiative--DARE (Democrative Approaches to Resource Efficiency). The recommendations are sufficiently discrete to allow follow-up in part or by organizations other than A.I.D.

A. POLICY LEVEL

Support creation of various fora for airing key policy issues related to successful buffer zone restoration and eco-development. Depending on the issues, the fora could bring together key representatives from the Ministries of Environment and Forests, Energy, Tourism, and Rural Development, the Planning Commission, the State Forest Departments and representatives of the NGO and donor community committed to working in natural resources management. Through regular meetings, the fora might consider the effects of government policies regarding issues ranging from alternative energy use to community rehabilitation and use of degraded forest land on the sustainability of ecological protection zones. Discussion could serve to elucidate strategic policy or adminstrative constraints to achieving agreed-on eco-development objectives. Alternative policy options might then be considered along with ways to leverage donor support against indigenous resources to help implement these strategies.

To assist this process, USAID could fund policy studies commisioned by the fora to inform their debate, or, where there

is consensus, position papers that reflect changes, reinterpretations or clarifications of existing policies governing protected area management. Among the issues that might be considered initially are:

1. **Energy Use in the Protected Area Zone of Influence**. Since heavy reliance on wood, dung, and leaflitter for fuel are directly responsible for severe degradation and suppression of natural regeneration of the core and buffer zones of protected areas, what options are available in terms of fuel conservation and fuel substitution to reduce the pressure on overexploited biomass resources from adjacent populations?

   > How much biomass would be saved by introducing more fuel efficient technologies into the buffer area? What are the constraints to doing so (economic, social, technical)?

   > What is the nature and availability of non-biomass-based fuel substitutes (such as kerosene, natural gas, solar and wind-powered converters) in the Buffer Area? What policies currently govern their availability (re: production, affordability, distribution)? What policy reforms could be introduced to overcome these constraints in urban centers supplied by Buffer Zone resources? Could special policies be implemented to help wean Buffer Area industries and urban populations away from fuelwood use?

2. **Alternative Employment in the Buffer Area**. Even under the most optimal conditions of sustainable increases in yields of fuelwood, fodder, timber, and non-wood forest products from Buffer Area resources, it is unlikely that such production will meet the long-term needs of an expanding population in this zone. Alternative income generating strategies will have to be developed within the Buffer Area which are environmentally benign--such as eco-tourism and germ-plasm collection, or which provide significant elements of the labor force with employment outside the Buffer Area System.

   > What are the opportunities for low-impact, income-generating activities based on the presence of a park or sanctuary in the area? What policies would have to be enforced to ensure that income/benefits generated from these industries (e.g., park entrance fees, taxes on the tourist industry, employment in the tourism services sector or in park management functions) would flow to neighboring communities as compensation for restricted access to park resources?

> How could a system of royalties paid by industry, foreign interests or the conservation community be put in place to compensate area residents for the cost of germ plasm conservation?

> Could Buffer Area residents (particularly marginalized groups) receive special preference in the recruitment of labor and in the siting of industry under government approved development schemes?

3. **Formal Arrangements Whereby Communities Can Become Directly Involved in Restoring Productivity to Degraded Buffer Zone Systems, and Reaping the Benefits on a Continuous, Profit-Sharing Basis.** Buffer zone eco-restoration and eco-development cannot be sustained without the broad-based support of area residents. An appropriate incentive structure must be set in place to attract the support of local interest groups and to ensure their commitment to sustainable use practices.

> What are the legal constraints, if any, to direct involvement by communities/eligible interest groups in the rehabilitation and management of degraded Forest Lands, on which their livelihood has traditionally depended? Where ambiguities in the law exist, as in the Amended Forest Conservation Act of 1980, what are the arguments for and against a positive interpretation of the Act by the Ministry of Environment and Forests in favor of joint management of these degraded lands by state Forest Departments and communities?

In considering policy formulations that would enhance popular participation in eco-restoration efforts, special attention should be given to the following:

> the nature of formal arrangements (i.e., contractual or otherwise) between communities and the Forest Department;
> formulas for benefit distribution;
> formulas for sustainable harvesting techniques and resource management;
> legal protection of community usufruct rights and enforcement of exclusive access to circumscribed areas of the Buffer Zone by contiguous communities;
> establishment of an impartial means for mediating disputes over protected area resource use (e.g., between community groups or individuals and

industry, the Forest Department, etc.) which can function outside the formal legal structure

4. **A Pluralistic Management Authority for the Buffer Area.** Protected areas cannot be managed in isolation from their surroundings. A systems approach to management of the preserve and the area around it, which are linked ecologically, socioeconomically, and politically, must form the basis for any ecodevelopment plans (see ANNEX 5).

In view of the diverse and often conflicting interest groups in the target area, alternative arrangements to the current management hierarchy dominated by the Forest Department need to be considered. Ideally, such arrangements would allow broad representation of interests, and participation in management decisions by the major interest groups.

An example of such an option is illustrated in Figure 4. Here, a Buffer Area Authority, empowered by the state, has administrative jurisdiction over the Buffer Zone and surrounding population centers. This Authority consists of a governing council which functions at the district level, and a local buffer zone management committee, which functions at the village level. The governing council, in the case of a Project Tiger Reserve, might include the following members: Park Director or designee, Social Forester, Rural Development Officer, one representative each of the tourist industry and the amalgam of other industries in the area, and a representative of each of the major functional categories of villagers, i.e., farmer, herder and laborer, drawn from the surrounding communities.

The mandate of this district level body could be the following:

- Review and coordinate development plans for the Buffer Area
- Create accountability for public and private sector programs
- Arbitrate resource use conflicts
- Negotiate with State and GOI on development of alternative employment opportunities for Buffer Area residents
- Set policies for protected area use (e.g., research, selective germ plasm harvesting, and eco-tourism in the core; usufruct rights, environmental education, outreach and

ecorestoration demonstration in the buffer zone), consistent with existing laws governing use of ecological preserves (e.g., national parks, reserves).

At the village level, the Buffer Zone Management Committee would serve to operationalize policies formulated at the district level and to specifically oversee restoration and management of discrete areas of buffer zone contiguous with the village in question. The Committee might consist of the Park Director's designee, the Social Forester, the Agricultural extension agent responsible for animal husbandry, and an equivalent number of elected villagers to balance the committee power structure. The responsibilities of the Committee would include:

- establishing the basis for exclusive village access to and responsibility for sustained yield management of neighboring portion of the buffer zone;
- obtaining both technical and financial assistance from available research and funding programs to implement eco-restoration programs on buffer zone and common lands;
- obtaining access to animal husbandry programs for stock and fodder improvement.

In this scenario, NGO's could serve to link the two administrative units of the Buffer Area Authority through information dissemination about policies and programs developed at the district level, mobilizing community action groups, creating environmental awareness and community support for park protection and the flow of benefits to the community, and help in mediating conflict between different interest groups.

Key questions the fora might consider would be:

> Is such a pluralistic scheme desirable or realistic?

> What institutional arrangements at the GOI, state, district and village levels would have to be made to operationalize this type of scheme?

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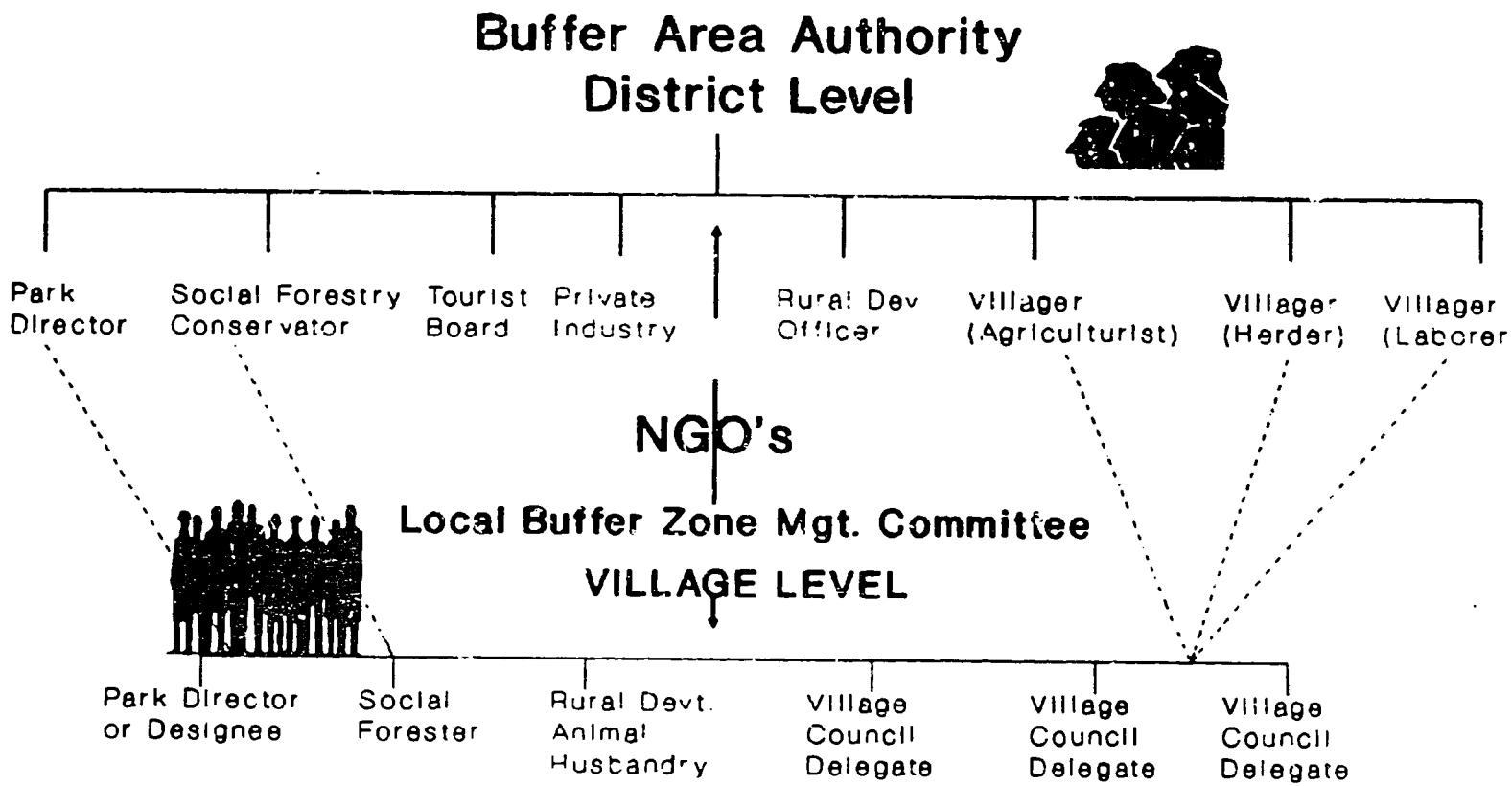
- Reviews & Coordinates development plans for Buffer Area
- Creates Accountability in Public & Private Sector Programs
- Investigates Alternative Employment Opportunities
- Arbitrates Resource Use Conflicts
- Sets Policy for Protected Area Use



- Establishes exclusive rights & responsibilities for B.Z. parcel mgt.
- Accesses T.A. from adaptive research programs for ecorestoration of common land & B.Z.
- Accesses Animal Husbandry Programs

NGO INTERMEDIARY ASSISTANCE
- Environmental Education
- Social Organization & Political Wi
- Access to Social Services
  - - - family planning & public health
  - - - rural employment program
  - - - literacy
  - - - credit

Figure 4

B. OPERATIONAL LEVEL

Although discrete policy changes related to questions of joint management of natural resources by user groups and public officials promise the greatest returns on investment for restoring productivity to degraded public lands, there are a number of activities on the ground that can enhance this process, pending resolution of key policy constraints. Some strategic interventions are listed below:

1. Based in part on the systems data gathered for modeling the Ranthambore Buffer Zone Systems (see Annex 5), develop Geographic Informations Systems for the Ranthambore Tiger Reserve and surrounding buffer area where eco-development plans are scheduled to come on line. Identify another Project Tiger site with similar characteristics and plans to serve as a control. Using GIS to focus, modify and evaluate alternative management interventions in the former, monitor the management efficiency and success in operationalizing eco-development plans at each site. To develop the GIS, include information on:

   > History of change in the park ecosystem over time, including change in biomass productivity, species diversity, ground water recharge, surface water runoff, microclimate, etc.
   > Areas of degradation within the Protected Area System
   > Available Landsat or Spot imagery to quantify changes in forest cover, including quality of vegetation and canopy characteristics
   > Changes in human and livestock populations in the buffer area over time
   > Fuelwood use and centers of supply and demand
   > Alternative energy sources in the buffer area
   > Human demography according to employment, caste, landholdings, etc.
   > Major agricultural markets and sources of non-land based employment in the area

2. In the communities bordering Hingolgadh Sanctuary, where the population is estimated at under 10,000, carry out rapid rural appraisal using the participatory approach (PRA) developed in conjunction with the National Environment Secretariat in Nairobi, Clark University, IIED and WRI, or other field-tested methodologies for agro-ecosystems analysis. The village microplans emerging from this community-derived appraisal of natural resource management issues can serve as a blueprint for eco-restoration of the Hingolgadh system.

3. Support establishment of a small research station at both Hingolgadh and Ranthambore to carry out applied research on restoration technologies currently available for use. The objective of these field stations would be to:

   - adapt generic technologies for soil and water conservation, improved fuelwood and fodder productivity, range management, livestock breeding, water harvesting and irrigation, etc., to the range of specific conditions found at each site

   - experiment with various combinations of tree, shrub and grass species under different conditions of soil moisture, texture, depth, fertility and slope to optimize yields of biomass, fruit, wood and non-wood products to farmers

   - standardize conditions under which research is carried out--e.g., on-farm or in controlled exclosures--for accurate analysis and comparison with data obtained from other research facilities off-site, e.g., CAZRI, ICRISAT, Range Management Institute in Jhansi.

   - monitor, analyse and disseminate results locally to farmers, park managers and social foresters, as well as through research networks, NGOs, technical journals and the media

4. Support grass roots NGO efforts at the Hingolgadh and Ranthambore sites to empower local groups, with special focus on women and maldari herdsmen, through education, social organization, and access to development resources, to manage common property resources for maximum sustainable yields. Encourage role of NGO's as local intermediaries in establishing a dialogue between Park Management and subsistence user groups in neigboring communities.

The above activities could be implemented under a grant, perhaps entitled, "Eco-development of Protected Area Systems," awarded to an appropriate NGO. Such an NGO would ideally have on the ground capability to work with local groups in the target areas, as well as links to the international conservation community. Specific activities under the grant might also be sub-contracted to other NGO's with technical capabilities in Rapid Rural Appraisal, GIS and Eco-restoration.

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ANNEXES

ANNEX 1

VEGETATION OF THE HINGOLGADH AREA

PART I. A PARTIAL LIST OF WOODY PERENNIAL VEGETATION

SPECIES (LOCAL NAME) *	FAMILY	COMMENTS *
Abutilon indicum (khapat)	Malvaceae	shrub, lvs. and fls. for boil treatment
Acacia farnesiana (tal-baval)	Fabaceae(mim)	bark and wood used for tanning; hedge planted
Acacia leucophloea (harmo-baval)	Fabaceae(mim)	wood for ag. tools; fuel
Acacia nilotica (okhai-baval, deshi-baval)	Fabaceae(mim)	multiple use wood; bark for tanning; gum for medicine; pods for goats, sheep, and cattle
Acacia senegal (gorad)	Fabaceae(mim)	Rp 40-80/kg for gum
Aegle marmelos (bili)	Rutaceae	leaf used in Shiva worship; fruit taken as laxative
Asparagus racemosus (ekal kanto)	Asparagaceae	scandant shrub; root for tonic & dysentery treatment
Azadirachta indica (limdo, limda)	Meliaceae	multiple uses; fuel
Bauhinia racemosa (asintro,jinj)	Fabaceae (caesal)	lvs. for "bidi" making
Butea monosperma (cackra)	Fabaceae (faboid)	lac making; dye source
Calotropis procera (akdo)	Asclepia-daceae	shrub; fine fiber from stems; pillow stuffing from fruit floss; sap for removal of splinters
Cassia auriculata (awal)	Fabaceae (caesal)	bark used for tanning
Cassia fistula (garmado)	Fabaceae (caesal)	fruit pulp as purgative; bark for tanning

Commiphora wightii (gugal)	Burseraceae	gum for incense; joint & arthritis treatment (trees formerly tapped by acid injection, causing mortality); planted from cuttings; goats eat the leaves
Cordia dichotoma (gundi/gunda)	Verbenaceae	fruits for Indian pickle
Delonix elata (sendesera)	Fabaceae (caesal)	lvs. taken with milk for leg pain; fallen lvs. eaten by cows & goats; wood stems still green 6 months after cutting, thus, high survival rate
Dolichandrone atrovirens (padri)	Bignoniaceae	structural timber
Euphorbia neriifolia (thor)	Euphorbiaceae	animal fencing; hedges; fuel
Euphorbia tirucalli (kharsani)	Euphorbiaceae	hedges; charcoal for fireworks making
Ficus religiosa (pipro, piplo)	Moraceae	roots for cough trmt; bark for skin irritation
Ficus racemosa (humro)	Moraceae	edible fruit
Grewia damine (sisoti)	Tiliaceae	ripe fruits edible
Grewia tenax (gangeti)	Tiliaceae	ripe fruits edible
Maerua oblongifolia (dudhiyo)	Capparidaceae	climbing shrub; grows in hedges; root for tonic
Maytenus emarginata (vikro,viklo)	Celastraceae	jaundice treatment
Moringa olifera (saragwa'o)	Moringaceae	multiple uses; fruits edible; many medicines; "drumstick" pod fruit
Opuntia elatior (hathlo thor)	Cactaceae	living fences
Phoenix sylvestris (kalela, kejur)	Palmaceae	small yellow dates; toddy; jelly
Pongamia pinnata (karanj)	Fabaceae (faboid)	seed for non-edible oil (soap) - "karanj soap"
Prosopis juliflora (gando-baval)	Fabaceae(mim)	charcoal

Pueraria tuberosa (fagdano velo)	Fabaceae (faboid)	climber; tubers and lvs. for urinary illnesses
Securinega xirosa (thumbri)	Euphorbiaceae	shrub; obovate lvs; wood for agricultural tools
Syzygium cumini (jambo)	Myrtaceae	wood for agricultural tools; edible fruit
Tamarindus indica (amli,ambli)	Fabaceae (caesal)	multiple use wood; bark for tanning; tender lvs. & fls. eaten; decoction of bark for diarrhea; pulp of fruit eaten; seeds rich in pectin
Tecomella undulata (ragat rohido)	Bignoniaceae	bark for skin diseases; decoction for anti-swelling treatment
Zizyphus mauritiana (bordi,ber)	Rhamnaceae	valuable edible fruit, thus grafting common; wood for ag. tools, furniture, wheel spokes

(butuckani)	vine, goat forage, ornamental uses
(sampilo)	fallen lvs. eaten by nilgai and cows; stump sprouts
(juien)	vine, sweet, small white fls.
(ranarudi)	"lady finger" tree, pods eaten by kids, cooked vegetable
(kashelo)	MOST COMMONLY USED FUELWOOD IN THE HINGOLGADH AREA; fruits
(kasheli)	tree
(ma'dita)	wood used for making mill stone handles
(andrjo)	tree, pods used for human worm treatment

ANNEX 1 (Cont.)

PART II. PARTIAL LIST OF HERBACEOUS PLANTS

Aristida adscensionis (lapdu)	mediocre forage quality; abundant
Cenchrus ciliaris (butedi)	planted; high forage quality; perennial bunch grass; dry open sandy sites
Cynodon daccylon (daro)	creeping grass used as lawn cover
Desmodium gangeticum (sameru)	high forage quality; seeds for cattle; planted; grows naturally in hedges
Dicanthium annulatum (jinjewo)	excellent forage quality, perennial bunch grass; water logged sites on black soils (vertisols); canal margins; common use as green fodder
Hydropogon contortus (ratu'd, cagediu)	excellent forage quality, found esp. in Saurashtra; productive on stony sites
Indigofera glandulosa (vekario)	good forage quality; all plant parts edible
Sehima nervosum (shaniyar)	excellent forage quality, found esp. in Saurashtra
Sorghum halepense (baru)	good forage quality; stout grass; grows along canals/streams; actively reseeded
(gawnlu)	excellent forage quality; good for hay-making
(kaliwu)	
(putia)	spiked grass, palatable when young and green
(samo)	
(shino)	

ANNEX 1 (Cont.)

PART III. LIST OF TREES PRESENTLY PLANTED IN HINGLOGADH AREA AGROFORESTRY PROGRAMS

Acacia nilotica (deshi-baval)	multiple use
Acacia tortellis (Israeli-baval)	multiple use
Acacia auriculiformis (bengali-baval)	multiple use
Adansonia digitata (goras amli)	fruits edible
Azadirachta indica (limda)	multiple use
Butea monosperma (khakhra)	dye source
Cassia fistula (garmado)	bark for tanning, fruit pulp used as a purgative
Citrus sp. (limbu)	fruits edible
Commiphora wightii (gugal)	multiple use gum, goats eat lvs.
Delonix regia (gulmohar)	ornamental tree
Ficus religiosa (pipro,piplo)	multiple use
Leucaena leucocephala (subabul)	multiple use
Manilkara sapota (chiku)	fruits edible
Prosopis juliflora(gando-baval)	charcoal, fuelwood, goats eat pods
Psidium guajava (jamphali)	fruits edible
Punica granatum (dadam, pommegranate)	fruits edible
Sesbania aegyptica (shevari)	multiple use
Syzygium cumini (jambu)	fruits edible
Tamarindus indica (amli)	multiple use

ANNEX 1 (Cont.)

PART IV. LIST OF GRASSES PRESENTLY PLANTED IN HINGOLGADH AREA PASTURE PROGRAMS

Cenchrus ciliaris (angan, dhaman)

Cenchrus setigerus (angan, dhaman)

Dendrocalamus sp. (vaans)

Napier bajra-21 (elephant/hathi grass)

Panicum antidolate (blue panicum) exotic species

Stylosanthes hamata

Stylosanthes scabra

* Identification of many of the above species was derived from common names obtained from local informants, which were then matched with the scientific names for each species by consulting the Forest Flora of Gujarat State, by R.I. Patel, 1984. Forest Department, Gujarat State, Baroda. Printed at the Government Press, Baroda.

ANNEX 2

PARTIAL LIST OF VEGETATION COMMON IN THE RANTHAMBORE PARK BUFFER ZONE

SPECIES (LOCAL NAME) *	FAMILY	COMMENTS *
Acacia leucophloea (reonj)	Fabaceae(mim)	woodfuel, fodder; COMMON IN BUFFER
Acacia nilotica (babul)	Fabaceae(mim)	multiple use; COMMON IN BUFFER
Adhatoda vasica (arusa)	Acanthaceae	roof thatch to support roof tiles; cough trmt; shrub; COMMON IN BUFFER
Anogueissus pendula (dhok)	Combretaceae	lvs. for goat fodder; fuelwood; staffs
Azadirachta indica (neem)	Meliaceae	multiple use; fuelwood; lvs. for blood purification
Balanites aegyptica (hingot)	Balanitaceae	fruit pulp used for washing silk and for goat food; COMMON IN BUFFER
Bauhinia racemosa (jhinjha)	Fabaceae (caesal)	edible fruits; fuelwood; goats eat lvs; COMMON IN BUFFER
Butea monosperma (chhola/choli)	Fabaceae (faboid)	glue from tapping bole
Cassia fistula (amaltes)	Fabaceae (caesal)	mixing medium in medicine making
Cenchrus setigerus (neenjna)	Poaceae	forage; grass; PLANTED IN NATIONAL SOCIAL FORESTRY PROGRAM
Commiphora wightii (gugal)	Burseraceae	joint/arthritis trmt.
Dicanthium annulatum (jinjewo)	Poaceae	hardy bunch grass; PLANTED IN OCF SOCIAL FORESTRY PROGRAM

Dichrostachys cinerea (goyakhair)	Fabaceae(mim)	roof thatch material to support roof tiles; COMMON IN BUFFER
Diospyros cordifolia (bastendu)	Ebenaceae	fruit pulp + salt for loss of cattle appetite; COMMON IN BUFFER
Emblica officianalis (aonla)	Euphorbiaceae	general health promoter
Manilkara hexandra (khirni)	Sapotaceae	small edible fruits; wood for tool handles
Phoenix sylvestris (khajur)	Arecaceae	edible fruits; rope fiber; toddy tapping
Prosopis cineraria (khejeri)	Fabaceae(mim)	woodfuel; COMMON IN PARTS OF BUFFER
Salvadora oleoides (pilu)	Salvadoraceae	ripe fruits as laxative; seed oil for rheumatism
Sehima nervosum (shaniyar)	Poaceae	PLANTED IN NATIONAL SOCIAL FORESTRY PROGRAM
Sterculia urens (kadaya)	Sterculiaceae	"gum kadaya" used by textile industry
Stylosanthes hamata	Fabaceae	PLANTED IN NATIONAL SOCIAL FORESTRY PROGRAM
Tamarindus indica (imli)	Fabaceae (caesal)	multiple use; edible fruit
Terminalia balerica (bahera)	Combretaceae	stomach ailments
Zisyphus mauritiana (ber)	Rhamnaceae	cattle fodder; woodfuel; COMMON IN BUFFER
(moruwa)		unknown shrub; COMMON IN BUFFER

* Identification of many of the above species was derived from common names obtained from local informants, which were then matched with the scientific names for each species by consulting the Forest Flora of Gujarat State, by R.I. Patel, 1984. Forest Department, Gujarat State, Baroda. Printed at the Government Press, Baroda

ANNEX 3

SUGGESTIONS FOR FUTURE DEVELOPMENT ACTIVITIES IN THE HINGOLGADH AREA

Donald Flickinger

PART I. CENTER FOR ENVIRONMENTAL EDUCATION (CEE)

The suggestions in this annex are provided as practical examples of operational programs that might figure in buffer area ecodevelopment efforts generally. They are also meant to offer tangible support to the Center for Environmental Education's on-going development extension work.

1) To follow up on the "smokeless chula" program, CEE could undertake heat utilization studies of a number of stove designs, including the CEDA (Gujarat Energy Development Agency) smokeless chula with a 3-4 meter chimney. Such studies are the only way to quantitatively prove the superior efficiency of one stove design over another, given a specific testing procedure. CEE Hingolgadh staff have been briefed about how such heat utilization studies are structured. Further information about stove design, testing, and dissemination can be obtained by contacting: ITDG (Intermediate Technology Development Group) Stoves Project, c/o ITDG Power Unit, Reading University, Reading, England; or Approvecho Institute, c/o 80574 Hazelton Road, Cottage Grove, Oregon 97424 (USA) Attn: Stoves Program.

Both of these groups have developed approaches for working with stove users (i.e. village women) in the design of stoves to suit their particular cooking needs. Both groups have also developed standardized heat utilization testing methods that could be easily adapted to the Hingolgadh area. And both groups publish newletters, the back issues of which CEE Hingolgadh staff would find most relevant and interesting.

2) The successful organization of the "gram van" or village-level tree planting on Lalavadar common land by the women's proto "mandal (societies)" indicates significant CEE progress in promoting ecodevelopment there. What has been learned during the 1989 monsoon planting can serve as a guide to future revisions in managing such afforestation efforts. To increase survival and fast growth of transplanted seedlings, several changes in technique could be tried.

- Pit size for each seedling could be increased from the present 30 cm X 30 cm X 30 cm to a maximum of 1 meter^3.

This would insure that tree growth is not arrested two years after transplantation.

- Pit soil could be amended to increase fertility and soil moisture retention. A suggested pit soil mix would be: 5 parts "black soil" (vertisols) excavated from the surrounding common land, 3 parts pit soil (taken from each excavated pit), 0.5 parts dung, 0.5 parts decomposed organic matter (compost), and 1 part unconsolidated sand (to keep the "black soil" from cracking apart as it dries).

CEE could experiment with a number of such mixes during the dry season, to determine which mixes retain moisture the longest. Equal weights of different pit soil mixes could be placed in wooden boxes (with perforated bottoms) out in the sun. Equal weights of water could be poured into each box to completely saturate each pit soil mix. After 2-4 days (or longer) the pit soil mix in each box could be weighted to determine which mix retains moisture the longest. The best mix would allow seedlings to use limited water (only three waterings, every 15 days, are presently given after transplantation) most effectively. Pits could also be covered with ceramic pot sherds or organic material to reduce evaporation losses.

3) Since school children are to be included in tree planting and maintenance activities, a source of water should be made available to them specifically for taking care of tree seedlings. One way to do this would be the construction of a 9-10 meter^3 bamboo cement rainwater catchment tank next to the school. Bamboo is available in both the Jasdan and Vichia markets. There is even one family that sells bamboo in nearby Gondala Village. The price is approximately Rp.1 per foot of bamboo. Complete information on how to train villagers (and yourself!) in bamboo cement tank construction can be obtained in English from: Yayasan Dian Desa, Kotak Pos 19, Bulaksumur, Yogyakarta, DIY, Indonesia (Attn: Publications/TARIK Section).

It would be wise to construct a mini-sized (2-3 meter^3) bamboo cement tank first on CEE property, to get familiar with this simple and highly transferable technology. Well digging is also possible, but may not be cost effective, given the limited financial resources of the women's group and the modest water requirements of the tree seedlings. Panchayat funds could perhaps, someday, support the digging of a well specifically for women's tree planting activities on village common lands.

4) In many respects, the key to CEE's success in ecodevelopment in the six villages surrounding Ningolgadh rests on its ability to work with the Rabari and Bharwad grazing castes (Maldaris). The February 6-8, 1990 CEE-NEAC (National Environmental Awareness Campaign) sponsored Maldari workshop in Amrapur Village presents a number of new opportunities for involvement with these groups.

Further CEE-sponsored field trips for community volunteers to see Maldari organizational efforts in communitites outside the Hingolgadh area can inspire local Maldari initiatives. Likewise, inviting Maldaris who have been successful outside the Hingolgadh area back to their native communities as information resources and role models can serve to motivate their brothers and sisters back home.

Mayabhai's (Bharwad) apparent enthusiasm to plant trees on Bhoinra "karabo" (community wasteland) in 1990 will be a test case in Maldari organizing and Bhoinra Village's (56% of which is Koli -agricultural caste (VIKSAT-CEE, 1990)) reaction to it. CEE will be better able to decide how to proceed with its Maldari-oriented programs after this Bhoinra test case occurs. If social fences or even exclosures can be instituted on Bhoinra common land, then range restoration demonstrations using high forage quality grasses can be started. Existing Maldari caste structures, such as the Rabari Milk Producer's Cooperative in Amrapur, may be tapped in the expansion of tree planting and range improvement programs on community lands. This process will require time, and patient persistence on the part of CEE in supporting Maldari initiatives.

An area of special research interest might involve grazing agreements between Bharwads migrating with their herds, and sedentary Bharwads residing in villages through which their migrating ethnic brothers and sisters pass. Not much is presently known about such arrangements.

ANNEX 3 (Cont.)

PART II. SUGGESTIONS FOR THE GEER FOUNDATION

Primarily mandated to protect and rehabilitate the 7 km2 relict scrub forest found within Hingolgadh Nature Education Park, the GEER Foundation is also responsible for management of a multi-faceted nature education program, and ecodevelopment outreach activities in the six villages that surround Hingolgadh Park. Yet long-range management strategies and internal, institutional structures to carry out this work need to be more clearly defined and sustained.

Future Hingolgadh Park management could be divided into three types of activities:

1) day to day park protection, management of nature camps, maintenance of the physical plant, and park administration;
2) applied ecological restoration research and rehabilitation monitoring activities;
3) community outreach and ecodevelopment programs in villages surrounding the park using park research plots as demonstrations of restoration techniques.

Most of GEER Foundation's resources are presently allocated to daily park protection and maintenance, such as catching illegally grazing livestock, repairing the perimeter rock wall, hosting nature camps, absorbing local labor in drought relief public works employment, maintenance of soil cultivation around naturally regenerating seedlings, etc. While there are several ecological restoration management efforts under way, GEER staff need to have a formalized, park-wide research framework by which these efforts can be prioritized and implemented.

With the aid of large-scale aerial photographs in stereo pairs (which are available from 1984 and perhaps earlier as well) hillsides and gullies requiring most immediate soil conservation measures could be quickly identified. Selection and application of "gradonies" (indirect contour terracing using bunch grasses and trees), staggered box trenching, hillside check dams, and nala bunding (contoured ditch and terrace lines) to specific hillside and gulley sites would permit GEER personnel to match its soil and water conservation strategies to site requirements on a park-wide basis. Quantitative monitoring of surface soil erosion and vegetation recovery rates associated with each strategy could be measured over several monsoon seasons, and then compared to the implementation cost of each strategy. Selection of vegetation and/or rockwork structures to be used would also be contingent upon maintaining sufficient corridors for wildlife movement, cover, and access to water and food. A combination of

Cenchrus setigerus and Commiphora wightii planting is presently being tried along gradony contours. This holds much promise, since both of these species are utilized by domestic livestock and wildlife. It is clear that long-term survival of Hingolgadh's woodlands can only be assured by comprehensive, sustained soil and water conservation techniques. The fate of several river drainages, and associated ground water resources, that originate within park boundaries also rests on the successful restoration of Hingolgadh's woodlands and forests.

Demonstration/Research exclosures could be set up inside the park using present trenching techniques, noxious living fences (e.g. Euphorbia neriifolia), or perhaps using 1/8" suspended, steel cable-deer fencing. Such cable is strung between tree stems using "come-along" hand winches (using rubber hose collars to protect tree cambium) approximately three meters above ground level, while deer fencing is suspended from it and staked into the ground. Cable fencing is quickly installed, easily moved, and inexpensive. Cable and wide mesh deer fencing costs in India need to be assessed. These exclosures would then serve as research plots. Both natural regeneration and reseeded/replanted plot vegetation recovery rates could be monitored continuously on a surface coverage and biomass productivity (dry weight) basis. A wide variety of native species (N.B. ANNEX 1: A Partial List of Woody Perennial Vegetation Common to the Hingolgadh Area) could be planted in different combinations and spatial orientations within these plot exclosures. GEER staff already have a good start in this work. The tangible evidence of recovery processes in these plots would constantly demonstrate what is possible to villagers when they visit the park to collect cut grass, work on drought relief public works projects, or attend nature education camps.

Forage production plots and watering holes specifically intended for the use of park wildlife have been undertaken, and could be expanded. There is apparently a need for a wider physical distribution of watering sites than presently exists. These activties will reduce crop damage caused by wildlife (esp. bluebulls) in surrounding village agricultural fields, while maintaining the health of wild park animals. Recurrent inventories of park wildlife populations based on transect sampling of scat, intensity of browsing/foraging on selected vegetation, actual counts, etc. would indicate how populations were responding to increased availability of food and water.

The quantitative effects of GEER's soil working techniques (i.e. cultivation around stems and mulching) around naturally regenerating woody plants needs to be systematically compared to untreated naturally regenerating plants of the same species. A number of low-cost/no-cost, alternative soil working techniques could also be tried for comparative purposes; including the use of soil amendments such as dung and organic matter, and ceramic

pot sherd and/or organic surface mulching to reduce evaporative soil moisture losses. Natural regeneration rates could also be assessed on a species basis, to identify flora that is progressively disappearing from the existing assemblage of Hingolgadh plants.

Drought area relief public works employment projects within the park (e.g., rock work check dam construction) are an ideal opportunity to employ soil and water conservation techniques that villagers can adapt and use on their own lands after returning home. Learning indirect contour terracing, box trenching, tree nurseries management, and tree transplantation techniques can all be easily transferred from park lands to village lands by trained villagers themselves.

A few motivated village volunteers could be provided with a daily wage from GEER Foundation as extensionists, to insure that techniques learned in the park are being applied correctly in the villages outside. These extensionists could be involved in identifying village common lands (gaucher) that are socially and ecologically the best candidates for successful demonstrations of restoration techniques. They would also serve as a bridge of sustained communication and exchange between park staff and the six surrounding villages. Finally, these extensionists, and those villagers who presently assist park cattle guards in exchange for wages, could serve as a point of departure in forming a park information and planning committee that includes village representation. Such a committee would help in mitigating misunderstandings and tensions between park personnel and villagers before they get out of hand.

It is important to note that only by having a coherent, long term park-wide restoration plan can park staff effectively absorb and utilize the huge labor resources that they command during times of extreme drought. The GEER Foundation should assume and expect that drought conditions will, sooner or later, arise again, forcing park staff to create mass employment for village people. If a park management plan is in place, such labor can be used rationally, in conformance with long-term park management objectives.

The executive management of the GEER Foundation can exercise many options in developing outside support for expanded program activities in Hingolgadh Nature Education Park. Assistance could be provided to both GEER Foundation board members and GEER's director in revising GEER's long-range management plan for Hingolgadh Park, and in finding the human, technical, and financial resources to put such a plan into practice.

ANNEX 4

SUGGESTIONS FOR FUTURE JAN KALYAN SHIKSHAN SAMITI DEVELOPMENT ACTIVITIES IN THE RANTHAMBORE AREA

Donald Flickinger

A. Key Elements of Successful Development Initiatives

1) Each activity must be clearly defined, to reduce the chance of confusion between targeted villagers who use park buffer areas and implementing organizations (e.g., Forestry Department (CCF) social forestry exclosures that are inevitably interpreted by villagers as closing buffer areas to their use forever).

2) All caste and socio-economic groups within a project area must be included as active participants in project planning and implementation. This is especially important for non-sedentary, grazing castes such as Gujurs.

3) The potential for suspicion among informal community leaders of "outsiders" must be minimized by building trust through a sustained presence in the community. (This is what Jan Kalyan Shikshan Samiti has been doing for two years in Khawa, Khandoj, Jagnaka Tapra, Mordungari, Padli, and also Ramsinghpura.)

4) The content of each development activity must serve as a common rallying point, requiring villagers to collectively face environmental problems, issues of social justice, and/or the detrimental impact of "third parties" (outsiders).

5) Information, technical inputs, and other resources associated with any development activity must be developed with the individual, village user/beneficiary in mind. Expensive, technically sophisticated, or large-scale inputs become barriers to progress of any activity. (This should be remembered when attention focuses on checkdam or andicut building and repair, soil preparation for range improvement, or the demarcation of exclosures for rotational range management.)

6) There must be strong individual incentive(s) associated with each development activity that answer the "what's in it for me" notion in villagers' minds.

7) Each development activity should be considered an opportunity to strengthen regular and sustained ties between villagers, government agencies implementing the activities, and facilitating/arbitrating organizations (often NGOs).

8) The impact(s) of each development activity must be reviewed every six to twelve months in qualitative and quantitative terms - to revise, augment or terminate the activity as may be necessary.

9) If a development activity is truly progressing, villagers will progressively embrace the notion that the maintenance of vigorous and productive forestlands is the key to their own survival and welfare. The growth of this kind of attitude is a good qualitative measure of development activity success.

B. Suggestions for Future Development Activities

1) A survey of the impact(s) of previous and existing afforestation programs that have been undertaken in the Ranthambore area could be done. Such information is invaluable in understanding what might maximize the possibility of future success in the area of social forestry. Survey elements could include: the nature and extent of local peoples' participation in these programs, the differential distribution of program benefits (fuel, fodder, etc.) to different socio-cultural groups affected by the program, cost-benefit analysis of program inputs versus products generated, the impact of these programs on site productivity, soil and water conservation, indices of biodiversity, and finally, whether each afforestation program actually seems to be reducing use pressure on resources within the neighboring national park. Survey sites could include:

- the greater Khandar region, where Prosopis juliflora has been occupying increasingly large tracts of the park buffer for years. Surrounding communities appear to have mixed feelings concerned the arrival of this exotic species;

- the Amli/Neemli region, where there is a two-year old CCF Social Forestry Wing buffer zone and park boundary effort that includes two 100 hectare mixed species tree planting plots (1100 trees per hectare), two 100 hectare range seeding and improvement plots (100 trees per hectare), and hillside "dhok forest"(Anogueissus pendula) exclosures that rely on natural regeneration from dhok coppicing. How neighboring villagers feel about these exclosures, and more importantly, the nature of their involvement in undertaking these social forestry activities needs to be clarified;

- the Ramsinghpura region, where CCF Social Forestry Wing activities similar to those in Amli/Neemli are to begin in 1990. There is much suspicion among local villagers about the intent of these activities, and whether they stand to lose access to precious buffer lands in the process.

The results of this survey should be shared with the Ranthambore District CCF Social Forestry Wing staff, as a way to show Jan Kalyan Shikshan Samiti's commitment to support and improve CCF social forestry activities. Jan Kalyan Shikshan Samiti might then be in a position to assist the Social Forestry Wing in working with Ramsinghpura villagers during the 1990-91 season.

2) Jan Kalyan Shikshan Samiti community tree planting and afforestation efforts could be divided into two parts: fruit and medicinal tree species planting on private land close to individual households; and multiple-use tree species planting on private agricultural lands, available commons (gaucher), and in the park buffer area. Tree species could be quantitatively prioritized according to their usefulness for specific project/village areas (i.e. more fuelwood production, more browse production, both fuelwood and browse production, timber production, open canopied species that permit forage production, species producing products having cash value in the marketplace, etc.).

Tree planting plans could be developed with individual villagers and with groups to select planting sites, size of site(s), species mixes (a list of candidate native species and their uses has been given to the director of Jan Kalyan Shikshan Samiti), responsibility for nursery management, seedling transplantation and maintenance, site protection after outplanting (including damage caused by park wildlife), etc. Pit preparation techniques, including pit size and soil amendments, would be training techniques critical to survival and acceptable growth of transplanted seedlings. Water conservation measures would be addressed by manipulating transplantation pit soil texture (especially in areas having excessively sandy or clayey soils), and providing for recurrent, inexpensive watering of seedlings.

Precedent indicates that if village commons, wastelands, and revenue lands are not turned to some productive use such as tree and grass planting, they may disappear to resettlement programs. (This has recently occurred in Rawal Village.) The importance of this kind of development activity cannot, therefore, be over-emphasized.

Jan Kalyan Shikshan Samiti could strengthen its formal contacts with: Mr. Sharad Joshi, c/o CECOEDECON, Shilki Dungari, Chaksu Block, Jaipur. His organization is gaining experience in dune stabilization and vegetation restoration work in Rajasthan, east of Jaipur. Taking Jan Kalyan community volunteers on field trips to see the work of CECOEDECON, "box trenching" being done in CCF project areas, or any other ecological restoration work presently being done in Rajasthan, could inspire similar efforts in the Ranthambore region.

Two other non-government eco-restoration resources in western India are: Kishore Saint, c/o Ubheswar Vikas Mandal, Udaipur, Rajasthan (eco-restoration work in Rajasthan's Aravalli Mountains); and Vitahal Bhai Patel, c/o High Density Plantations for Electric Energy Project; Surendrabag, Kardej Village, Bhavnagar, Gujarat (work focuses on plantation silviculture of Prosopis juliflora, Zisyphus sp., and Eucalyptus sp., stressing biomass production).

3) Jan Kalyan Shikshan Samitit could begin a series of simple, small-scale vegetation restoration experiments in village-determined exclosures that apply different forms of vegetation management (i.e. natural regeneration of "dhok" forests, seeding of native grass species such as Cenchrus spp., Dicanthium annulatum, Sehima nervosum, Stylosnathes hammata, etc.), using hand-cultivated ridges for grass seeding, and systematic pit planting of native tree seedlings. After one year, comparative biomass, browse, and/or forage productivity measurements could be made in the different treatment exclosures. In the longer term, different grazing regimes (i.e. rotational grazing, different grazing intensities, grazing by different animals, etc.) could be applied to different vegetation management exclosures while monitoring range condition and trend. The CCF District Social Foresty Wing could be notified of the methodologies used in this community-based research, and research results shared openly with CCF foresters.

4) Dryland agricultural training techniques could be formally transferred to villagers where Jan Kalyan Shikshan Samiti works by inviting the collaboration of training staff from the Central Arid Zone Research Institute (CAZRI), Jodhpur. Informal follow-up after such a dryland agricultural training course could become one of Jan Kalyan Shikshan Samiti's ongoing extension activities in its five active village project areas.

5) The issue of rotational management of buffer range areas (and village commons where they still exist) could be a topic to organize villagers with goat and cattle herds. In Padli Village, on the central western side of Ranthambore Park, there appears to be interest to form a "meeting" of grazing families. Such a coalition could decide how much land it could comfortably enclose and protect from uncontrolled grazing as a first step in range management. The social and ecological "demonstration value" of this would be invaluable. Jan Kalyan Shikshan Samiti could help catalyze the formation of this "meeting."

6) Any Jan Kalyan Shikshan Samiti involvement in dam maintenance, dam construction, or other surface water management efforts could be contingent upon an AFPRO commitment to permanently post technical field staff in the Ranthambore area to

work with Jan Kalyan Shikshan Samiti on a day-to-day basis. Any weaker AFPRO commitment than this might put Jan Kalyan in a sensitive position vis-a-vis the volatile socio-political issues tied to dam construction and maintenance. There are numerous examples of failed dam projects and bitter memories as to why these projects failed all around the perimeter of Ranthambore Park.

7) Jan Kalyan Shikshan Samiti could continue its functional literacy programs. New training materials developed for this program might include livestock management, veterinary extension resources locally available and how to use them, range management, dryland agriculture techniques, and silvicultural techniques associated with community tree planting efforts.

8) Efforts could be made to identify income generation activities that relieve stress on the park buffer and core areas, and assist villagers in obtaining training in such activities. Existing cottage industries, such as construction and firing of ceramic pots, could be supported by finding ways to grow stove fuelwood in the villages, close to where pots are fired.

9) Jan Kalyan Shikshan Samiti could continue to forge regular contacts between individual villages and park managment. Dialogue could be directed towards developing an informal agreement permitting limited village control over specific blocks of park buffer areas by designated hamlets, villages or groups of villages. This would foster the desire to protect such blocks among those villages involved (i.e. limited access leads to ecological maintenance of a commons). At the same time Jan Kalyan could also continue to assist villagers who must enter the legal system to defend their rights in conflicts over use of the buffer zone (i.e. loss of livestock, harrassment, physical injury, etc.).

10) A search could begin to find a female extension worker to join the Jan Kalyan Shikshan Samiti staff in its Ranthambore community development program. Ideally, such a person would be a native to the Sawai Madhopur region, have an educational background relevant to Jan Kalyan's work, enjoy working in a rural setting, and be flexible in terms of work schedule(s) if she has family responsibilities. "Feelers" could be put out immediately to begin the search for such a unique person.

ANNEX 5

METHODS USED IN MODELING THE RANTHAMBHORE BUFFER ZONE SYSTEM

Stephen Berwick
Ajith Kumar
B.K. Mishra

I. INTRODUCTION

Described below are the workshop and modeling which has been one feature of the Ranthambhore Buffer Zone analysis. We have omitted a description of the value and constraints of this planning tool, and refer readers to: Berwick and Faeth. 1990. Planning in the Dark: Illuminating Natural Resource Management using a System Approach (available from International Resources Group, Washington, D.C.); and Richmond, B. et al. 1988. STELLA users Guide (available from High Performance Systems Dartmouth, New Hampshire, USA).

The modeling team consisted of Drs. Ajith Kumar, B.K. Mishra and Stephen Berwick, Wildlife Institute of India (WII). The WII is currently using the same approach to help identify and prioritize research, analyze environmental impacts and plan ecodevelopment around India's National Parks and other protected areas. Ranthambhore has been a WII ecodevelopment research site for about 2 years and the contacts, insights, and data available from that effort have been very useful in this effort.

II. THE WORKSHOP

A fundamental tenet of our Integrated Planning Technology (IPT) approach to analyzing natural and human systems is the incorporation of the human residents of the system in the construction of a model of the system. Not only is the model informed by knowledge which is often eccentric and site-specific, but corporate construction increases the likelihood of enhancing understanding among the participants of their empirical as well as personal views. The vehicle for eliciting the mental models of the various concerned parties is the Project Systems Workshop. An IPT workshop fosters an interdisciplinary approach incorporating the various guilds and types of knowledge which reflect various sectors and elements of the system - the biologist, farmer, sociologist, economist, etc.

At Ranthambhore, a mutual facilitator elicited views from participants according to a structured, well tested protocol. This protocol provides the vehicle for a logical, sequential exposition of the system. Each step facilitates the next until the system is exposed in flow diagrams in enough detail so that

modeler/programmers can work on them and enhance them to a point where they can dictate the logic of equations describing the system. At this point the model can be encoded for computer simulations of its behavior over time (if various management interventions wish to be evaluated for their value and impacts). Alternatively the modelling process could end with a qualitative model whose products will point toward information needed for understanding and managing the system (from the variables identified), and provide participants with an enhanced understanding of the system and each other.

The protocol moves participants from the identification of their goals for the system (in the Ranthambhore case the buffer zone and adjacent core and outer multiple-use areas) to listing two-to-four problems they have encountered or could foresee in achieving each goal. Because of insufficient time (we usually run 1 1/2 to 2 days per workshop under the best circumstances - i.e. literacy, a common language, etc.), we omitted the next step in the protocol - developing three or four "key questions" to address each problem. It is a fairly straight forward step to move from key question to identifying the information required to answer the question. The data needs are thus classified into "stocks", "rates", or "variables" which can explain and define the rates. For example, if a goal is to enhance understanding between foresters and herdsmen, one problem could be demands for bribes. A key question could be which job categories of forester are most likely to ask for bribes. Stocks would include the number of forest guards, foresters, RFO's, etc.

The shift from problems to structure obscured much of the logic (e.g. from the problem of bribery to the structure of a job description) for participants, but was a necessary expedient given the time constraints. Once the structure was defined, the workshop participants developed the stocks, inputs and outflows to them, and the primary influences upon these flows.

The facilitators made every effort to elicit information and avoid imposing their own views, only prodding as participant inputs slowed or ceased.

III. MODELING

Post-workshop activities included:

> <u>reduction</u> <u>and</u> <u>transformation</u> of workshop sketches of variables and their relationships into flow diagrams suitable for coding. For example, at the workshop we noted that forage was consumed by wild herbivores. From that, we must explicitly model the process so that we can use algebra if we wish to simulate the process. The number of wild forage consumers is divided by the amount of forage to

derive food per capita which becomes the independent variable in a table by which consumption per day is derived with a curve of the relationship. Consumption/day/head, times the wildlife population yields a portion of the forage output rate (consumption). It must be rendered just this way in the flow diagram - i.e. the process must be depicted as well as the relationship;

> data collection is directed by the variables in the flow diagram. If the data are in a variety of units or scales they must be transformed to common units. We believe the data we need to run and debug the model do exist, but would require about one month to collect from sources all over India. Field inventories at Ranthambhore will be necessary to render the model adequately site-specific to be useful as a policy tester/planning instrument. That process would take a year or two. The model restricts and defines data requirements so that they are the minimal set able to address the goals and concerns of workshop participants. An initial prioritization of research activities can be generated by noting which of the variables lack data of acceptable quality;

> drawing the flow diagrams and defining the equations (logic) with STELLA (a simulations software package). Each required data input is then entered;

> testing and debugging each sub-model to achieve realistic equilibrium behavior. Introduce shocks to the system to check robustness (e.g. appropriate response and return to some equilibrium);

> communicating the results.

IV. APPLICATION OF THE MODEL

The applications of modeling for enhancing our understanding of the Ranthambhore system employ some of the reconnaissance methods of "rapid rural appraisal" (i.e. structured but quick assessment of concerns and a collection of data from residents and other sources) but is guided by the IPT workshop. The workshop is best viewed as offering pointers to direct research and development activities. These activities provide the understanding and information for a model, but would be enlightening even without model development. Both inventory and the kind of research which tests hypotheses to clarify system processes demand time and thought, particularly in the field where subjects are elusive and seasonal phenomena cannot be conveniently scheduled.

Therefore, the flow of insights and the application of the model for testing policies for the real system at Ranthambhore will be truly possible only after the process begun by our initial reconnaissance has produced the necessary data. A validation would also be useful.

The identification of these detailed data requirements are one very important product of our work to date. However, the modelling efforts have already produced broader, but no less useful "products".

The public nature of the workshop reduced the effects of personal bias or agendas each participant brought to it. It is difficult to subtly direct such a forum, or to dominate it, or fool it. As a guide to data collection, the model's data requirements drove the team members to collect a broad spectrum of information which would not have been gathered otherwise. Although one team member may have wished to count wildlife, another to pursue the issue of corruption's effects on constraining management of the buffer, they partially subsumed their diverse interests to gather the data required by a systems approach.

An additional outcome of the modelling exercise was that our NGO partner was exposed to a potentially useful approach to both land use planning and environmental mediation. The workshop is a vehicle for communication, because the protocol demands constant procession toward a physical as well as intellectual product. This type of dynamic guards against the danger of a community-oriented NGO becoming identified as an advocacy group rather than a mediator between local villagers and the Forest Department. In the hands of a skillful facilitator who projects an even-handed consideration of all participants and a strong-armed ability to keep them producing and progressing, the workshop can foster CEE/JTK goals. As shown when one of its principals become the facilitator, this role is very plausible.

Furthermore, we feel that NGO's themselves develop and use the model, which can facilitate their discussions with other parties such as government. The objectivity, data and graphic products have considerable power in policy dialogue.

V. MODEL DESCRIPTION

Before visiting Ranthambhore, the modelling team depicted their partially informed view of the system to focus pre- working data collection and to help structure their approach to the workshop and problems of the buffer zone. The original vision employed 24 state variables (or stocks). The post- workshop model employs 16 variables. The distillation involved

incorporating some original variables as converters under the remaining stocks (e.g. "government management" into "government activities"), dropping some stocks (e.g. predators, leisure time), and combining some (e.g. Wild grazers and browsers as "wild ungulates").

The working list of sub-models and stocks is shown in Table 1. As can be seen the educated guesses of the modelers include most of the workshop participants' insights (which are enumerated in parentheses next to the relevant stock).

Table 1 First Post-workshop list of stocks in Ranthambhore Buffer Zone Model.*

SUB-MODEL	STOCK VARIABLE (WORKSHOP VARIABLES)
I. Forage and Animals	Forage (Amount eaten, Production) Agricultural Crop Production (Crop Value) Core Wildlife Buffer Wildlife Livestock (Livestock Quality)
II. Social/Cultural	Tourism Conflict Level (Communication, controls, violence) Extension Education
III. Populations and Income	Agricultural crop production (Value) Agricultural and grazing families (population, wealthier segments) Other employment Government activities (level of regulation, obstructive structures, bribes) Cash/Debt/Liquidity

* 5 km zone from Core Boundary

A. Animal and Forage Sectors

1. Overview

For developing the simplest possible representation of the model for the Ranthambhore Buffer Area, we employ four stocks:

- CORE WILDLIFE POPULATIONS
- BUFFER WILDLIFE POPULATIONS
- BUFFER LIVESTOCK POPULATIONS, and
- FORAGE

This model is linked and largely driven by two stocks from other parts of the model:

- Crop production, and
- Human population

One additional input, precipitation, will significantly effect all of the stocks because it determines forage production, hence the viability of the animal populations which must consume the forage. Several useful accounting calculations are added to help assess the degree of overuse or excess resources available - i.e. the comparison of proper forage use with forage actually being consumed.

2. Description of structure

To walk through the model, begin with the central stock, <u>forage</u> (Figure 1). It has two inflows: (1) primary productivity (growth) and (2) agricultural residues which are a product of crop production, which is driven by precipitation. It is reduced by cutting and lopping related to fuel and fodder needs of the human population to which it is linked. It is also reduced by consumption by both wildlife and livestock. Note that the rate of consumption, like birth and death of stock and wildlife, is governed by a converter or auxiliary variable with a small tilde in the circle. This indicates that the rate is "informed" by a table of relationships. For example, the food per capita (independent variable on the x-axis) determines the consumption/day by a curve describing the relationship. STELLA plucks the value from the curve. As the flow diagram illustrates, forage consumption is simply the product of the number of stock and their forage consumption per day, plus the same for wildlife.

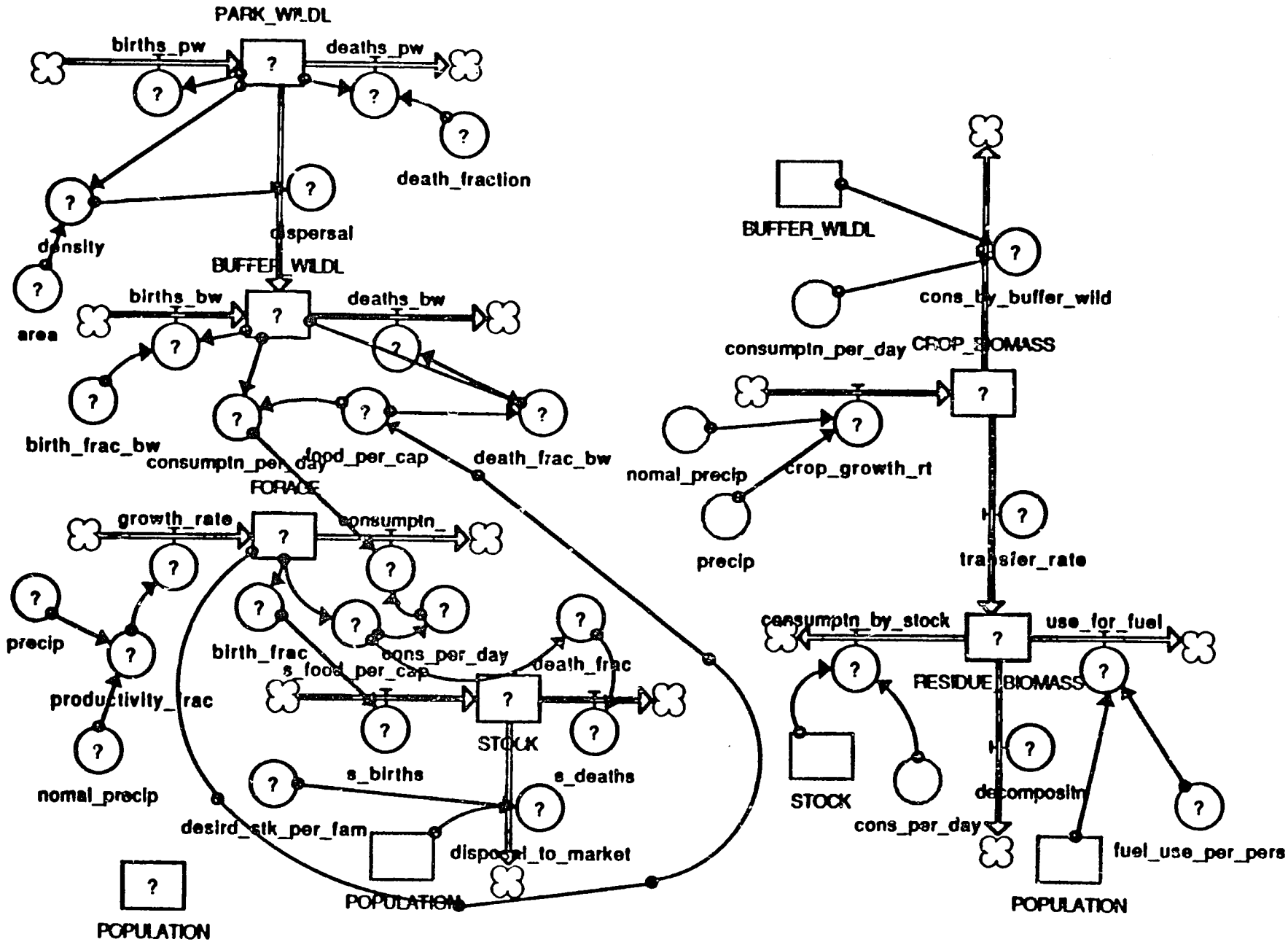

FIGURE 1: ANIMAL AND FORAGE SECTORS

Wildlife has two inputs and one source of loss. Animals disperse in the buffer from a very simple model of the core zone wildlife. The resident (or near-resident) wildlife also have young, as we noticed in the field. The populations are drained by deaths related to the amount of forage they can access and the number of animals using the forage. In this way, as for births, both wild and domestic animals are limited by density-dependent forage-related factors.

Livestock mirror the structure of the wild animals with the exceptions of no core animal input and an output called "disposal to market" which was revealed at the workshop. For the present, we have related the disposal rate to the number of stock which each family needs or desires, thereby linking this output with the human population portion of the model and its dynamics.

3. Status and Potential

As noted this first cut is a bit simpler than the inputs gleaned at the workshop would have implied. These models are built upon incrementally, after making sure that the early version is in equilibrium, doesn't misbehave (e.g., simulate negative numbers of wildlife) and is robust (shows appropriate behavior and resiliency when prodded during its testing and de-bugging). One such "prod" can be a sudden step increase in an inflow such as the dispersal of wildlife from the core area of the Park.

The animal/forage model is complete enough to produce the necessary inputs to other portions of the model which need it (or will when the thing is eventually satisfactorily linked together). Furthermore it has the feedback loops in its structure to produce a variety of behaviors typical of systems. For example, the births are a product of both the birth fraction (some percentage of the population which is usually related to the type of animals - e.g. mice or elephants) and the population stock itself. This feedback loop for the stock results in exponential growth. Other loops in this structure produce asymptotic approaches to goals and oscillations. These latter provide the negative feed backs which control the explosive growth (i.e. form the birth structure) and give stability and resilience to the system. However, with a system as complex as this, even though it appears simple, it is not possible to predict which feedback loops will dominate at any given point in time during the simulation - at least not using the bits and pieces most of us can bring (toes and fingers, wandering minds, etc.)

4. Future Development

Finally, it might be of interest to posit some of the enhancements future iterations of this portion of the model may

incorporate. The enhancements would be made to

> enhance/enlarge the available database. Data are not often found in aggregated form.
> enhance the reality of the structure and responsiveness of the model to the rest of the environment.

Any enhancements would need to clearly relate to the goals and questions which surround this system and which arose at the workshop. For example, crop damage by birds was 5% or less of total wildlife caused damage, so it was omitted during this initial run. We are not likely to model soil erosion unless we have data or strong evidence that it is fundamentally effecting important stocks. Some future elaborations may include:

> detailing the fractions of specific crops which become forage for stock;
> breaking forage into woody and herbaceous stocks, and the latter into annual and perennial grasses. The breakdown permits examination of the different uses and production rates of browse and grass, as well as the effects of an overgrazing - related shift from perennial grass to annuals on soil water retention and fertility;
> separating browsing from grazing animals if woody and herbaceous plants are distinguished;
> depicting the use of the core area by illegal stock and its effects;
> the modeling of areal closures for rehabilitation and its effects on stock forage. This can enable later evaluation of rehabilitation as a policy.

B. SOCIO/CULTURAL SUB-SYSTEM

1. Tourism

The structure of this model is essentially the same as that of the conflict model exhibiting initial dominance of the compounding growth of the stock (# tourist per year) (Fig. 2). Eventually the dominance shifts away from the compound process towards the draining (stock-adjustment) process. In this system, while the inflow is generated as the product of the average rate of increase in visitor days and the stock, the outflow is generated as the product of a draining fraction and the stock. The draining fraction here is a graphical function which depends on the stock relative to goal. Facility carrying capacity of the park here is referred to as the goal. This model is connected with other parts of the model by a stock called Cash through a series of converters.

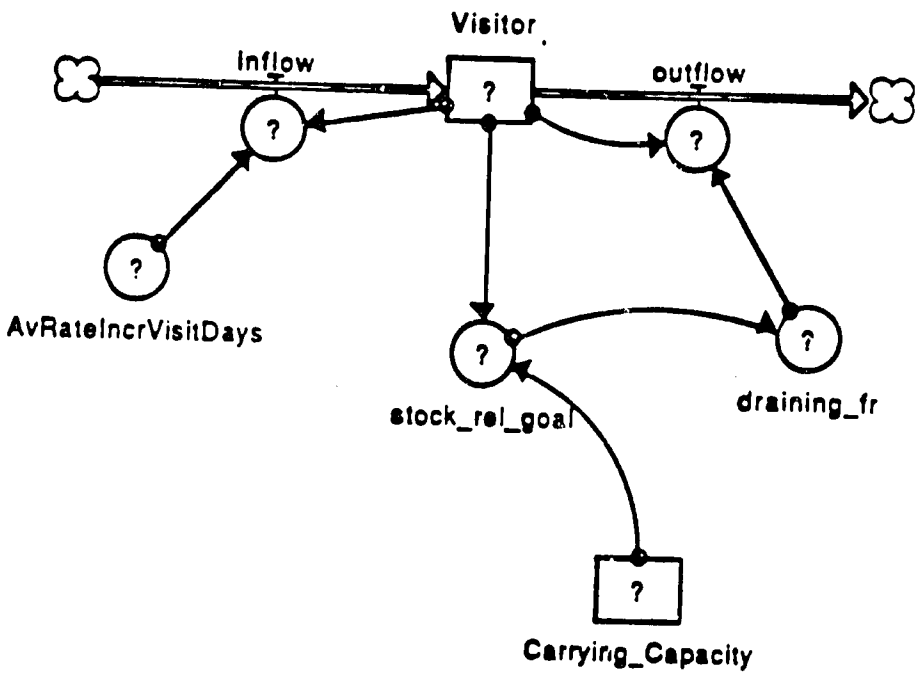

FIGURE 2: TOURISM MODEL

Equations:

Stock	=	# Tourists per year
Flow-in	=	(Average rate of increase in visitor days)* (Tourist per year)
Flow-out	=	(Draining Fraction) * (Tourist per year)

Data Requirements:

tourists per year

Average rate of increase in visitor days in the last 5 years

Visitors in last 5 years

Average duration of stay in the last 5 years

Facility carrying capacity = (# beds available) + (# seat per vehicle * # vehicles * frequency of run)

2. Conflict Model

This sub-system contains essentially two generic processes (Fig. 3). A compounding process feeds the stock (level of conflict) and a draining process which drains it. Behavior thus exhibited is a S-shaped growth of the stock. The inflow is generated as the product of the stock and a compounding fraction which is a constant and is the sum of encounter fraction, crop damage fraction and rigid-forester fraction. Output from this system is generated as the product of the stock and a draining fraction which is a graphical function that depends on the stock relative to goal. Our goal here is the level of conflict between forester and the local villagers away from the JPA. This sub-system is linked and largely driven by two stocks from other parts of the model. These are Agricultural Family and Extension Education.

Equations:

Stock	=	Conflict level measured on a 1 to 10 scale.
Compound flow	=	(Rigid Forester Frac. + Encounter Frac. + Crop Damage Frac.) * Conflict
Draining flow	=	Stock * Draining Frac.

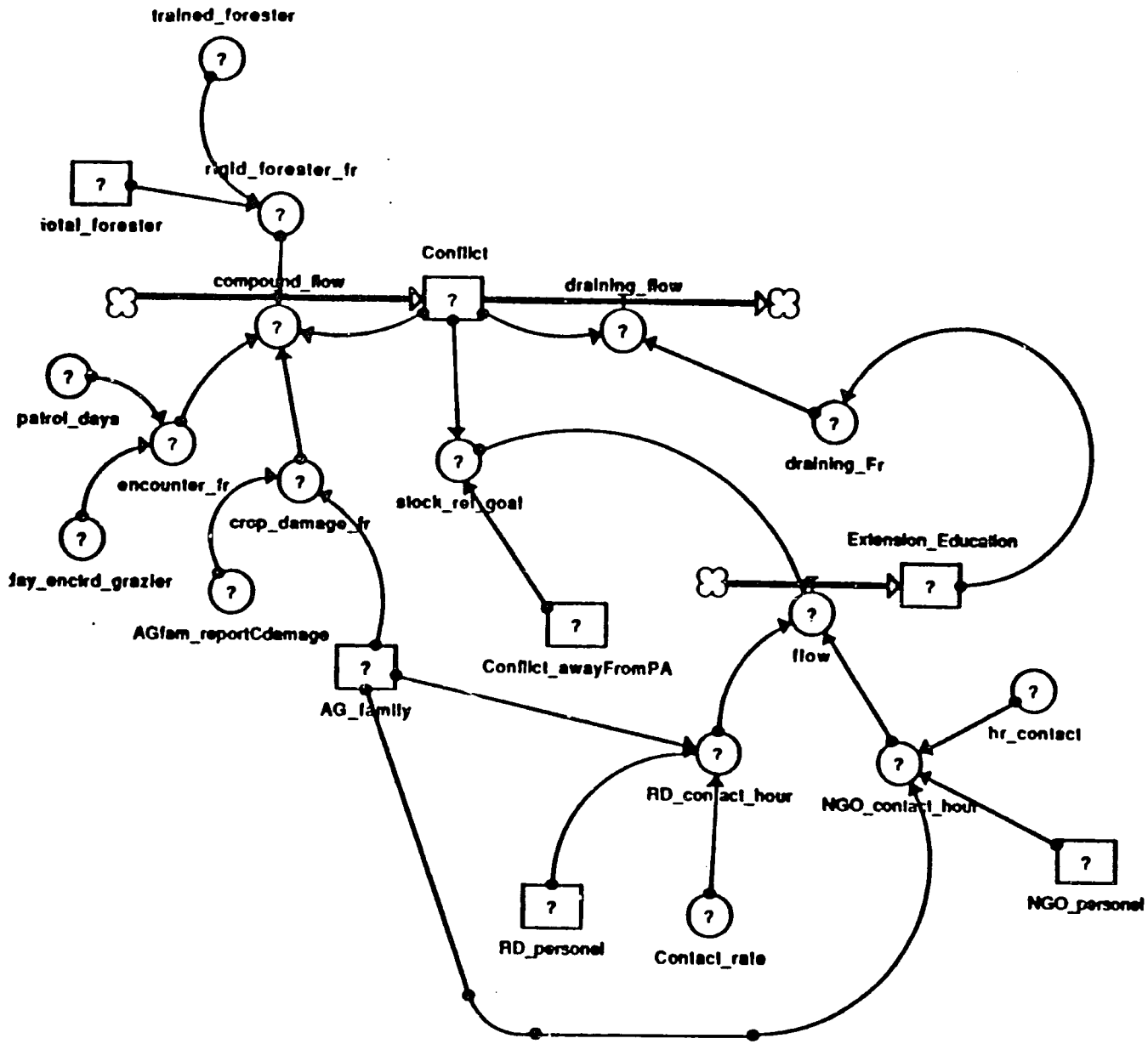

FIGURE 3: CONFLICT SUBSYSTEM

Data Requirements:

Rigid Forester Fraction	=	Fraction of Foresters who are not exposed to extension training.
	=	(# Foresters - # Trained Foresters) * (# Foresters)
Encounter Frac.	=	(# patrol days encountered grazier)/ (# patrol days) or (grazier encounter/patrol days/yr) * (# Foresters)
Crop Damage Fraction damage per year	=	Fraction of AG Family report substantial
	=	(AG Family report substantial damage)/ (# AG Families)

3. <u>Extension Education Model</u>

Structure of this sub-system essentially resembles that of an External Resource Production Process. Two inputs to this process are: the productivity term and the external resource for production. Flow of production is generated as the products of these two inputs. This sub-system is linked with the conflict level through a graphic function.

Data Requirements:

Rural Development personnel
Contact hours per year
NGO personnel
Contact hours per year
Sensitized Agriculture Family

C. POPULATION AND INCOME SUB-SYSTEM

This sub-system deals with the flow of income in the agricultural and grazing population who constitute the most significant part of our area of interest. It has three major stocks: the area of interest, population in that area and the cash that an average family has (Fig. 4). The area of interest is now loosely defined, but would include the clearly defined core and buffer zones, and an undefined zone around the Park where most of the population live and where most of the agricultural lands are. The zone might change in area as we

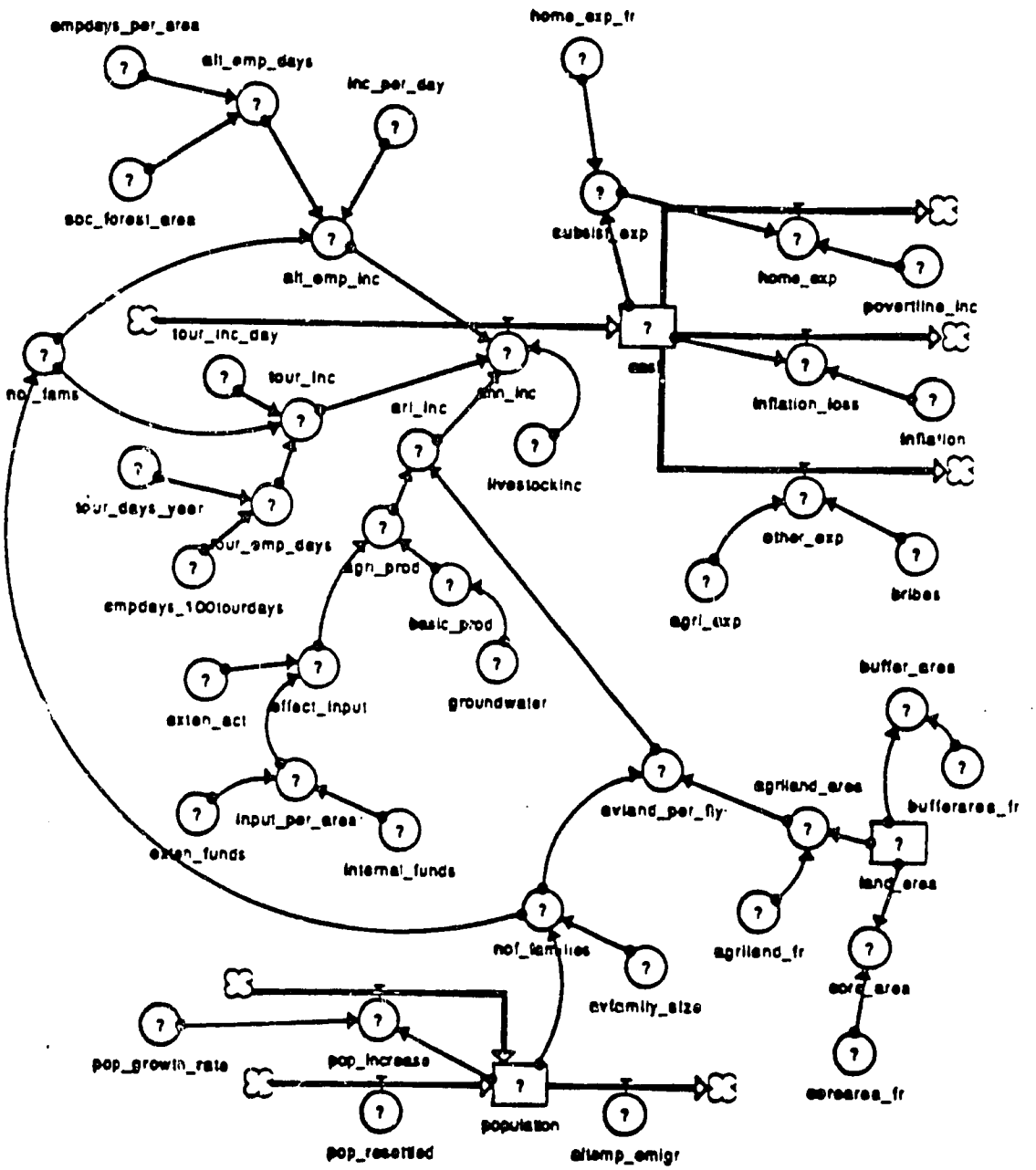

FIGURE 4: POPULATION AND INCOME SUBSYSTEM

change our radius of interest or it might change as land use pattern change.

Since the current problem is largely related to agricultural and grazing activities, the focus as far as human population is concerned is on the agricultural and grazing part of it. Their change is assumed to follow the general trend indicated by the Indian average, except for local modifiers like resettlement of people into the area from inside the park and people emigrating from the system as a result of alternate employment. People living inside the park are not considered as part of this model for two reasons. Firstly, they form only a negligible proportion of the overall population in the area. Secondly, they are currently being resettled to areas outside the Park and, therefore, would be out of the system in the near future. The population, therefore, represent only people outside the park, but in the zone of interest.

Cash income is modeled for an average agricultural-grazing family. These income result largely from agriculture, livestock and alternate employment. Each of these is modeled as converters. Cash outflow result largely from subsistence expenditure, agricultural expenditure, inflation and expenditures related to the existing conflict (e.g., litigation).

1. <u>Agricultural Crop Production</u>

This is considered a major converter which contributes significantly to cash liquidity of the population in the area. It is modelled as annual income per unit area. Actual income per family is the product of annual income per unit area and mean land holding. Although a number of factors might affect agriculture production, the major ones are agricultural financing, cash liquidity of the family, extension activity and ground water level. Some of these (e.g. cash liquidity, agriculture financing and extension activities) would enhance the extent of agricultural inputs. Ground water level and erosion would affect the basic productivity of the area. The nature of impact of inputs on productivity is expected to be sigmoidal.

<u>Problems</u> - Agricultural production as modelled now does not incorporate various crop types, the area under each crop type, and seasonal variation in cropping pattern. These could, however, be done only after a more extensive study. Moreover, the nature of the relationship between basic productivity and various modifiers would differ with crop type. For want of a better conceptual base, number of extension workers per head or unit area is taken as the modifier of effectiveness of agricultural input.

2. Agricultural and Grazing Population

Most of the population in our area of interest fall into these two categories of families. In the absence of more specific data, they are modelled as one stock. Major inflow into the stock are births and reported seasonal graziers. Of these, births might be significantly modified through ongoing family planning programs which might decrease the birth fraction. Education level might increase age at marriage (or first birth, more precisely) and thus decrease the eligible couple fraction.

The major outflow from the stock is through death, which might be significantly altered through education level and through better access to medical facilities. The second major outflow is through seasonal emigration of the people, i.e. of those graziers who immigrate for a season. Another potential outflow from this stock is those people who get alternate employment outside the area of interest and therefore leave the system.

The level of the stock would be largely the result of the compounding process - one increasing it and the other decreasing. It is also likely that this stock could be simplified to a significant level if one were to assume that the overall trend of rate of growth of population in the area would be like the rest of India, i.e. at a current rate of 2.25%. In this case the only outflow would be alternate employment.

3. Other Employment

Alternative employment is considered in this model as those which do not make the people move out of the system entirely. It is likely that some drop entirely out of the system (i.e. agriculture and grazing) but those are modelled in agricultural and grazing populations. The major sources of alternative income are tourism (e.g. as guides) and from employment in forest departments (e.g. social forestry). Income from minor forest products (honey, medical plants, etc.) was considered first but was dropped after the preliminary study revealed that there was only a marginal potential for it as a major source of income.

Income from tourism is modelled as the number of man-days of local employment that could be generated as a product of total number of tourist days/year and number of local man-days of employment generated by a unit number of tourist days (say, 100). The resulting local pool of man-days of employment is shared by the local families.

Problems

a. It is very likely that the employment potential generated by tourism could be more effectively used locally through better

training education and through other infrastructures.

b. Indirect employment generated through tourism (e.g., money flow into the local economy) has not been modelled and is probably not very important.

c. In social forestry also job potential could more effectively be exploited locally with better education and training.

d. Other alternative employment has not been modelled. While things like a new industry in the area could drastically change the scenario, other source of income in the area, which could significantly contribute to income, are probably marginal.

4. Government Activities

Government activity in the area of interest are obviously of varying kinds. The specific areas of government activity that we are interested in are these:

a. Agricultural, livestock extension.

b. Education and training.

c. Enforcement of forest protection measures.

Of these the first two have been explicitly or implicitly modelled as factors modifying agricultural and livestock productivity. The last one could have an inhibitory effect on agriculture for example in preventing expansions of area under agriculture. It could also affect livestock productivity by preventing grazing.

For the time being, however, government activity in the form of enforcement is not incorporated explicitly into the agricultural system. It is however, implicitly modelled by making the area under agriculture a constant. It is explicitly modelled in other parts of the model as conflict inducing and as a factor which would increase the productivity of the forest by limiting accessibility to livestock grazing.

5. Cash Liquidity

Cash is taken to mean mobile cash available with one family. The major inflows into the stock are from income from agriculture, livestock and alternative employment available locally (i.e. families still remain part of the system). The major outflows are inflation (which reduce the value of cash at hand), household subsistence expenditures, agricultural expenditures, health care, education. Conversion to capital is accounted for only in the case of cattle purchase. Purchase and selling of land is not included since it is not expected to

change average land holding in this closed system dealing with a constant area. Conversions to live stock is also not included in the cash stock as it is modelled in livestock subsystem. Other capital conversions are included under subsistence expenditures, which is taken to be a fixed proportion of cash at land, subject to a minimum requirement. Informal expenditure is probably a major factor especially when cash is low as further draining of it would increase the conflict level.

VI. LESSONS TO EMERGE FROM THE MODELLING PROCESS

What the team derived from our activities was more than information required to proceed with modeling and probably more than we were able to contribute to the knowledge of the various local participants.

In the process of developing the model of the Ranthambhore system, the team re-affirmed and re-oriented several initial impressions. One basic lesson is that more than one day is needed for the workshop, particularly when many of the participants are illiterate and when the workshop facilitators cannot speak the local language. A better alternative would be the training of a native-speaking facilitator, but it was not feasible in this case. Another reason to provide at least 3 days was to permit the informal, relaxed and often jovial atmosphere which produces the best interactions and workshop products.

The cultural and linguistic issues could be partially overcome by video-taping the exchanges for full translation later. The educational/PR/demonstration value of tapes could be useful in, for example, training NGO's in the IPT technique.

We also found that the participants can't be pre-judged. We were informed that older men would be uncommunicative. However, this was not the case. The older gentlemen also have the power to influence future action.

The activity described in this report reflected the considerable hard work and professionalism of a very talented team. The dual danger is that:

the five days in March might generate recommendations beyond what our meager data and impressions can support; and

that premature uses of the model will do the same. This however, is probably less likely, because people inherently suspect models (at least those people we have dealt with to date), while there is a development world full of five-day wonders.

We believe that with careful working and an on-going pursuit of the work at Ranthambhore, quick fixes or recommendations are unlikely and would be unnecessary. The contribution of the model is in its guidance for further investigations. At the same time, however, the model should be provocative to government and the donor community. For example, if projections suggest a significant impact or catastrophic trend, it will be provocative - BUT is should not be taken as predictive or prescriptive until it is refined and more adequately supported.