COOPERATIVE AGREEMENT ON HUMAN SETTLEMENTS AND NATURAL RESOURCE SYSTEMS ANALYSIS

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ASSESSMENT OF HILLSIDE AGRICULTURE IN TWO WATERSHEDS OF JAMAICA

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George R. Armstrong
Chief of Party

Executive Summary

In late summer, 1985, the AID Jamaica Mission arranged with the Institute for Development Anthropology (IDA) to conduct an assessment of hillside agriculture in two selected watersheds of Jamaica.

To carry out the work, a five-member team was organized consisting of an economist, two anthropologists, a soils scientist and an agroforester. Geographically, their inquiry was to focus on hillside agricultural systems and programs that would tend to increase the efficiency of hillside agriculture while simultaneously helping to meet the interests and goals of downstream land users and urban consumers, not only for the selected watersheds but also, potentially, for other hill regions in Jamaica. Their recommendations were to be considered in the eventual preparation of a project paper on hillside agricultural development.

The soils scientist was to assess the extent and severity of erosion on soils in the two watersheds under various land use practices. He found the upland soils to be widely acid and infertile, less than half of them considered cultivable and only 14% cultivable without risk of erosion or soil constraints. Soil erosion appeared to result in part from open-soil cultivation, especially of root crops, but also in significant measure from roads improperly constructed and maintained, land clearing for human settlement and forest removals. Fragmentation of farms was encouraging a trend toward continuous

cropping of the better lands, often without adequate fertilization. This was leading to soil productivity declines. Lack of appropriateness of current soil conservation practices was laid to inadequate transfer of known techniques to practitioners, and to an inadequate program of local research.

The agroforester was to identify economically feasible agroforestry systems designed to alleviate soil erosion problems and improve or sustain crop production levels, and to consider how to get them adopted. While he found the use of wood for fuel to be increasing, enough was available at no cost to make fuelwood plantations economically non-viable. Former tree-planting programs were shown to be extremely high cost and of limited value in soil conservation. Reclothing steep and eroded lands by natural regeneration was cited as more effective than planting.

Small size of farms often militated against planting trees for commercial, single use purposes. While productivity of crops and livestock could be considerably improved by judicious use of trees for windbreaks, shade, fodder and soil rehabilitation, such improvements were rarely being brought to farmers by extension or development programs, primarily because program personnel lacked adequate knowledge of agroforestry practices. Because of the small size, dispersion and widely differing site conditions on hill farms, no agroforestry system was named as singularly useful. Solutions would have to be found and applied on a farm-by-farm basis. The recommendations were

for better information transfer and local research to identify socially and economically acceptable agroforestry alternatives.

The social scientists were to review and assess the constraining influence of social and institutional factors (such as land tenure, community organization, migration patterns, demographic factors, and linkages between farm households, community organizations and public/private sector institutions) on the adoption of sustainable, economically viable farming systems, and soil and water conservation practices.

They found a rural population generally dedicated to self-sufficiency and only weakly inclined to organize to meet joint goals. Farming was viewed as a low prestige activity and as a means of survival rather than as a business for profit. Although land ownership was seen as a symbol of success, the general wish was to see ones children escape from farming into other pursuits.

Farmers often lived not on the land but in small villages from which they traveled daily to their farm properties. They viewed the road system as a vital link in their activities and saw lack of road development and maintenance as a continuing problem. Major social needs included the need for strong leadership, for a stronger sense of community and joint organization, better opportunities for youth in agriculture, better ability to plan ahead, and a stronger sense of the real value of farm enterprise to the Nation.

The economist was to evaluate the likelihood of adoption and sustainability of proposed agricultural production approaches. Several major constraints were evident. Due to low productivity, many of the lands being cultivated were not economically suited to farming, and ideally should be retired from agriculture. Advanced agriculture in the plains areas was usurping markets that hill farms had once dominated. Small size and fragmentation of farms frequently limited the economic viability of farm operations.

On the input side, farmers were found to lack capital and access to capital as well as technical and managerial competence. In the product markets, they were seen to need better advance information than they currently have for determining what to grow, what price to charge or where to ship; and they needed better technical guidance for handling, storing, packing and shipping commodities.

Small farmers, generally, were seen to be operating close to the margin. They were risk avoiders, typically amenable only to incremental change. They lacked the tools for making competent economic decisions, and did not have a clear view of the operating alternatives open to them. Meanwhile research and extension efforts by government were being decreased.

For these many reasons, a shift to livestock raising and cropping perennials, both being potentially profitable and soil conserving under good management, faced serious constraints.

Taken together, the observations of team members do not disclose a farming system or systems that, at low risk and over a relatively short time period, can substantially increase farmer incomes while reducing erosion and otherwise conserving the land. They do disclose a picture of widespread, simultaneous inefficiencies in land allocation, production and marketing that past attempts at development have not overcome.

Basic team recommendations are more toward strengthening the farmer's ability to make and carry out effective, economically viable resource decisions than to choose them for him. Thus, attention shifts away from the development of procedures for applying a given technology and toward procedures for encouraging independent decision making such as better information transfer, broadening the array of options for income improvement consistent with soil conservation needs, and attention to tools and methods for making wise decisions in a practical context.

To meet these ends, simultaneous actions are recommended to rationalize the land use pattern, to improve marketing methods, to stimulate development of a new farm leadership group and to improve practical farmer training in the face of a diminishing extension force. Techniques for implementation of the recommendations are outlined.

II

TEAM EVALUATION AND GENERAL RECOMMENDATIONS

The Problem

Agriculture is of tremendous significance to the Jamaican economy. It employs almost one third of the labor force, more than any other sector. It generates close to 7% of Gross Domestic Product (GDP), and through its forward linkages with manufacturing, transportation and other productive sectors indirectly provides much more. Agricultural products account for between 15 and 20% of all exports. Almost one and a half million acres of land are dedicated to farm production.

In spite of its current contributions, Jamaican agriculture could do much more. Over 15% of the Nation's current imports, which cost dearly in foreign exchange, consist of food products. Local substitutes might be found for them. New export markets could be developed, and existing ones better satisfied than they are now, for Jamaica presently fails to meet its export quotas even for such well established crops as coffee and bananas. And increased output could help keep the prices of several domestic foods from rising beyond the economic reach of a growing minority. But these things do not happen, and the basic resource, the land, meanwhile shows severe signs of erosion and depletion.

What is keeping Jamaica's 184,000 farmers poor? What is keeping them from looking after their land? What is keeping them from increasing the variety, quantity, quality and availability of farm products so as to meet these challenges effectively and profitably without resource depletion?

These questions are not new. People have been asking them for more than 40 years, and the answers have always proved evasive. In seeking answers, the basic assumption has been that agriculture is faced with certain restrictive forces, and that if key constraints among them are alleviated, farmers will enjoy a new prosperity, agricultural production will rise and conservation practices will improve.

Since the 1950's a steady succession of programs has been launched to eliminate the barriers to agricultural growth. The Farm Improvement Scheme of 1949-55, the Farm Recovery Scheme of 1952-55, the Farm Development Scheme of 1955-60, the Agricultural Development Program of 1960-62, the Farmers Production Program of 1963-68, the Farmer Development Program of 1968-72, Operation GROW of the mid 70's, the Emergency Production Plan of 1977, the 5-year Development Plan of 1978-82 and the current 5-year Policy and Production Plan of 1983-87 have followed each other in quick order.

Many of these programs included soil conservation and land improvement subsidies, credit plans and low cost inputs. And they were interlarded with donor projects totalling almost $50 million (U.S.) for training and extension, credit programs, input subsidies and conservation works. Included among them, in recent years, have been the First and Second Integrated Rural Development Projects and the project of the International Fund for Agricultural Development (IFAD project) which appears to be a close replica of the Farm Development Scheme of 1955-60.

Taken as a group, these many programs have not created any notable or sustained change in farmer activities or wellbeing. Today, he seems just as much in need of credit, just as wedded to traditional production methods and just as likely to neglect soil conservation works on his farm as he was 40 years ago.

Donors are notably cautious now in allocating further resources in this direction. They want to know why nothing is happening, what constraints might have been overlooked, or what program characteristics might have weakened the effort.

The Response

This team has examined the agricultural problem in the Jamaican watersheds from ecological, economic and sociological points of view. Literature review has been supplemented with field evaluations, and by consultations with knowledgeable practitioners in many public and private organizations. The focus has been on small farmers, not only because they are typically very poor and because there are so many of them (88% of all Jamaican farmers own less than 10 acres), but also because they dominate so much of the market. For example, more than three quarters of all the coffee, cocoa, and bananas that enter the export market are produced by small farmers. And average output per acre on small farms is substantially higher than that on larger farms.

It is well to remember how the small farmers got into their present situation. In essense, they are victims of an earlier problem. In the days of the big plantations, sugar was the mainstay of the Island's economy and hill farming was the poor sugar worker's way of making do. Compared to sugar, his activities had little economic significance. His current land use pattern of mixed cropping on tiny farms is an outgrowth of a system in which the individual worker did not really matter. So it is not an irrational, tradition bound pattern that we view today. It is a rational response to yesterday's economic forces. If it does not fit today's needs there is no compelling reason to suspect that the farmer, given the right tools, cannot amend it.

At present, in the watersheds at issue, the Rio Cobre and the Rio Minho, these small farmers are feeling pressure for change from four directions. First, a rising population is pressing them for rural living space and for water. Second, a new agriculture is emerging on the plains areas which subtend the hills. This new agriculture is producing crops, like bananas and vegetables, that hill farmers have always produced. It is doing a better job, on better lands, so farmers are losing competitive position and must seek alternative forms of production. Plains agriculture is also demanding more water for irrigation. Third, both an emphasis on exports and changing wants in the domestic market are shifting attention toward quality and timing of delivery in the marketplace and away from price. Fourth, larger farms by exercising careful business management, usually on better lands, are realizing economies of production and are usurping an increasing share of the domestic market.

Three responses are called for. One is for the small farmer to seek out new land use options, not under competitive assault. The second is to supplement his skills as producer with skills as manager and decision maker as well as marketer. The third is to provide a level of conservation and land husbandry that preserves the productivity of the soil and helps maintain water supplies at socially acceptable levels.

Farmers however, appear to be in poor position to respond. They are shackled by poverty and ignorance of how to deal with change. Part of their problem can be solved by helping to remove the marketing, production and land-based inefficiencies that plague them. The most notable of these inefficiencies are shown in Table 1.

TABLE 1. AREAS OF FARMER INEFFICIENCY

LAND BASED INEFFICIENCES

1. Low site productivity
2. Inappropriate plot size or location
3. Tenure limitations

MARKETING INEFFICIENCIES

4. Lack of timely, unbiased mkt. information
5. Limited command of market services and expertise
6. Lack of strong, collective voice

PRODUCTION INEFFICIENCIES

7. Limited view of land use alternatives and of productive techniques
8. Lack of economic and other tools for decision making
9. High risk of loss

The more subtle part of their problem can be tackled only by avoiding top-down coercive types of action. Basically, it is by broadening the array of alternative courses of action available to the farmer; by improving his ability to choose among them; and then by letting him make his own choice, in his own way. In particular, this approach is educative rather than prescriptive. The focus is on theintellectual task of decision-making rather than on the more mechanical tasks of adopting a procedure or accepting a subsidy. This does not imply extensive schooling and academics for all farmers. It merely means that in dealing with the farmer the emphasis is placed on "how to determine what to do" rather than on "what to do".

The general recommendations for action made on the following pages with respect to marketing, farm production and land use are not unique or unusual. In several cases, their implementation depends simply on the use of programs that are already planned or underway. But what they do offer when taken together, is a very broad array of options to the farmers, and a tested way of giving the more forward looking among them access to better ways of selecting among those options.

This broad, multi-pronged approach is advantageous to an agency like USAID because, as it proceeds, if certain facets prove to be non-viable, resources can be shifted to other program elements that show more promise, or new elements may be introduced under the marketing, production and land use umbrellas.

Furthermore, there are ancillary forces, outside the recommended program, that offer significant support. The influx of suburbanites that St. Catherine is feeling so strongly now, and Clarendon is beginning to experience, will bring with it rising land values, a sharing of the cost of social services, increasing demands for roads, schools and protection, increasing opportunities for the masonry and other building trades, for small business and for forestry activities. All of these options represent job prospects for the rural unemployed and will help to siphon off a large number of those who could never be happily accommodated on the land.

The recommended approach does not, as originally expected, identify a particular farming system or systems that will prove economically viable and sustainable while at the same time protecting and conserving the steep and fragile uplands from the erosion and diminishing productivity that they exhibit today. It is well recognized that a shift to perennial tree crops like coffee or cocoa, or to livestock production under careful management would be economically sensible and conservative of the lands on many hill farms. But much of the acreage that is being misused now is in the hands of those who would not or could not entertain these options because of constraints in production, marketing, land ownership, and decision taking that need first to be eliminated or alleviated. The following suggestions address that reality.

General Recommendations[1]

Marketing Program

A. Support the implementation of a comprehensive, timely market reporting system using farm radio to bring daily data on market conditions throughout Jamaica to the farmer and to market intermediaries (higglers) to improve income distribution as well as physical product distribution.

Vehicle: The Marketing Division of the MOA.

B. Develop and implement a long term market planning service to guide farmers in selecting crops and allocating acreages for the following season.

Vehicle: The Marketing Division of the MOA.

C. Support, within the watershed, a pilot program for developing and upgrading various stages of the marketing process, including:

1. Harvesting techniques
2. Grading
3. Packaging
4. Weights and measures
5. Handling and transport
6. Storage
7. Selling techniques - merchandising.

Extend the findings to intermediaries (higglers) as well as to farmers so that both groups can adjust their practices simultaneously to the new methods.

Vehicle: The local Producer Marketing Organization (PMO).

D. Keep regional offices of the MOA and of the JAS well-informed of plans, findings and their applications. Encourage farmers to seek joint representation in the marketplace through such organizations as the JAS.

Farm Output and Production Program

A. Establish within the watershed several (e.g. 3) clusters of farms, each cluster containing representative farm sizes (e.g. 2 acre, 7 acre, 20 acre) on representative (medium productivity) soils with no special advantages (e.g. no separate water source). Provide each farm manager with resources and budget representative of those in the area. Use students of agriculture to help run the farms.

B. Attach to each cluster of farms a small extension center containing simple dormitory facilities, classroom space and demonstration plots. This center will be manned by extension specialists and will have a separate budget. The quality and ability of the specialists in charge will be critical to the success of the units.

C. Establish strong lines of communication between the experimental farms and the Crop and Livestock Research Units of the MOA; the Research and Development Unit of the Dept. of Forestry and Soil Conservation, including the Soil Conservation Division of the MOA; the National Agricultural Research Institute, the Farming Systems Research Project and the School of Agriculture. Provide equipment and operating funds to these research units as well as refresher training for staff, so as to ensure their continuing, effective contribution. Broaden their activities to include agroforestry research.

D. Use the cluster farms to apply and test realistic procedures for income improvement consistent with conservation goals. These farms shall seek to become self-supporting.

E. Use the extension centers on the farms to:

1. train extension staff of the MOA (refresher courses),

2. teach visiting farmers the rudiments of farm management, decision making, economic valuation,

3. extend to visiting farmers viable ideas, and to receive information from them - expecially in regard to problems that they face,

4. arrange with visiting farmers demonstrations of appropriate methods on their own farms

5. Continue the education of agricultural students.

Land Use Program

A. Apply, within the watershed, the land development procedures of the Special Projects and Programs unit of the MOA, including:

1. cadastral survey

2. mapping of all Government lands

3. locating, mapping and rationalizing tenure for all private lands

4. mapping current land use patterns.

B. Zone the watershed, using the accepted capability classification for:

1. agricultural productivity potential

2, Conservation risk (e.g. excessive slope, erodable soil type)

3. and assess adaptability for given uses (as for coffee, citrus, cash crops, and livestock)

C. Design and set in motion a Government trade and buy program to raticnalize the land use pattern. Use the findings of Step B, above, to guide

1. reduction of risk by retirement of lands rated submarginal for agriculture or high conservation risk.

2. raising operating efficiency by blocking in lands to create farm units of workable size and continuity.

3. raising economic productivity by guiding lands into types of agricultural use for which they are best fitted, such as grasslands and tree crops for lands of capability class IV.

D. Support a program of road improvement with special attention to soil and water conservation effects. In particular, attend to road grading and conservation works such as ditching, check dams as a direct means of obtaining effective conservation controls.

E. Assist in the implementation of non-subsidized programs of freehold farm establishment by Government for:

1. people without land

2. people who wish to relinquish sub-marginal land

3. capable youth

F. Develop and implement procedures for enlisting the support of downstream water users, as by taxation of water consumption above specified, metered levels. Use these incomes to support conservation works.

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[1] Individual recommendations that appear in the technical annexes are for the most part subsumed within the general recommendations.

III

TECHNICAL ANNEXES

Annex 1

Soils and Ecology
Luis A. Manrique

Annex 1

SOILS AND ECOLOGY

Luis A. Manrique

University of Hawaii

Jamaica is an island of contrasting physiography and wide variety of agroenvironments and land use patterns. One half of its population lives in the rural area, and agriculture is the main activity. The following analysis considers the major physiographic regions of Jamaica and how they are being developed for agricultural use. Particular reference is made to the upland regions of St. Catherine and Clarendon which embrace nearly all of the Rio Cobre and Rio Minho watersheds.

A. LAND RESOURCE BASE.

1. Geomorphology.

The island of Jamaica comprises three main physiographic regions: (1) the dissected limestone plateau and hilly uplands, (2) the interior mountain ranges, and (3) the coastal plains and interior valleys.

The plateau and the hilly uplands are the main domain of the small farmer, as these areas have proved unsuitable for plantation-type agriculture. Elevations of the plateau range from near sea level to more than 3000 feet in elevation. The plateau surface is heavily dissected with steep slopes dominating the upland areas near to the coast. The rough landscape of the plateau is known as karst, a limestone terrain dominated by sinks, underground caverns and streams, steep hills and caves (Kaplan et al. 1975).

The mountain system is composed of two ranges: the Blue Mountain range where the Blue Mountain peak rises to more than 7400 feet, and the Central range located in the middle of the island. The landscape of these mountains is heavily dissected by deep valleys and steep hillsides, highly vulnerable to indiscriminate deforestation which accelerates soil erosion.

The coastal plains, located along the north and south coast, are the lands best suited for intensive agricultural use. Water is the main constraint for successful exploitation of the southern coastal plains of both Clarendon and St. Catherine parishes. Rainfall is less than adequate for intensive production, so irrigation is required throughout the year. Presently underutilized due to salinity and drainage constraints, extensive swamps of the coastal plains offer a possible alternative for relocation of landless farmers of the upland regions. Major limitations for successful reclamation and development are capital and technology.

The interior valleys are areas with slightly undulating topography

occurring at various elevations of the limestone plateau. Most of these valleys are karstic features of the limestone plateau. Like the coastal plains, these areas are highly suitable for intensive agriculture.

2. Geology.

The mountain ranges are made up of the oldest rocks found in Jamaica (i.e., igneous and metamorphic rocks). Outcrops of these rocks are observed on the southern slopes of the Blue Mountain range. Cretaceous rocks form the main core of the island, and are made up of fossiliferous sediments (i.e., conglomerates, shales, and tuffs mixed with limestone), which were laid down through several unstable cycles of sedimentation as the whole island was subjected to periodic subsidence during Cretaceous times. Tertiary white and yellow limestones of the plateau and surrounding hills were laid down in the middle Eocene when more stable sedimentation conditions prevailed. After the formation of the white limestones, extensive uplift accompanied by extreme faulting affected the whole island. The uplifted white limestone underwent karstification resulting in a contrasting topography, much like the current landscape of the limestone plateau. The coastal plains are made up in large proportion of quaternary alluvium transported from the limestone plateau and interior valleys. A sizable portion of these transported materials is of mixed origin, being composed mainly of constituents from the cretaceous rocks.

Both the Rio Cobre and Rio Minho watersheds form part of the tertiary limestone plateau. Approximately 50% of the Rio Cobre watershed is occupied by white limestones (Newport and Walderston formations), whereas coastal alluvial deposits cover the remaining area. Northeast of Spanish Town, interior valleys with quaternary alluvium deposits are found near Linstead. The Rio Minho watershed has a geologic pattern similar to that described for the Rio Cobre watershed. However, large portions of the Central mountain range are made up of cretaceous rocks (Main Ridge and Summerfield formations). Yellow limestone deposits (Chapelton formation) are found near the mountain range, but they represent only a small part of the watershed.

3. Soils.

Soils of Jamaica (Table 1) are the result of the interaction of parent materials, contrasting topography and uneven rainfall distribution. Depending upon the degree of leaching and mineral weathering, different soils were formed from similar parent materials. Thus, it is not uncommon to find Ultisols, Mollisols and Oxisols formed on parent materials derived from similar old alluvial deposits. Oxisols, for example, were formed from old alluvium and limestone deposits of the interior valleys. The high rates of weathering associated with the porous nature of limestone materials and the stable landscape of interior valleys provided favorable conditions necessary for the formation of Oxisols. These Oxisols have high content of organic matter in the soil surface and large accumulations of gibbsitic materials in underlaying horizons. These soils are inherently less susceptible to soil erosion than other adjacent soils, but possess extreme fertility constraints for crop production.

Table 1. Classification of Jamaican Soils according to Soil Taxonomy
Source: CRIES (1982).

Order	Suborder	Great Group
Entisols	Orthents	Ustorthents (1)*
(9)		Troporthents (5)
	Psamments	Tropopsamments (2)
Inceptisols	Tropepts	Eutropepts (34)
(70)		Dystropepts (20)
		Ustropepts (9)
	Aquepts	Tropaquepts (7)
Alfisols	Udalfs	Tropudalfs (12)
(23)	Ustalfs	Haplustalfs (11)
Vertisols	Uderts	Chromuderts (10)
(24)		Pelluderts (2)
	Usterts	Chromusterts (5)
		Pellusterts (7)
Mollisols	Udolls	Hapludolls (10)
(20)	Ustolls	Haplustolls (8)
		Calciustolls (2)
Ultisols	Udults	Tropudults (12)
(27)		Paleudults (8)
	Ustults	Paleustults (3)
	Aquults	Albaquults (1)
		Paleaquults (3)
Oxisols	Orthox	Eutrorthox (5)
(5)		

*Number between parenthesis indicate the number of soils in each category.

Ultisols of the high rainfall areas were formed from highly weathered cretaceous rocks. These soils, in association with acid Entisols and Inceptisols, occupy the steep slopes of the mountain ranges and the limestone plateau. Ultisols are very acid and infertile, although under natural forest the soil surface provides enough nutrients for exuberant plant growth. Under cultivation, these soils are highly susceptible to erosion, and once the soil surface is lost, the clayey subhorizon acts as a physical and chemical barrier to plant growth. Large portions of steep lands of the Rio Minho watershed, which are presently covered with short scrub vegetation and impoverished pastures, are actually severely eroded Ultisols that were previously cleared, cultivated and later abandoned.

Alfisols, Mollisols and Vertisols were formed from white and yellow limestones. Alfisols and Mollisols, are found in close association with Oxisols. Vertisols are commonly known as "black marl" soils. Black marl soils are described as deep, heavy clay and poorly drained soils (Anonymous, 1978).

A large proportion of Entisols, Inceptisols, Mollisols and Alfisols were formed in materials derived from quaternary alluvial deposits. These soils are located in the coastal plains and interior valleys. However, some Inceptisols and Entisols were formed from cretaceous rocks of areas surrounding the mountain ranges.

Strongly acid Ultisols dominate the hilly landscape of the upper portion of the Rio Minho watershed. These soils are derived from extremely weathered cretaceous rocks, and because of the advance stage of weathering, most of them are very acid and infertile. Soil series classified as Ultisols are Wirefence (32), Wait a Bit (95), Wild Cane (96) Deepdene (98,198), Boghole (99, 199), Effort (130), and Four Paths (205) (Table 2). Inceptisols, particularly Eutropepts (D amond series, No. 34) and Dystropepts (Donnington series, No. 36), account for approximately 40% of the Rio Minho watershed. These are shallow soils on steep lands with high susceptibility to soil erosion. Large portions of Vertisols (Carron Hall series, No. 94) are found in close association with Ultisols and Inceptisols.

The fertility status of 39 selected Jamaican soils is shown in Table 3. The study includes 15 soils of the Rio Cobre and Rio Minho watersheds. Most of the soils have a pH in water higher than 6.0. Sixty percent of them are deficient in available phosphorus (8 ppm P, Olsen method), and 49% are deficient in available potassium (20 meq K/100 g soil, 1N NH4OAc method). Greenhouse experiments conducted on these soils showed a significant yield response of maize (Zea mays L.) to nitrogen, phosphorus and potassium fertilizer applications in 38, 31 and 14 soils, respectively (Cornforth et al. 1968). The above findings reveal not only kinds of limitations associated with a large portion of Jamaican soils, but also reveal an unescapable reality associated with agriculture on tropical hillside lands, that is the need to apply high levels of inputs to ensure sustained crop production.

According to the land capability scheme used by the Rural Physical Planning Unit of the Ministry of Agriculture (Table 4), only 14% of the total land in St. Catherine and Clarendon parishes is suitable for cultivation with

Table 2. Soils of the Rio Minho Watershed. Source: Rural Physical Planning Unit. Ministry of Agriculture, Jamaica.

Order	Suborder	Sub Group	Soil Series Number
Ultisols	Ustults	Typic Paleustults	205
	Udults	Typic Tropudults	98
		Aquic Tropudults	33, 198, 130
		Dystropeptic Tropudults	95, 32
	Aquults	Umbric Paleaquults	199, 99
Inceptisols	Tropepts	Typic Dystropepts	30, 96, 36, 37
		Fluventic Dystropepts	105
		Typic Eutropepts	31, 34, 46
		Lithic Eutropepts	75
		Fluventic Ustropepts	124
	Aquepts	Typic Tropaquepts	102
		Aeric Tropaquepts	20, 79
Mollisols	Ustolls	Cumulic Haplustolls	101, 103
	Udolls	Cumulic Hapludolls	24
		Fluventic Hapludolls	25, 15
Vertisols	Uderts	Typic Chromuderts	92, 94
		Entic Chromuderts	41
Entisols	Psamments	Typic Tropopsamments	29
	Orthents	Typic Troporthents	91
		Lithic Troporthents	77
Alfisols	Udalfs	Typic Tropudalfs	74
Oxisols	Orthox	Typic Eutrorthox	78

Table 3. Fertility Status of Some Selected Jamaican Soils*

Soil Survey No.	Soil Name	pH H20	Avail. P ppm	Exch. K --meq/100g--	CEC	B.S. %
12	Fluvaquentic Eutropepts	6.3	13	0.08	14.9	65
15	Fluvaquentic Hapludolls	6.5	22	0.06	29.9	100
19	Fluventic Ustropepts	7.0	5	0.30	15.6	100
24	Cumulic Hapludolls	7.7	5	0.16	17.8	100
25	Fluventic Hapludolls	7.5	11	0.72	58.7	100
32	Dystropeptic Tropudults	5.1	5	0.55	16.1	53
34	Typic Eutropepts	6.2	5	0.08	44.2	98
36	Typic Dystropepts	7.0	4	0.31	31.0	100
38	Typic Dystropepts	7.0	7	0.20	24.9	100
43	Typic Chromuderts	7.2	16	1.10	69.2	100
46	Typic Eutropepts	6.5	7	0.03	22.4	100
47	Typic Ustropepts	7.6	4	0.28	31.8	100
50	Typic Dystropepts	6.4	2	0.01	14.6	82
52	Ustic Dystropepts	6.8	7	0.01	8.7	100
55	Typic Chromuderts	7.0	3	0.89	44.1	100
61	Typic Paleudults	7.8	4	0.28	29.2	100
67	Typic Eutrorthox	7.2	5	0.11	10.8	100
73	Typic Eutrorthox	7.0	111	0.30	6.7	100
74	Typic Tropudalfs	6.8	3	0.08	10.8	100
75	Lithic Eutropepts	7.4	6	0.66	25.5	100
78	Typic Eutrorthox	6.5	4	0.07	4.4	77
84	Typic Tropudalfs	7.4	21	0.18	23.5	100
86	Typic Paleudults	7.6	23	0.23	8.5	100

91	Typic Troporthents	7.3	7	0.58	42.2	100
92	Typic Chromuderts	7.2	7	0.12	17.2	100
94	Typic Chromuderts	5.4	2	0.18	18.2	91
95	Dystropeptic Tropudults	4.6	1	0.06	26.0	27
104	Fluventic Ustropepts	7.4	15	0.35	19.0	100
114	Udic Chromusterts	5.9	4	0.02	9.7	62
122	Aquic Eutropepts	6.9	7	0.32	47.4	100
124	Fluventic Ustropepts	7.6	35	1.02	14.9	100
127	Fluventic Ustropepts	7.6	8	0.16	18.2	100
128	Fluventic Ustropepts	7.5	28	0.90	9.4	100
191	Typic Eutropepts	7.5	5	0.46	11.0	100
202	Udic Chromusterts	6.7	12	0.06	23.6	100
204	Typic Paleustults	7.5	10	0.21	10.9	100
207	Typic Haplustalfs	6.9	4	0.06	11.2	100
215	Typic Haplustalfs	6.8	16	0.03	24.5	92
220	Udorthentic Pellusterts	7.3	5	0.28	19.5	100

*Available P (Olsen method), Exchangeable K (1N NH4OAc), CEC (Cation exchange capacity, 1N NH4OAc)

Sources: CRIES (1982), Cornforth et al (1968)

Table 4. Distribution of Lands at St. Chatherine and Clarendon Parishes. Source: Henry (1978)

Land Characteristic	St. Catherine	Clarendon	All Jamaica
	----------acres----------		
Slope, degrees			
0-2	55,000	67,000	193,968
2-5	11,000	24,000	269,784
5-10	22,000	23,000	323,099
10-20	20,000	55,000	414,168
20-30	155,000	60,000	705,194
30	17,000	45,000	625,565
Land Capability			
Class 1	20,000	21,000	78,453
Class 2	27,000	20,000	280,425
Class 3	85,000	91,000	598,835
Class 4	98,000	45,000	262,764
Class 5	43,980	30,000	451,698
Class 6	52,000	85,000	866,980
Total	331,980	286,000	2,539,155

no or slight limitations due to risk of erosion or soil constraints (Classes 1 and 2). Twenty seven and 30% of the land in St. Catherine and Clarendon, respectively, are suitable for cultivation with major limitations due to risk of erosion, soil constraints and poor drainage (Class 3). The rest of the area, which constitutes the bulk of hillside lands, is rated unsuitable for cultivation due to severe constraints imposed by steepness of slope and shallowness of soil (Classes 4, 5 and 6).

4. Climate.

Jamaica has a wide range of climatic conditions, as a result of its irregular, mountainous landscape and the influence of the northeast trade winds. Maritime tropical conditions prevail in the coastal plains, with summer and winter temperatures of about 28 and 26 C. respectively (Table 5). Diurnal temperature variations on the coastal plain are around 9 C, while similar fluctuations on the limestone plateau range from 11 to 13 C. Because of its elevation, the plateau has a somewhat cooler temperature (22 to 25 C) that is highly suitable for crops such as potatoes (Solanum tuberosum L.), vegetables, and coffee (Coffee arabica L.) and for pastures. It is less suitable for tropical crops such as bananas (Musa paradisiaca L.), maize and cassava (Manihot esculenta Krantz). These crops manifest slow growth and experience longer growing seasons due to unfavorable effects of wind and temperature.

Although the average annual rainfall is more than 1500 mm, there are substantial differences among different regions in both amount and frequency of rainfall received. Rainfall distribution is erratic, and drought spells are not uncommon during the rainy months. In general, a bimodal distribution characterizes the rainy season, with rainfall peaks in May-June and September-October. Large masses of clouds are associated with the northeast trade winds, and heavy rains fall on the north coast. However, the mountain ranges form a rain barrier and the leeward side of the island wherein lie the subject watersheds receives much less rain. The dry months of the year are from December through April, with less than 40 mm of rain per month falling on the coastal plains and lower elevations of the Rio Cobre and Rio Minho watersheds (Table 5). Water balance studies for the whole island show a large portion of the limestone plateau with potential evapotranspiration exceeding rainfall in six months of the year (Anonymous, 1978). Presumably therefore, most crops grown on hillside lands suffer from water stress at some time during their growing season.

5. Vegetation.

The natural vegetation pattern of the island is largely associated with the temporal and spatial distribution of rainfall. Montane forests and rain forests, and exuberant vegetation are prevalent on the high rainfall windward slopes of the mountains and northern coastal plains, respectively. Leeward slopes, however, receive much less rainfall, and vegetation formations common to semidry ecosystems prevail. Dry deciduous forest and second growth scrub forest are common in hill slopes, whereas natural or introduced pasture covers most of the limestone plateau. Savanna type of vegetation is

Table 5. Mean Monthly Rainfall and Mean Monthly Temperature at Selected Meteorological Stations.

Source: Statistical Yearbook of Jamaica, 1982.

Place	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Rainfall, mm													
Worthy Park [1]	37.8	46.9	44.4	119.8	218.2	155.8	111.1	140.8	202.4	232.0	31.5	60.5	1401.2
Spanish Town [2]	30.0	40.0	32.5	57.5	127.8	92.5	65.0	115.0	117.5	227.5	112.5	27.5	1045.3
Bowden Pen [3]	492.5	387.5	290.0	410.0	722.5	662.5	610.0	580.0	632.5	922.5	960.0	775.0	7445.0
Kingston [4]	22.5	25.0	17.5	32.5	100.0	122.5	57.5	110.0	112.5	172.5	77.5	32.5	882.5
Chapelton [5]	42.5	42.5	60.0	97.5	225.0	150.0	107.5	150.0	190.0	310.0	135.0	55.0	1556.5
Castleton [6]	202.5	157.5	125.0	175.0	380.0	242.5	170.0	315.0	332.5	467.5	467.5	402.5	3437.5
Air Temperature, C													
Castleton [6]	22.2.	22.3	22.9	23.5	24.0	24.9	25.0	25.1	24.5	24.1	23.3	22.6	23.7
Caenwood [7]	23.0	22.7	23.1	23.5	24.8	25.8	26.1	25.8	25.7	25.4	24.2	23.6	24.5
Kingston [4]	25.5	25.7	26.2	26.8	27.7	28.2	28.8	28.4	28.4	28.0	27.4	26.9	27.3

1 St. Catherine, 1250 ft; 1976 - 1980
2 St. Catherine, 1931 - 1960
3 St. Thomas, 950 ft; 1931 - 1960
4 Kingston, 60 ft; 1931 -1960 (Rainfall), 1976 - 1980 (Air temperature
5 Clarendon, 1931 - 1960
6 St. Mary, 496 ft; 1931 - 1960 (Rainfall and Air temperature)
7 Portland, 250 ft; 1931 - 1960

characteristic of the southern coastal plains, whereas herbaceous swamp and marsh forest abound on poorly drained areas adjacent to the coastal plains.

6. Land Use.

Of the total area of the country, agricultural lands occupied approximately 46% in 1979 (Table 6). This was a drop from the 55% in 1970. In 1979, export crops occupied 45% of the total agricultural land, whereas domestic and mixed crops accounted for about 21 and 9% of the total land, respectively. In Clarendon and St. Catherine parishes, lands with domestic crops were 13 and 17% of the total land, respectively. Lands with mixed crops were 4 and 8% of the total land in Clarendon and St. Catherine parishes respectively. The above figures show a small acreage of the total agricultural land being actually grown with mixed crops whereas twice that area is used for livestock production.

Among crops, yams (Dioscorea so.), red peas (Phaseolus vulgaris L.), tomato (Solanum licopersicum L.) and cassava occupy the largest acreage at both Clarendon and St. Catherine parishes (Table 7). The area for vegetables, except for carrots (Daucus carota L.) and cucumber (Cucumis sativus L.), was slightly larger in Clarendon than in St. Catherine. But on the whole, the parishes show similar land use patterns, with most of their agricultural lands being used for export crops. The current land pattern reveals the emphasis given by the Government and foreign donors to the coastal plains as the areas having the best agricultural potential for intensive exploitation.

7. Human Element.

A large proportion of the total population of Jamaica resides in the rural areas (Table 8). The early spread of human settlements in the upland areas was the result of large sectors of the population actively seeking lands to provide sustenance for their families. Accelerated population growth and overexploitation of resources have resulted in less available land, and excessive fragmentation of farms. Currently, a large proportion of the rural sector is either landless or unemployed. The problem of unemployment was traditionally eased by exportation of labor surpluses to U.S.A., Canada and Britain. However, recent migration barriers in these countries have worsened the unemployment situation. Creation of job opportunities in agricultural and nonagricultural activities in the coastal plains may relieve some of the population pressure being exerted on more fragile ecosystems of the plateau.

B. FARMING SYSTEMS AND THEIR ECOLOGICAL IMPACT.

1. Cropping systems.

Multiple cropping is a system that prevails on the rugged terrain

Table 6. Land Use Distribution, Clarendon and St. Catherine Parishes, 1978-1979*

Land Use[1]	Clarendon	St. Catherine	All Jamaica
	acres		
Total Area	294,653	295,593	2,715,829
Agricultural Area	153,381	147,186	1,246,772
Domestic Crops	20,145	25,671	266,204
Livestock and poultry	17,210	10,025	307,150
Export Crops	110,161	100,112	567,018
Mixed Crops	5,865	11,378	106,400

*Source: Census of Agriculture 1968 - 1980. Department of Statistics.

[1] Land Use categories represent types of major income earning agricultural activity.

Table 7. Lands Used for Selected Crops at Clarendon and St. Catherine Parishes, 1981*

Use	Clarendon	St. Catherine	All Jamaica
	----------Acres----------		
Yams	3087	3022	26,266
Potatoes	153	118	3,221
Sweet Potato	605	497	6,687
Red peas	1096	818	11,064
Cabbage	411	242	3,451
Carrot	97	118	3,533
Cucumber	146	260	1,425
Tomato	708	469	4,510
Cassava	744	774	4,836

* Data Bank, MOA. Unpublished data.

Table 8. Distribution Pattern of the Jamaican Population (1979)
Source: Aitken - Soux et al. (1980)

URBAN			429,598
RURAL			968,504
Non-Agricultural		62,813	
Agricultural		905,691	
Farmers	193,359		
School Children (14 - 19 years old)	94,063		
Labourers in farms and sugarcane workers	163,744		
Adult unemployed	454,525		
TOTAL ACTIVE POPULATION*			1,398,102
TOTAL POPULATION			2,160,900

* Urban plus rural active population (14-65 years old)

of the Rio Cobre and Rio Minho watersheds. The cropping pattern does not follow closely either seasonal variation of rainfall and temperature, or trends on the local market. It is an array of crops grown mainly to meet food needs of the small farmer. Occasionally, the routine is changed and cash crops are grown to meet sudden demands of the local market.

Warm and humid microclimates of depressions and gullies of the hillside lands are suited for a wide range of tropical crops. Here, fruit crops such as bananas, citrus and coconut (Cocusnucifera L.) are grown with coffee, cocoa (Theobroma L.) and vegetables. On steep lands, yams, sweet potato (Ibomea batata L.), and potatoes dominate the landscape. They are grown at low plant densities on mostly uncovered soils, and are accountable for large soil losses and productivity decline on hillside lands. Monoculture is practiced with high price crops on a limited basis. Some technical inputs are used in monoculture (fertilizers, pest control) while such inputs are used less frequently on food crops grown for the farmer's consumption.

2. Livestock Systems

The small farmer generally keeps goats, pigs and poultry and occasionally a cow or two. There has been a considerable recent increase in goat population in both the Rio Cobre and Rio Minho watersheds as shown below (Engle, 1983):

Parish	1978	1980
St. Catherine	4,000	13,000
Clarendon	26,000	60,000
All Jamaica	259,000	283,000

Nevertheless, goat production has received so far little special attention from the farmer. Small farmers regard goat production as an accessory activity to their farm chores and little time is spent on a more rational production. Expansion of goat herds is further constrained by larceny and dogs. So far, the small population of livestock in hillside areas has not constituted a threat to the ecology of the watersheds except where grazing is allowed on lands highly susceptible to soil erosion.

3. Research and Technology on Farm Production.

One striking feature of crops grown on hillside farms is their low level of productivity. Yields of some crops are not even close to one-half of yields obtained when high levels of input and expertise are applied (Table 9). This is a clear indication of the low technology applied in producing these crops.

The agricultural research system in Jamaica has been strongly oriented to produce technology needed to grow export crops. Thus, the low technology used by the farmer is at least in part a result of the continuing failure of the research system to effectively address the complex problems of upland agriculture. This is a critical situation since most of the food

Table 9. Yields of Main Crops at Pindars River and Two Meetings Watersheds. Source: MOA, 1981

Farm size	Sugar-cane	Bananas	Potatoes	Sweet potatoes*
Acres	----------Tons/acre----------			
1	18.8	2.9	3.2	-
1-2	13.5	2.8	2.2	1.3
2-5	16.4	2.7	2.4	1.0
5-10	15.3	2.4	2.3	3.9
10-20	12.7	2.7	2.4	4.1
20-50	11.0	2.1	-	0.1
50	6.0	0.5	-	-

* National average yields for potatoes and sweet potato are 6.6 and 8.2 tons/acre, respectively (Statistical Yearbook of Jamaica, 1982).

consumed locally consists of crops grown by small farmers operating in the upland regions.

Considerable research on multiple cropping has been conducted for several years in many tropical areas having environmental and soil constraints similar to those found in the uplands of Jamaica. Unfortunately, this large body of relevant technology is not reaching hillside farmers because of the lack of a resource data base as a means for technology transfer, and the inefficiency of local mechanisms (research and extension) to effectively ensure technology transfer. There is an urgent need to complete and update the natural resources inventory of the country (soils, climate and crops) so that transfer of technology can be scientifically based on the characteristics of the land and the requirements of the crop. The existence of a reliable resource data base will enable local scientists to use advances in computer technology and crop simulation techniques to predict and validate yield performance of a given crop for a particular tract of land with limited trial and error research. What is implied here is the need for a more rational and scientific approach to efficient land use in the upland regions of Jamaica.

C. NONAGRICULTURAL SYSTEMS AND THEIR SOCIOLOGICAL IMPACT.

1. Forestry and Lumbering Operations.

In the past, shifting cultivation was a sustained production system for small farmers. However, under the present conditions of high pressure for lands, slash and burn cycles of shifting cultivation have been shortened to the point that steep lands are continuously cropped without appropriate soil conservation practices. Uncontrolled activities of loggers for lumbering operations in hillside lands have also contributed in some measure to the process of deforestation. A quick survey of the upland regions of the Rio Cobre watershed, for example, has showed significant areas of forest lands being cleared and cultivated. In addition to the decline of productivity of these lands due to soil losses, there are other impacts of deforestation, (for example, on downstream ecology of the Rio Cobre watershed) that are already evident such as an increase in runoff and sedimentation at the Rio Cobre dam.

2. Roads.

The total road network of Jamaica consists of some 7000 miles distributed as main roads (2700 miles) of which 50% are paved, and secondary roads (4500 miles) (UNDP, 1971). While the positive impacts of roads, especially secondary roads, on the economy and well-being of small farmers, have been largely recognised, little attention has been given to their unfavorable ecological impacts such as accelerated erosion and landslides. Visits to the remote, high rainfall areas of the Rio Cobre and Rio Minho watersheds, have revealed roads that are severely eroded with poor surface drainage and lack of vegetative cover on side slopes. There is a need for

sustained road maintenance to offset costly repairs and reduce damages to property and crops.

3. Human Settlements.

The total urban area in Jamaica for 1970 was 100,000 acres. Projected urban area for 1990 is approximately 142,000 acres (UNDP, 1971). It is expected that 10,000 acres from natural range and grass lands plus 22,000 acres from forest lands and 10,000 acres from marginal lands will be used to accommodate the expansion of the urban area. Most of these 42,000 acres are located on the hillslopes of upland Jamaica. Moreover, if current trends of population expansion continue, a very large proportion of the total will occur in the Rio Cobre watershed.

Although no quantitative information is available on the impact of urban centers and rural settlements on the ecology of watersheds, severely eroded lands, found near unfinished construction activities of rural residents of the Rio Cobre and Rio Minho watersheds, are a clear indicator of accelerated erosion associated with rural settlements. Soil losses often may be prolonged on lands cleared for rural dwellings and farm buildings, as small farmers frequently take long periods of time to build their houses due to economic constraints.

D. LAND EROSION ASSESSMENT.

1. The Land Capability Classification.

The land capability classification system used to assess erosion problems of Jamaican lands is a modification of the USDA land capability system, with special features to "fit extreme soil erosion hazards of hillside lands in tropical and subtropical regions" (FAO, 1977). This land assessment was primarily designed to identify general agricultural uses (i.e., cultivated lands, pastures, etc.) without specifying crops that can be grown at the different levels of the classification scheme (Table 10). Furthermore, the classification was based on only three limiting factors: soil depth, slope and climate. It was assumed that chemical constraints are not permanent limitations and can be overcome by soil management. Although climate was listed as a diagnostic criterion, none of its basic components (e.g., rainfall or temperature) were actually used to develop the classification scheme.

The FAO capability system is a "treatment-oriented" scheme (FAO, 1977). For each capability class there is a set of soil conservation practices. For lands with slope below 7 degrees, any soil conservation practice is recommended. Above 7 degrees , six major conservation practices are advised: bench terraces, hillside ditches and individual basins for lands up to 25 degrees, and orchard terraces, hexagons and mini-convertible terraces for steep lands above 25 . All these soil conservation practices require a complex array of specifications, instructions, materials and equipment.

Table 10. Scheme of the FAO Land Classification System.
Source: FAO (1977)

Soil Depth cm	Slope Degrees	Code	Capability Class
90	<7	C1	Cultivated Land 1
	7-15	C2	Cultivated Land 2
	15-20	C3	Cultivated Land 3
	20-25	C4	Cultivated Land 4
	25-30	FT	Fruit/Food trees
	30	F	Forest Land
50-90	<7	C1	
	7-15	C2	
	15-20	C3	
	20-25	C4/P	
	25-30	FT/F	
	30	F	
20-50	<7	C1	
	7-15	C2/P	
	15-20	C3/P	
	20-25	P	
	25-30	F	
	30	F	
20	<7	C1/P	
	7-15	P	
	15-20	P	
	20-25	P	
	25-30	F	
	30	F	

2. The Soil Conservation Program.

The Soil Conservation Division (SCD) was created in 1973 with major responsibilities in devising and implementing technical aspects of soil conservation components of rural development projects. Additional responsibilities included research and training. The SCD accomplished most of its responsibilities within the limitations of being a project service organisation rather than a technical institution with long-term goals and continuous financial support. After more than a decade of working in soil conservation, the future of SCD is now uncertain. There is no long-term national soil conservation program to effectively support its existence. Meanwhile, the SCD has been annexed to the Ministry of Agriculture as part of the Forestry and Soil Conservation Department (Forestry and Soil Conservation Department, 1985).

3. Research and Technology on Soil Conservation.

During the 1970's the SCD, with assistance of FAO experts, developed an array of mechanical control methods designed to counteract soil erosion losses in hillside lands of Jamaica (FAO, 1977). This technology was meant to guarantee the permanency of control devices because of failure of conservation practices used in previous development projects (FAO, 1973).

Field research conducted at Smithfield demonstration farm showed that soil losses in newly terraced soils grown with yams were about 10 ton/ha/year whereas soil losses in similar plots without terracing were as much as 134 ton/ha/year (Sheng and Michaelsen, 1973). A similar trend in soil losses, when compared with control plots, was observed in plots with hillside ditches. The field results suggested a marked decrease in soil losses by the use of terraces. However, the effectiveness of terracing against less cumbersome conservation practices was not studied. Based on these findings, the Government of Jamaica embarked on an ambitious program of soil conservation within the Second Integrated Rural Development Project (IRDP), where terracing was one of the selected mechanical control methods. Soon it was realized that terracing was costly and ineffective for local farming conditions (Wahab et al. 1980; Blustain, 1982, 1985). However, the construction of terraces continued almost until the end of the project in 1983. Ironically, the International Fund for Agricultural Development (IFAD) is currently using similar soil conservation practices as a requirement for small farmers who want agricultural loans. Hillside ditches constructed with IFAD loans were observed on very steep lands of the Rio Minho watershed, where perhaps the best solution was not to crop these soils at all. This is an indication of the increasing pressure for credit as small farmers are willing to abide by the short-term soil conservation responsibilities in order to get the loan. But it also reveals a most deep-rooted problem, a poor technical judgement on the part of soil conservation officers in devising and supervising soil conservation practices on lands that are for all agricultural purposes unsuitable. Given the weak technical base for the soil conservation component of IFAD loans, it is doubtful that IFAD can achieve better success than previous rural development projects.

One of the main reasons for the lack of success of terracing was the absence of proper maintenance. The use of grants and subsidies promoted short-term participation of small farmers. A lack of understanding about the long-term benefits, in both crop production and reduced soil losses, of sustained soil erosion control may have contributed to the farmer response. So did the high labor costs involved in annual maintenance.

Whether the soil conservation technology generated by SCD could substantially reduce soil erosion in Jamaica, remains as a subject of controversy (Blustain, 1982, 1985). But the fact is that yields of most crops, as a result of terracing, declined over time either as a monoculture or in mixed stands (Campbell et al. 1979; Harrison et al. 1982; Sheng and Michaelsen, 1973). Several reasons can be listed, but it is most likely that exposure of subsoil, as a result of terracing, may have also exposed hidden physical or chemical constraints. These soil constraints need to be addressed differently as soils and land use change. For example, clayey, high KCl-extractable Al, nutrient deficient subsoils of Ultisols, if subjected to terracing, would provide a harsh environment for plant growth and would need inordinate amounts of soil amendments for sutained crop production. Subsoils of Mollisols subjected to terracing would be less limiting to plant growth and would require less inputs than Ultisols for crop production. The above situation clearly emphasizes the need to combine effective agronomic practices with soil conservation technology to ensure acceptance and use by the small farmer.

A major criticism of the IDRP experience is that it lacked an effective research back-up system to address, on a timely basis, multiple technical problems associated with the development of the project. For example, it was realized in 1981 (four years after the project was established) that soil loss studies were needed to measure the impact of IRDP on soil erosion control (Blustain and Powell, 1981). Time and time again, the question of the lack of appropriateness of the technology used in IRDP, and its lack of flexibility to accommodate to hillside conditions, has surfaced in published reports, field trips and personal communications. What clearly emerges is the fact that not enough research was carried out before or during the life time of the project to provide technology in sufficient depth and quality to attain the soil conservation goal of IRDP. Clearly, much research on soil erosion is needed if new rural development projects, with a soil conservation component, are going to be implemented. The SCD technology needs a greater range of solutions to a given soil conservation problem and more flexibility in selecting among them.

E. CONCLUSIONS AND RECOMMENDATIONS.

Lack of qualified staff has constrained the SCD in providing effective leadership in design, execution and maintenance of soil erosion control practices (Sheng, 1984). If the SCD upgrades its staff through short-term and long-term academic training, it can take far better advantage of worldwide technology being generated in soil management of hillside agriculture. What SCD needs is to increase its visibility and strengthen its

capability not only as a service to provide technical expertise, but also to provide qualified assistance in planning, executing and monitoring upcoming hillside rural development projects.

The need for a long-term soil conservation program for Jamaica already has been stressed (Sheng, 1984). The success of a soil conservation program in Jamaica, however, will depend not only on the ability of local scientists to judge critically whether a piece of land has a given erodibility risk, but also on their ability to identify effective control measures to counteract soil losses and agronomic practices designed to ensure sustained crop production.

The FAO land capability system used by the SCD produces erosion assessment outputs and recommends soil conservation practices based on limited soil information. It disregards basic soil characteristics that determine inherent susceptibility of a soil to erosion. Soil erodibility depends on aggregate stability and particle size distribution. In the Universal Soil Loss Equation (USLE), soil erodibility is quantitatively defined by the erodibility (K) factor. The K factor can be quantitatively estimated from physical and chemical properties which are available in most soil surveys conducted in Jamaica. Hence, provisions need to be made to incorporate the K factor in the FAO land capability system. In addition to soil depth and steepness of slope, estimated K values can be used to group and rank soils in terms of their susceptibility to soil erosion. This, in turn, can be used for conservation planning purposes as well as for erosion control.

The FAO land capability system is actually a land assessment based on one attribute of land: erodibility. However, several land attributes or qualities (i.e., soil acidity, water availability, nutrient availability, etc.) determine the overall suitability of a given land for a particular use (Manrique and Uehara, 1984a; 1984b; Manrique, 1985). Failure to recognize the fact that crop performance depends on the interaction of several land qualities would lead one to believe that once soil erosion control measures are instituted, related soil or environmental constraints should be readily overcome. But application of terracing, or other mechanical controls, does not change the fact that a strongly acid Ultisol is not suitable for maize or beans unless soil amendments are applied. Measures need to be taken to assess land capabilities for future rural developments on the basis of all attributes controlling plant growth and yield. The concept of matching crop requirements to land characteristics should be thoroughly revisited.

Prevention of soil erosion is no less important than its control on hillside lands of Jamaica. The SCD has conducted soil erosion surveys at reconnaissance level, and published soil erosion maps for the whole island (Sheng, 1984). Soil survey studies using Soil Taxonomy (Soil Survey Staff, 1975) have also been completed (CRIES, 1982). The use of Soil Taxonomy as a basis for updating current soil erosion maps is strongly encouraged. Soil Taxonomy is a hierarchical system that permits basic data on soil erodibility to be extracted at any step of the taxonomic ladder. The potential for practical application of Soil Taxonomy in Jamaica, not only in erosion assessment but also in land use interpretation and land use management, should be fully explored.

Jamaica needs more than rainfall frequency studies (FAO, 1977), to assess the impact of rainfall intensity on soil erosion in hillside lands. As a general rule, rainfall is recorded and expressed on a monthly basis. Although very useful to determine soil moisture regimes and water availability for crops, mean monthly rainfall is not directly related to soil erosion. Among rainfall factors, the kinetic energy of raindrops is the factor most closely correlated with rainfall erosivity. Drop size determines the amount of energy of each drop. As rainfall intensity increases, the size of individual drops also increases, thus increasing the energy of the storm (El-Swaify et al. 1982). For practical purposes, the E130 index, which is the product of the total kinetic energy and the maximum 30-minute rainfall intensity (Wischmeier, 1959), is the best way to assess rainfall erosivity. Based on cumulative values of this index, isoerodent maps can be readily prepared for a given watershed. Isoerodent maps, in conjunction with soil erodibility maps can greatly improve the accuracy of soil erosion assessment. The expansion of current weather gathering techniques to include measurements of rainfall intensity and duration can help to make this possible.

There is an increasing need to offset mounting criticism regarding the lack of "appropriateness" of soil conservation technology used in previous rural developments projects. Research efforts to counteract soils losses and productivity decline of hillside lands should be directed to develop feasible and affordable alternative soil conservation practices designed to keep the soil covered at all times. Research on planting dates for different local crops aimed to match growing seasons to periods of low rainfall erosivity risk should be accompanied with studies on plant densities and fertilization. The selection of cultivars tolerant not only to intrinsic soil constraints but with a proven ability to produce acceptable yields under high plant densities or weed competition in zero or minimum tillage systems, is of critical importance in the development of suitable cropping patterns for hillside lands.

Considerable research on soil conservation practices has been conducted elsewhere to decrease soil particle detachment and transport and to increase soil infiltration. Such practices usually involve the incorporation of different organic materials (e.g., green manure) and the use of mulches. These practices, if used in hillside lands, should enhance the effectiveness of cropping systems to reduce erosion losses in lands with low to moderate slope. Lands with steep slopes have fewer alternatives for crop production. Research on erosion control must be oriented to develop long-term cropping systems with perennial crops and pastures as main components. Research on pasture improvement, range management and forestry, is vital to strengthen the effectiveness of soil erosion control measures.

One of the lessons that arises from previous development projects in Jamaica is the need to use a multidisciplinary approach to solve soil and crop constraints afflicting hillside agriculture. For example, failures to achieve increased yields of mixed crops grown at experimental soil conservation plots (Wahab et al. 1980) are the result of neglecting soil and crop components (disease and pest control, plant competition, fertilizers, etc.) in systems where more than one crop is grown at one time. Technology on multiple cropping is available elsewhere. With careful consideration of local conditions it can be readily adapted to the requirements of hillside agriculture in Jamaica.

Research efforts to address problems of hillside agriculture in Jamaica are undermined by (1) proliferation of short-lived technical organisms within the Ministry of Agriculture, (2) lack of continuity sufficient to effectively pursue long-term research goals, (3) absence of qualified staff in both research and extension with the ability to generate, display and deliver technology to the farmers, (4) lack of effective governmental support, and (5) ineffective linkage between research and extension. To re-establish confidence in research and build up credibility on technology outputs, the creation of an autonomous agricultural research center outside of the Ministry of Agriculture is recommended. This institution should incorporate all current agricultural research and extension organisms under its umbrella. This institution should provide a comprehensive framework to (1) tackle soil and environmental constraints of both upland and lowland agriculture, and (2) to provide the means for effective transfer of technology. Training, which appears to be the main constraint in both research and extension, should be a major institutional responsibility of this organism.

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Annex 2

Market Conditions and Their Effect on Hillside Farming

G. Armstrong

Annex 2

MARKET CONDITIONS AND THEIR EFFECT ON HILLSIDE FARMING

G.R. ARMSTRONG

This paper focuses on selected characteristics of the market structures through which the hill farmer sells his goods and obtains his factor inputs, and on the ways in which those markets affect his welfare. Many excellent reports have described how these several markets are structured and how they operate. They are listed in the bibliography, and serve as partial background for the observations that follow.

Product Marketing and Distribution

Hillside farmers, because of their preference for multiple cropping combined with animal raising, typically enter into several markets and deal through several market mechanisms. The individual may sell both for export and in the domestic market. And he may use the special facilities and services of the higgler, the export-oriented statutory marketing boards and cooperatives, or any of several types of associations that are meant to facilitate and streamline such activities as handling, grading, packaging, storage, transportation and transfer of market information.

The time-honored higgler system dominates the domestic market. Structurally, it approaches pure competition, with thousands of intermediaries dealing directly with thousands of farmers and with thousands of consumers. Its special strengths seem to be in the higgler's willingness to deal in small quantities, to help in harvesting, to provide pickup and transportation from the farm gate direct to the marketplace, and to control market information. Its weaknesses appear to rest in post harvest losses arising out of rough and frequent handling, poor quality control, inadequate storage facilities, and poor distribution practices which entail much cross hauling.

The higglers' special competitive advantages lie in their ubiquity, ability to handle small quantities of produce, low overhead costs and, in spite of occasional claims that they take too high a markup, generally low margins which appear to be in the neighborhood of 30% of retail. There is, too, the fact that many are friends and relatives of the farmer they service.

Until recently, the Agricultural Marketing Corporation was a significant alternative mechanism for farmers throughout the country. Started in the mid-60's, it promised to farmers assured sale of products of acceptable quality, while simultaneously offering local food distributors an assured supply of quality goods and low prices to the poor. It provided purchasing, collection, grading and packaging for domestic sales and for export of non-traditional crops. It also aimed to provide for the purchase and distribution of grower's supplies. By the late 1970's, it had expanded operations to include some 200 buying stations, scattered countrywide, eight

regional branches, 19 greengrocer retail outlets and almost half a hundred other retail stores. It was said at that time to command about 20% of the domestic wholesale market. Importantly, it offered farmers a guaranteed price floor for their production. This, together with managerial inefficiencies and relatively high overhead appears to have been its undoing. Although it served as an important outlet to government institutions, hotels, restaurants and supermarkets, and although it was organized to conduct extensive retail operations, it is now defunct. The price floor concept, given the violent swings that occur in market production from time to time, too often left it with quantities of perishable goods that had to be offered at prices too low to cover costs of operation.

Its potential replacements in the marketing scene are the Producer Marketing Organizations (PMO), a number of which are being established about the country. They will aim at increasing the volume of sales of produce, particularly for export but also locally. The stated aim is to improve farmer incomes. The strategic focus is to be placed on expanding consumer demand by broadening the array of products in the marketplace, and ensuring higher and more uniform quality and more uniform product availability throughout the year. Emphasis will be placed on harmonizing deliveries within the country to smooth out local surpluses and shortages, and on making available packaging and storage services that higglers cannot provide, thus substantially reducing post harvest losses. A guiding rule will be to keep overhead costs low, and to depend heavily on selling techniques rather than on massive capitalization.

This kind of development, while protective of the small farmer's interest, also requires from him more care in harvesting and handling, and more rigorous culling of low quality stock than the higgler has traditionally required. So it calls for some change in on-farm procedures.

A third option for the farmer is to do business through the statutory marketing boards which have been established to handle the export of traditional commodities such as bananas, cocoa, coffee, sugar and tobacco. Other export crops, like citrus, are regulated by cooperatives. All those export mechanisms embody some degree of Government control, and some coops have been faulted by small farmers as being dominated by large producers.

These traditional export markets have some special, current characteristics important to the small farmer. Except for sugar, they are supplied primarily by small farmers, have been consistently unable to meet consumer demand (i.e. to produce the quantities that the boards can sell overseas) and have rigid quality requirements that are hard to meet without very careful management.

Small farmers have not risen to the challenge of meeting quantity of production requirements, although prices for several of these commodities are relatively high. Established plantings on many farms are not receiving treatment to improve productivity, and it appears that few idle lands are being converted to these crops even though (as in the case of coffee) they may be well suited to such production.

As a result, a new competition has emerged. It has two important aspects. One is that production is beginning to shift into the hands of larger-scale producers who can take advantage of some scale economies, manage for quality and grade, and keep productivity high by applying advanced methods on better soils. Another is a beginning shift of production emphasis from the hills to the plains where a new technology promises consistent, high level performance. Bananas are a case in point, and increasing numbers of vegetable crops may be expected to follow. The long term prospect appears to be for hill producers to lose the markets for some commodities to lowland producers, and for larger producers in the hills to capture an increasing share of the market from small producers.

Another aspect of this export market worth noting is the weak current linkage between export and local sales, wherein farmer deliveries (e.g. of bananas) are culled to meet export requirements, but provision is not necessarily made for the lower quality stock to be merchandised elsewhere to his benefit.

A fourth option for the farmer has been to seek out hotels, restaurants, institutions, greengrocers, supermarkets and food processors, such as local canneries as a consumer group whose special needs he can meet. What stands out about them is their typical emphasis on standards of quality, and timing and regularity of delivery.

Finally there are the livestock markets. Statistics on livestock raising, slaughtering and marketing in the hill areas are scanty. Much of the output of the industry appears to derive from casual operations on small farms, where livestock are not scientifically managed. Rather, they serve as a living savings account which is called upon as needed.

Although production data are probably only rough estimates, there is indication of a pronounced rise in numbers of livestock in recent years. Two reasons for this may be first in the recent proliferation of "landless" farmers who undertake to raise a small herd of livestock, most typically small ruminants, as a means of livelihood; and second is the method of using livestock as an income substitute for crops on lands for which adequate labor, fertilizer, chemicals or other inputs may not be currently available. Thus, casual livestock raising comes to represent a temporary solution to the inability to put the land into cultivation.

The market for livestock appears to be one to which little attention has been paid. Itinerant butchers serve as the intermediaries. Quality requirements are minimal, and much of the meat is handled and sold in an informal, loosely controlled way. Information on demand and price appears to be transferred even less effectively for meat than for crops. Profits for farmers appear to be modest compared to final selling prices.

The current intensification of animal raising on hill lands raises an important question of land use. The carrying capacity of available lands is typically low for livestock as well as for crops, most frequently because of steepness and infertility. The impact of heavy grazing can be to retard the recovery of grasses and herbaceous cover on lands taken out of cropping and

left in fallow. Thus, erosion problems may be created on lands that otherwise would be returning to grass and tree cover. Attention needs to be paid not only to the profitability of livestock raising on hill lands of varying quality, but also to the pressures unwise management can create for further depletion of soils and water holding potential.

What can be drawn from this quick review of characteristics and conditions of markets within which small hill farmers currently deal? At least four important trends have been pointed up. One is the beginning of a shift of production of some commodities out of the hills and onto the plains, where entirely new technologies are being successfully applied. A second is a rising interest in larger scale production of single crops on hill lands carefully selected to give improved economic returns. A third is the emergence of a stratified market in which quality of product, time of delivery of and dependability of supply have become increasingly important both for export and domestic sales. The farmer is being asked, increasingly, to substitute his product for imported foods, and this means matching quality levels that hotels, institutions and the like have come to expect. The fourth is the intensification of farmer interest in livestock raising in the almost complete absence of effective market information and controls or management guides.

Input Characteristics and Markets

Current land use in the hill areas depends heavily on the availability and effectiveness of inputs as well as on market trends for outputs. Four such inputs recommend themselves for review: land, labor, capital and expertise, both managerial and technical.

Land

The quality of much of the land available to upland farmers is low and declining. The parent materials are acid and well leached. The clean cultivation methods widely used by area farmers, combined with the steep slope of much of the land invite soil erosion and further reduce soil fertility. Farm activities such as fertilization and the use of mulch, humus and organic cover for the land are infrequent, and so add little in the way of replenishment of soil productivity. By reason of steep slope and adverse soil factors, much of the plateau has been ranked in land capability class IV or higher. These classes are viewed as being marginal or sub-marginal for agricultural use. A large share of the privately owned land is occupied by persons who cannot demonstrate firm proof of title. Much of it is "family land" owned jointly be several persons, though perhaps farmed by only one. Additional areas are remote from roads and inaccessible, or have very steep slopes of 30 or more, or have other features which set severe limits on their utility for farming and investment. For these several reasons, plus low farmer incomes which prevent easy purchase of lands for expansion or new farm development, sales of agricultural land are limited in number.

Census data for the period 1968 - 1978 actually show a modest decline in farm acreage within the parishes which embrace the watersheds. There was a concurrent tendency for large farms to grow larger. Medium size farms (10-49

acres) decreased in numbers and average size, probably because they were absorbed into, or grew into, larger farming units. The number of small farms remained about the same.

Most of the land purchases made in order to expand larger farm operations have been characterized by the agricultural extension officer as consisting of better quality lands. Current purchases of marginal properties, judging from field observations, are most likely to be made by urban workers seeking a rural residence. Such properties tend to be small and easily accessible by paved road.

Current land prices cover a wide range. Good quality farm lands reportedly sell for as much as $12,000J per acre. Poorer quality, untended lands are selling as low as $500J per acre.

Lack of money capital, advancing age and development of off-farm employment appear to have encouraged a shift away from active agricultural use of land. So the total amount of idle land in the two watersheds is rising. Such land tends to be relatively inaccessible, and otherwise marginal or sub-marginal for agriculture.

The general picture that emerges is one of a modest rate of transfer in land ownership, primarily of better lands into the hands of larger farmers, but occasionally also (and particularly in St. Catherine parish where pressures toward urbanization continue to increase) a trickle of less productive land into the hands of rural residents. At the same time, the fund of unused, idle land is increasing. Small farm owners seem generally to lack the capital to utilize such lands effectively. This unused land tends to be less accessible, workable, or productive than those lands still actively farmed. Large acreages of land lacking clear title, or jointly owned, also constrain activity in the land market.

Labor Input

Agricultural labor is currently facing high unemployment and relatively low hourly wage rates. Because the urban labor market is concurrently shrinking, surplus rural labor has no viable employment alternative of significance. The ranks of the rural unemployed may even be augmented as some farm-bred urbanites return to their home communities. Accordingly, it has been relatively easy for employers to find labor at going rates ranging from about $10 to $16J per day. Moreover, changes in these rates seem to lag behind the rise in the cost of living.

In spite of this labor surplus, recent surveys do mention labor shortages as a farmer problem. This may be because local circumstances can combine to make for temporary shortages both in the quantity and quality of farm labor. Seasonal variations in work load make the biggest difference. During planting and harvesting of traditional crops, peaks of employment may be experienced for short periods which the local work force cannot satisfy. Also relevant is the rigor of some work, such as hand preparation of the soil, which makes for low productivity among untrained or unseasoned workers; and the length of hire, which farmers caught in a cost-price squeeze typically try to

keep to a minimum number of hours. Because the better workers get longer-term employment, the short term jobs tend to fall to those who are less productive. So the "shortage" may refer to those who can work effectively. An even simpler explanation is that a "lack" of farm labor really means an inadequate supply at prices the farmer is willing to pay.

Allowing for these temporary conflicting conditions, the general prospects in the upper watersheds are for agricultural labor to be available in sufficient supply into the foreseeable future to keep labor prices from rising materially. Although the technical sophistication of the workforce (its ability to use advanced machinery or methods) continues to be generally low, typical farm operations are not geared to advanced methods. So neither labor quality or quantity presently stand as important limiting factors for hill agriculture.

Capital Inputs

The typical roster of physical capital needs among hill farmers embraces seeds and growing stock (including livestock), feeds, fertilizers, herbicides and pesticides, tools, and occasionally also machinery and transportation devices, irrigation equipment, packaging materials and farm building materials.

Bourne and Pollard[4] found that the quantities of agricultural inputs that are imported, such as fertilizers, tools and machinery and planting materials tended to decline throughout the 1970's. Furthermore, while real prices of fertilizer, chemicals and handtools rose less rapidly than did the price of labor, small farmers and producers for the local food markets had less access to them than did larger, export oriented farmers. The relative decline in imported agricultural input availability was therefore seen to impose an artificial constraint on local food production and to create dependence on imported foods. Exacerbating the situation was a decrease in farmgate prices relative to market prices. So farmers received relatively less money with which to buy inputs that were becoming scarcer.

Small farmer savings are typically modest. A recent survey[9] shows that more than one third of them do not save. By implication, many are probably dissavers. And of those who do save, two third put aside less than $500. It follows that input requirements are often met with borrowed money. The survey showed 42% of the sample population to be borrowers. Sixteen out of 421 got formal loans in the sample year, and 10 times that many (163) obtained money for "investment" by less formal routes such as from higglers, family and friends.

These loans and "investments" were typically small, about 90% of them being under $300, and the borrowings were used primarily for planting materials. Land preparation and fertilizers came second, and other interests were negligible.

Judging from these observations, small farmers do not normally appear to have access to capital sufficient to provide inputs for substantial

improvement of their farm productivity or output. The literature suggests that this is largely because they either do not have something appropriate to offer as collateral (land title is a common requirement) on a loan, or because they have failed to repay an earlier loan. Failure of loan repayment proves to be common. In representative P.C. Banks, for example, 30-40 percent of all loans were found to be in arrears more than one year[18].

If we assume that the farmer wants to repay the loan, the likely reason is that he cannot because his recent income was not sufficient to support repayment. Among possible reasons, one stands out as a likely possibility. It is the effect of improper risk assessment. In fact, there is reason to suspect that goals of development projects sometimes are not met because the influence and size of the risks faced by the small farmer have been underestimated. The following two scenarios will help to make the point.

> Scenario 1. The farmer's borrowings are invested in seed, fertilizer and chemicals. Within the following several months any of the following can occur: drought, cloudburst, hurricane, personal injury or illness, unknown plant disease, crop theft, severe market price drop. The chance of any one of these occurring can be measured and is probably small. Its impact may range from negligible to loss of the entire crop. Taken as a group the chances of occurrence of one or more, and the effect of their combined impact on crop losses become significant.

> Scenario 2. The farmer earns a modest profit in the marketplace. Cash in hand, he reflects on his position. There is illness in the family he owes a higgler money at exhorbitant interest rates, and inflation has just boosted his costs of operation by 10%. The risks of illness, usury, inflation are not well reflected in the estimates of income and expenditure postulated on the loan form. Yet they are a stark reality for the small farmer.

Given the circumstances of Scenario 1, the economic payoff from estimated physical production on a year by year basis is patently unrealistic to the farmer. He tends to discount yields far more than will the agronomist who is thinking only in terms of the physical capability of the crop. And Scenario 2 suggests that loan repayment may be given a new priority in the face of unexpected demands for his earnings.

What seems to be missing, in evaluation of payoffs to be derived from following a farm plan or shifting to a new crop, is explicit recognition of the many possibilities of partial or complete failure and what their combined weight may be. Studies of the real reasons why payments were not made and why, and how often crop failures occur are needed to make realistic payoff estimates.

Managerial and Technical Input

Embodied here is the intellectual capital of the farmer; his ability to plan, organize and implement; and his background of training and experience in the techniques needed to run an effective farm production and marketing operation under changing conditions.

Farmers build their technical and managerial skills in at least four ways; from formal training, from expert assistance (as from the agricultural officer), from other farmers, community leaders and associates whose techniques and procedures they can seek to emulate (or avoid), and from their own day to day experiences.

Recent sociological studies describe the small and medium farmer as seriously deficient in formal training. Clarke6 found that while 11% had had a secondary education, 16% had never gone to school, and many, because of their advanced age, had been away from formal training for a long time. The MOA recently labelled 40% of all farmers as functionally illiterate.10 Even for those who had received a secondary education, attention to managerial and technical principles and practices and their relation to agriculture was virtually nonexistent.

Expert assistance comes primarily by way of the agricultural extension or soil conservation officers. Although they tend to work more with small and medium farmers than with large, their work is watered down by the large numbers of farmers they are responsible to advise (currently 400 per officer), by limited availability of transportation, by lack of up-to-date research input, by lack of technical training among their field assistants, and by supplementary non-extension type assignments. Importantly, they are said to devote increasing amounts of time and attention to second jobs.

The result of those several constraints is to make direct extension support for the individual farmer both modest and infrequent. Allsides surveyors found that none of the farmers in their sample gained information from their agricultural extension officer. In other studies he is labeled as a low frequency source of information.

Day by day practical experience, and sharing information with others in the community appears, therefore, to be the primary learning input. This observation is significant because such learning tends generally to promote incremental change and adjustment in established and accepted patterns rather than opening the mind to new patterns of thought or activity. To put it another way, personal and community experience tends to promote and protect the stability of a way of life, while information derived from outside, such as is (or should be) provided by the schools and agricultural extension officers, tends more often to promote change and importantly, ideas about how to deal with change. The recognized social pressures being brought to bear on hillside agriculture presage strong and sometimes abrupt change in established patterns of activity. Because they lack formal and extension-type preparation, most farmers do not have the managerial or technical tools needed to respond effectively to the need for change. To prepare them for the future, they appear to need both formal training and adequate demonstrations of how the lessons can be practically applied.

Clarke6 asked farmers how important they thought training to be. Ninety eight percent viewed it as important, but only half of them knew (or thought they knew) what kind of training they needed. They expressed the following needs: Agricultural Practices 42%, Farm Planning and Management 10%,

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Farm Problems 5%, No response 43%. What respondents seemed most anxious to have were 1-3 days per month of training split between the classroom and the field. These findings suggest that farmers are receptive to the idea of further education, realistic in their demands upon their own time, and practical about what they need.

Interpretation and Recommendations

The foregoing brief examination of the input and product markets, and the economic context within which hill farmers operate, may be capsulized as follows:

Government is calling on the hill farmer to increase both his output and productivity as a means of better meeting local and export demands for farm products.

The farmer is shut off from rapid, meaningful compliance because of important input constraints. Land and labor are not the culprits, although some of the land he farms is of such low productivity that to encourage him to continue working it is a certain misuse of the nation's resources. The most pressing limitation is in his inability to obtain sufficient capital. Loans are hard to get. Even when capital can be borrowed, important inputs like fertilizer are not always available in quantities sufficient to meet his needs. Because of government import priorities, the possibility of obtaining machines to carry out some labor intensive tasks is even more remote.

Even if the farmer did have the requisite physical inputs, he would likely use them inefficiently and unprofitably because he normally does not have enough technical and managerial training to assure wise production and marketing decisions and practices.

Meanwhile, the market for his product is changing. It is calling for a wider array of products that can be used as substitutes for expensive imports, and is becoming more demanding with respect to both quality and timing of delivery. This is due both to emphasis on exports that can be used to generate foreign exchange, and to the rise in significance of the large hotel or institutional buyer and a rich minority who are willing to pay more if they can get quality products when they want them.

The inability of smaller farmers to meet local and export market needs has given rise to a new competition. These are large scale producers situated both in the plains and in the uplands who treat farming as a business rather than as a tradition, and have better access to capital, physical inputs, and advanced methods. While the impact of their emergence is only beginning to be felt, there is good evidence, much of it from the experiences of other countries, that the bulk of production of some crops now dominated by hill farmers will shift to the plains, and that larger producers in the hills will capture enough of the high quality end of the market for specific crops that smaller farmers will be forced to seek areas of specialized production that they do not exploit now. Evaluation of varying combinations of soil, climate

and slope will help to define which crops will be best to grow on individual small farms. These crops will include some annuals, but it is already clear that several perennial crops offer long run advantages to the hill farmer, and are well fitted to continuous production on the low quality, erodable soils he commands, sometimes in association with other, annual crops.

To date, small farmer responses to economic pressures and market shifts have been dual. The most notable response has been a shrinking down of land in active cropping, and a recession from more remote or less productive properties so that limited capital can be concentrated on the best lands. This contraction of activities is supportive of national output goals as it tends to increase per acre productivity. The second reaction has been to increase livestock output so as to derive some income from otherwise unused land.

What do these observations imply, given that the goal is to improve hillside farmer welfare, while at the same time safeguarding soil and conservation values?

We see the farmer as one whose efficiency as producer permits him to maintain but not materially to improve his economic position. And whose inefficiency as planner and marketer seriously constrains his ability to interpret what is happening around him and to respond effectively to his implied responsibility as contributor to GDP and as steward of the land.

How can his efficiency be increased? Development experiences of the recent past have shown that topdown, prescriptive approaches are unlikely to work. As Blustain put it, "the farmer is the final arbiter of project success"[3]. The decision to act in such a way as to raise his efficiency is his alone. What one can do is to increase his options; give him the tools for selecting among them; let him make his own action choices; and then develop new options fitted to the direction in which he is going.

Increase the Options

What kinds of options are involved? First, there is a wider range of uses for the land; the offering up of a broader array of crops, livestock and farm-based activities that offer economic promise. Second, there is a wider array of tools and techniques for improving and upgrading farm output. Included here are procedures for treatment of the land, as well as methods for the culture and management of crops and livestock. Third, there is improved availability of the factors of production such as land and fertilizer, so that the farmer is able to use them in more effective combination. And fourth, there is a wider range of organizations and institutions designed to assist and service the farmer, such as by providing him with better information, and stronger representation in the marketplace.

The number of options offered need not be large. In the present context, initial stress probably would be placed on soil and water conserving options such as the development of perennial crops and pasture, the retirement of lowest quality lands from agriculture, and the use of agroforestry techniques; on high payoff options such as can be derived from careful use of

fertilizer or advanced methods of coffee culture; on low cost options such as mulching or use of late maturing varieties to take advantage of the market; and on organizational options that stand to improve the collective voice of the farmer such as the Producer Marketing Organization.

Some of those options are very easily demonstrated. It is simple enough to show how to mulch, and what may be achieved by it. Others are vastly more complex, like taking lands permanently out of agriculture which requires not only development and application of effective measures of land capability, but also the creation of institutional mechanisms which will make it possible for the farmer to give up the use of his land to his own advantage (as by trading with, or selling to, government).

Provide Tools for Selection

What the farmer seems most to lack is adequate information on which to base firm decisions. The Farmer's Almanac, the confidences of the higgler and the half remembered production levels of last year are not enough. Before he can sell to advantage he needs timely, unbiased information about market conditions. Before he can enthusiastically support an organization, he needs to understand all that it can do for him, and how to utilize its strengths effectively. Before he can assess the potential of a new use for the land, he needs to know how to measure more precisely what it is doing for him under its present use.

If he is slow in making decisions, or is not considered to be making good decisions, it is in large measure because the media through which he receives information are not giving him quality information in usable form.

A second set of tools he needs is a better appreciation of the principles of management, of planning, of decision making, of marketing, of soil conservation etc., and how to use them in his enterprise. This does not imply intensive formal education. It does suggest the need for explanation of his experiences in terms of principles, and demonstrations of how those principles can be applied to solve problems and meet goals.

The third tool that farmers need, and that seems to be lacking, judging from a quick review of the literature and of the knowledge levels of men in the field, is the effective measurement of farm based activities in economic terms. When a single change is made in a farm process, it stimulates other changes in the long chain of events that leads forward to the consumer or backward to input provisioners. Because the net impact of those changes, on the farmer and other actors in the process, is frequently not traced through carefully, conclusions and assumptions about the economic validity of the process seem often to be poorly based. Both more and better research is needed to make sound economic measurements; more training is needed for extension workers so they can interpret the results in meaningful terms to farmers; and the farmers themselves need to be shown how to use economic tools more effectively in their own decision making.

Recommendations for Action

What can be done to present the farmer with viable options and to provide him with the tools for generating action? Seven activities recommend themselves.

1. Establish a series of experimental farms within the watershed. Use them to test the effects of alternative farming and conservation methods on selected crops and on livestock and soils. These farms also will serve an important role as a school for groups of farmers who elect to come for short periods of a few days to get a combination of classroom and fieldwork. The training aspect is particularly significant. It can provide needed background on such things as farm record keeping, or how cooperatives function, or how to go about borrowing money, or how to prune fruit trees or combat soil erosion. But even more important, it can be used to help identify farm leaders and prime movers who can generate direction and pace for local agriculture. It can be used to establish rapport with practitioners so that their needs and problems can be recognized and given proper attention. It can help to get participation from commercial farmers who will be willing to demonstrate how new ideas work on their farms. And it can help to gain clearer perceptions of why farmers act as they do. In short it becomes an information exchange wherein extension people can meet farmers under conditions particularly well designed for 2-way communication.

2. Institute an effective, nationwide market reporting service that provides daily market information by radio.

3. Support a long-term program to optimize land use within the watershed by matching land capability with use. Begin by providing for the retirement of lowest quality lands from agriculture. Help farmers on sub-marginal land to relocate. Develop economically viable methods for converting medium quality land to agricultural uses conservative of the soil.

4. Support within the watershed a program of inventory of all government lands. This is an essential if Government is to effectively meet its responsibility as steward of the public lands and to arrange for their wise and timely use. It is crucial also to the operation of the preceding program, which involves the retirement of private lands from agriculture. It is government alone which can supply workable alternatives to those owners who are saddled with lands that cannot lend them much support and represent a conservation risk for society.

5. Provide for balanced support from downstream water users. The problem of conservation is not the farmer's alone. There is good reason to ensure a more equitable sharing of the conservation responsibility with those who may be wasting or indiscriminately using the water that farmers are asked to husband so carefully upstream.

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6. Strengthen both the Agricultural Research Service and the Agricultural Extension Service and encourage a close working relationship between them. Use picked individuals from the two Services to man the research and training activities of the experimental farms.

7. Support policies that will help reduce the risks in farming.

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Annex 3A

Social Forces Affecting Farmer Decisions
R. Mitchell

Annex 3A

SOCIAL FORCES AFFECTING FARMER DECISIONS

R. Mitchell

I. Introduction

This annex considers the reactions of the Jamaica farmer to conditions in the world around him such as its infrastructure, the ways in which land is held, and prevailing attitudes about farming and farming practices and about success and its manifestations.

It is based on formal and informal interviews and on field observations, as well as on literature review. The procedure for the reconnaissance investigations was adapted with full cognizance not only of the serious constraint on time, but also of the necessity for some amount of first-hand information about farmers within the two watersheds. The procedures employed were as follows:

(1) Formal Interviews. These were carried out in about ten districts across the length and breadth of the two watersheds with twenty farmers from each watershed. Effort was made to diversify the respondents in terms of age, sex and tenure arrangements. The respondents were not scientifically sampled, however, and because of small sample size the inquiry lays no claim to statistical representativeness. However there is no other strong reason to believe that those farmers interviewed were not representative of the small farmers of the respective watersheds.

(2) Informal Interviews. These were carried out in general discussions and question-and-answer sessions with Ministry of Agriculture personnel at the St. Catherine and the Clarendon Land Authorities, and with farmers and district residents as we did exploratory travels within various sections of each of the watersheds on three separate occasions.

(3) Observation. This included a cursory examination of farming and farm lands, cropping patterns, soil conservation measures and land use (or misuse) as well as housing and the general socio-cultural aura within the watersheds.

II. Findings

Findings of the investigations are treated below in three parts. Parts A and B deal with farmer reactions to objective forces such as the infrastructure and land tenure and crop patterns. Part C considers subjective forces and farmer responses.

A. Infrastructure

(1) Physical. This is usually thought of in terms of (domestic) water, roads and light (electricity). Although only the towns and, to a lesser extent, central villages of the watersheds were supplied with piped water, there was no complaint in this direction. Farm families did not seem to be bothered too much by having to fetch water from springs, rivers or standpipes for domestic purposes. Even in times of drought, farmers seemed to manage. Electricity was lacking in the remote villages, but even where electric lines passed, there were many houses without it. Apparently electricity is a luxury that most rural small farm families are prepared to do without (see Mitchell, Vere Sugar Farmers, 1978).

The most notable infrastructural problem lies with roads. That is the complaint of farmers individually (wherever one is addressed) and collectively (in various informal gatherings or as at a Producers' Marketing Organization meeting at Harker's Hall in the Rio Cobre watershed, October 9, 1985). The watersheds are served by an efficiently linked road system, but the roads are nearly all in a state of disrepair. The farmers are clamouring for the parochial roads to be serviced, and for those on settlement properties (some almost non-existent at present) to be resuscitated. They want good roads that can accommodate vehicular traffic to take their produce to markets or to marketing points, and to bring their inputs (fertilizers, planting materials, chemicals and implements) from the stores in the towns to the farms or to points within reasonable distance of farm and home.

(2) Social. These include the formal institutions and other socio-cultural organizations. Most of the farmers belong to at least two organizations, one connected with the Church and another with the farm. Many are members of churches and, particularly among the Pentecostal groupings, they hold offices such as Deacon, "Mother" and leaders of groups. Some were not members but visited church services or week-day group meetings at frequencies ranging from occasionally to regularly.

Memberships in the Jamaica Agricultural Society (JAS) tended to be low (below the 50% margin) but some respondents claimed membership to such groups as "the Land Authority Group", the Producers' Marketing Organization (PMO) and even the Registered Farmers Group (perhaps with the thought that registration meant enlistment in a special organization). The Parent-Teachers' Association (PTA) was the only non-church and non-farming organization to which anyone belonged, and membership was very low.

The informal labour groupings that once flourished among rural small farmers seem to be all but extinct. Asked whether farmers do not join "partnerships" (an informal grouping of exchange labour known also as "day-for-day", "morning sport" and "circus") anymore, most of them reported that the custom was dying out. When asked why, one farmer said that the "partners" got to know the farm too well and were sometimes responsible for theft operations. This sort of exchange labour flourished when sugar cane for sale to the factories was a significant crop among small farmers. With the contraction of the export market in sugar and the consequent closure of some factories, small farmers rarely cultivate cane for sugar anymore. Localized

sugar production, which was labor intensive and depended exlusively on the exchange labour system, is now obsolete. Among small farmers there has been an agro-cultural shift from growing cane for sugar production to growing cane for local consumption. This opinion was supported both by the interviews and by personal observations in the visits to the two watersheds. That system of labour exchange used for sugar-cane production has not been applied to the production of other crops with much significance.

Partly as a consequence of all of the above, there was a severe problem with labour in almost every single case. Farmers were not able to provide adequate labour single-handedly even where holdings were less than two acres. Grown-up siblings had either left to pursue other occupations or to operate their own farms and children could only assist in a very limited way. Consequently, farmers depended upon hired labour to supplement their own; but they could not afford to pay for hired labour (ranging from $10 to $15 per day plus lunch) to meet all their requirements. The result is low labour input, as is the case with other kinds of inputs, and consequently low production; it is a vicious circle.

B. Land Tenure and Cropping Patterns

Tenure in the two watersheds was examined under the five subheads into which it is divided by practice. It is discussed here in conjunction with cropping patterns within the watersheds.

(1) Owned Land. This is land that the operator has obtained by purchase or has had conveyed to him (by will, by transfer, or by verbal transfer which the donor intends to make legal) and for which he is solely responsible. The majority of the farmers spoken to (27 out of 35) had at least one parcel of land that was their own. Parcel size varied from one-fourth of an acre to four acres; it often was only one of a number of parcels which the farmer cultivated.

Owned land is a source of pride to the operator, and the importance the small farmer places on it can never be over-estimated. It is one of the important indicators of his social placement in his community. Psychologically it gives him a sense of security and assurance, and it is the land on which he puts his permanent crops particularly his food, fruit and timber trees. It is also the land on which he will invest most in terms of his time, his agro expenditure and his development plans including soil and erosion treatments.

This will be the land hardest for him to give up or to neglect, even if it is marginal. Where such land is too steep (over 30 degrees), however, or where the soil is very shallow he may, over time, be educated into utilizing it in the best way possible.

The farmers who were interviewed expressed willingness to plant trees having economic value; that is, trees for food, fruit and lumber. They were much less willing to put in trees merely for charcoal and firewood. Probably this question was put to them for the first time, however, so there was no history of thinking about the matter and discussing it with others as is

believed to be the case with other trees. The point is that the opinion expressed was less reasoned and crystallized. Individuals, however, did not wish to go in for large-scale tree planting (within their context, this means from a quarter of an acre to an acre of trees) except for coffee, cocoa and citrus because they had not enough acreage to spare for purposes other than food production.

(2) Family Land. This refers to land corporately owned by the family of orientation and which has not been formally or legally allotted to individuals. Usually, however, portions of it are operated by individual members with a general family understanding of where and what belongs to whom. Such parcels may contain permanent tree crops planted by the older generation; the current operators may also plant a mixture of permanent and semi-permanent crops, but this is usually done with the belief that the particular parcel will fall to him or to his immediate heirs. (The masculine pronouns include the females, who operate approximately 20% of the small farms). Pride of ancestors and their land-ownership is important, but the individual operator does not feel the same sense or degree of pride in family land as he feels about that which he has purchased. Where there are no owned lands however, family land takes precedence over the operator's other holdings. Fourteen of the 35 interviewees worked on some family land. Where such lands are marginal they may be disposed of with much less reluctance than in the case of ownership by purchase; it is necessary that all the heirs agree on the decision made. Disposing of the land may also be a means whereby family land disputes are settled, since the income from such sales can be divided easily into shares.

(3) PLL II and III. Project Land Lease (PLL) operated from 1972 to 1980 as a project to make more farm lands available to small farmers for agricultural production. The project operated under three phases. Phase I was a scheme under which small farmers were leased additional acreages to increase what lands they already had for a 5-year term; Phase II was a 49-year lease and Phase III was a 49-year lease with a house. Altogether, the project aimed at providing more farm lands and some housing for poor small-farm families. The long-term leases were inheritable and could be renewed at the end of each term. The present policy is to convert the Land Lease programmes into settlement programmes, whereby Government lands will be made available to the farmers under a free-hold system.

The principles that apply to owned land will also apply to these free-hold settlements in terms of cropping and psycho-social sentiments. Where the lands are marginal, the present is the right time to convince the relevant arm of government to retain them for forestry and pasture rather than to allow such sales and then expect government to re-purchase in a few years' time. It would be a tremendous example of resolve and plausibility if Government were to initiate the correct uses of such lands in a marginal land usage development action programme. Only four of the interviewees were participants in a PLL scheme.

(4) Private Lease and Rent. Operationally, in deep rural Jamaica, lease and rent are two distinct and separate tenure arrangements. In lease-hold tenure, the lessor gives to the lessee exclusive possession of the land for a fixed

period of time under fixed terms and conditions on the part of both with a fixed rental and intervals for payment; the lease agreement is documented with both signatures affixed. In rent-hold tenure, the tenant is allowed to appropriate the use of the land but all other rights, such as the fruit from existing trees, belong to the landowner; rental as well as tenure are on a month-to-month basis, and all agreements and understandings are verbal.

Tenants plant cash crops and all operations on the land are short-term (as with cash crops) or moveable (such as in animal rearing).

Seven persons (or 20% of our haphazard sample) depended upon rented or leased parcels to augment their own small acreages. One operator in the Rio Cobre watershed depended entirely on lands leased from private ownership; he operated one one-acre parcel for which he paid $25 annually and a two-acre parcel for which he paid $30 annually. In his case the lessors were local farmers who owned more lands than they needed for their individual farming practice.

This situation attests to a perception that farm lands are not available in the quantities required. One may argue that since someone possesses enough to lease, then the problem is not the availability but the distribution. Those who are able to obtain lands on lease-hold are by no means indicative of the many who, it is believed, require lands but are not able to obtain them at prices they can afford.

One way to alleviate the situation would be for Government to extend the settlement plan to include younger people. Rural schools have some sort of farming or farm experience as a part of their extra-curricular education. It may be functional for the Ministry of Agriculture to liaise with rural schools to conduct aptitude tests in order to identify and train potential young farmers whom the Ministry could settle, at a rate of say 300 per year, on farm lands where such may be available. It would not be difficult to shift these people at this stage of their lives as it would just be a part of the general pattern of the young moving out and hopefully moving up. That could relieve the burden on limited lands and alleviate the land fragmentation process in the rural hills.

(5) Rent Free Lands. Rent Free lands fall into two orders. The first order consists of lands worked with the permission of the owner. The second order consists of cases where operators work the land without the permission (and sometimes without the knowledge) of the owner; in effect the operator is a squatter on the land, a condition that is referred to as "capturing" in Jamaican parlance.

Captured lands usually fall under government ownership, collective ownership (such as the Church or other organizations), large-scale individual ownership or absentee ownership. In the interview, only two rent-free cases were reported, and no capturing was reported. This may be because the sample was not statistically representative, or not large enough; because these two watersheds contain few government properties; because the areas are deeply rural where capturing does not pose a problem and lands are managed and

used by owners who live on or near their holdings; or because interviewees did not want to admit capture.

Sentiments are attached to such lands but only in-so-far as the user needs to use the land and not because he has any long-term commitment to it. Usually such an operator cultivates cash crops and subsistence food only. He may even put a dwelling on such lands if he has nowhere else to live but, like his agriculture, the dwelling is a temporary affair. No matter what the tenure may be, where the farmer has adequate acreages, there should be no problem in persuading him to plant tree crops on his marginal lands. The cropping pattern already shows tree planting as an integral part of his initial practice. He plants fruit, food and timber trees (though in limited quantities) on his own lands and short-term crops on lands on which he has short-term tenancy. The problem lies where most or all of his acreage is marginal, and he has no access to sufficient land suitable for food crop production. One solution could be to educate him into the proper use of his marginal lands while providing him with lands on some secure tenancy system for his food crops. This will necessitate a programme of education, land-allocation and land-use promotion efficiently initiated and effectively operated by Government. Such a programme might include tree planting on marginal government lands by Government and the allocation of productive government lands (through some secure tenure system) to farmers who will use them.

(6) Organization and Patterns. In his own view the farmer is very well organized and what appears to be a haphazard and disordered procedure in an objective sense is the very essence of his organization in order to survive and "make ends meet". An examination of his practice shows that the small hillside farmer typically experiences multi-cropping, multi-parcelling and multi-tenancy.

Multi-cropping

He mixes up several types of crops and several subtypes of each type on any given parcel of land which may be as small as a single square (one tenth of an acre). These could include several types of tree, semi-permanent, root and cash crops. Asked why he does this his answer is three-fold. First, if he "lose off one, gain on the other;" that is, if one crop fails to produce, some other crop will produce to provide him with a little income as well as some basic food for the family. Second, the various crops come to fruition at varying times during the year so he is assured of reaping something for the family pot right through the year. These views are held by small farmers islandwide, and were voiced over and over within the two watersheds. Another view is that various crops require various kinds of soil nutrients and, mixed together, they make maximum use of the nutrients that a piece of land provides. For these reasons the farmer says that he grows "a little of everything" and this is literally so.

He seeks to put in a few trees on his land, particularly if that is land that he owns through purchase. It used to be customary in rural areas to plant a tree, particularly the coconut palm, when a new baby arrived. As the tree grew and prospered so would the child, it was thought; the gesture also

engendered in the child a sense of belonging, pride of place and security of ownership. The custom has been declining, but still flourishes in some sections of the watersheds.

The cedar tree was the timber that was given highest preference; "the wood can sell" and "it make coffin" they said. Nearly every rural homestead used to plant one or two or more cedar trees in order to be able to provide lumber for the coffin whenever a family member dies. That reason for planting the tree was still given by some of the interviewees; others spoke of its economic benefit.

Fruit trees such as the mango, plum, sour-sop, guinep, star-apple, lime and other citrus trees were, and still are, part of the institution of the homestead. That children must have access to fruit trees of their own is an unwritten and sometimes an unspoken rule in establishing the homestead.

Coffee and cocoa, "even a few roots" as the small farmer puts it, are also an integral part of his operations; these provide his family with morning tea. (In Jamaica "tea" is used as a generic word for the breakfast hot drink which everyone is supposed to have; so Jamaicans speak of coffee-tea and cocoa-tea).

Multi-parcelling

The farmer cultivates on the steep hillsides and marginal lands although even he is quite aware that it is an uneconomical procedure. Asked why he does this, he replies without hesitation that he has no where else to go. If these farmers could obtain access to lands of higher classification, not too far away but within reasonable distances, it is believed that they would avail themselves of the opportunity.

Multi-parcel farming is also an integral part of farm practice; this is no tradition to which he has to adhere, nor is it a design to speed away hours in non-work; the simple fact is that circumstances have converged to make him operate several little parcels and if he didn't he would be the worse off. He is in effect making the best use of extremely difficult circumstances.

He acquires his first parcel probably through inheritance or gift from an older relative, but he is unable to obtain another parcel contiguous to that so he buys another bit elsewhere. The two together may be less than two acres or even one acre, so he rents another piece which is available some distance from the first two pieces. Many farmers operate as many as five small parcels, not by design or preference but by adjustment to contingencies. Such parcels may include owned, leased, rented or rent free lands.

Tools

Tools, for the most part are the traditional machete, hoe and fork. The tractor is rarely available to him because of his economic circumstances. Even if it were, his farm operation is not likely to be topographically suited to tractor usage. Neither he nor government nor anyone else in Jamaica has

tried seriously to invent tools that both his pocket and his land can accommodate.

C. Subjective Forces

Many forces, other than economic, affect the life of the small farmer. Such forces include the institutional and structural, the cultural and environmental, the familial and individual. When the elements of those forces impact upon one another and collectively upon the human unit (whether such unit be a person, a group, a community or a nation) they create for that unit a force that directs its meanings, behaviours and interpretations. That subjective force (that is the composite of meanings, behaviours and interpretations from the unit's point of view) needs serious examination in order to begin to identify the precise kind of assistance that people really need and how best to make that assistance available to them.

The discussion that follows deals briefly with the subjective determinants of the rural small farmers of the watersheds in terms of their organization and patterns and their perceptions and perspectives as they relate to them, their farms and their families.

The motivating factor that literally drives the farmer on is his [almost innate] desire to be self-sufficient, at least in terms of basic food items for himself and his family. Should he relinquish this drive, the result is starvation since his extremely limited cash reserves do not permit him to buy food for survival.

(1) Perspectives and Perceptions. Interviews, reports and experiential observation reveal that most small hillside farmers do not view farming as a business for profit. Consequently, the entire farming operation is conducted on a hit-or-miss basis that is devoid of records, long-term planning or any costing of operator's and household members' labour. After approximating how much he spent on input and how much he makes from output, one farmer said that if he kept records he "would go mad" because his is a losing battle. From his perspective, this approach reduces anxiety and helps him to face the inevitable with greater fortitude.

Small farming is seen and accepted as a low-status occupation to which one resorts because no other occupational avenue is opened up to him. One does not aspire to be a farmer as one does to be a lawyer or a plumber or a teacher. When one fails to find a niche in another area owing to a high unemployment rate or academic failure, only then is he expected to turn to farming. This expectation is expressed daily on all levels of the public and private sector. One popular perception, even from the farmer's own viewpoint, is that there is no vocation to farming and there needn't be. Consequently the farmer is not trained, and his only exposure to authentic agricultural practice is the sporadic visit from an extension officer, hints from the media and farmers' organizations, or the observations he draws from the better operated farms.

Ambition

The small farmer's ambition for his children does not include farming as a way of life. He accepts that for them only when they fail to achieve higher-status occupations. He will recall with pride that a son works as a driver in Kingston, or a daughter works at the factory. He is almost apologetic when he reports that another son does "farming some place in the area here."

The thirty-five farmers sampled together account for sixty-six adult children who left home "to seek employment" (for the vast majority), to attend school, "to learn trade" or because they "come of age." Out of that number five or six had gone to the United States either as residents or as temporary farm workers. About the same number lives in the area as farmers or spouses of farmers. A slightly larger number left for other rural areas or small towns. The majority, however, had migrated to Kingston where four are self-employed, another ten variously employed and about twenty have joined the ranks of the unemployed.

If they had remained at home they would have been experiencing the many-faceted land and farm problems that prevail, but life has not improved for the greater proportion of them in their new environs either. The point that is relevant here is that the farmer generally desires a non-farm occupation for his child because his own life has been so hard. He becomes tangled in a web of inadequate land, inadequate land use, inadequate farming practice, inadequate input and the inadequate socio-economic returns that inevitably inhibit farm expansion and upward social mobility.

Yet, there seems to be a residual feeling of security in the land, and a confidence that one day it will bring the benefits that seem so elusive at present. Now the land is an instrument of survival; then it will be a source of a living.

When the farmers were asked, if they could be assisted in whichever option they chose, whether they would remain on the land and produce, get a job and work for wages, or migrate to the United States or Canada, the great majority said they would remain on the land. It is believed that those who chose migration either did not understand the question or they were the younger and more adventurous of them.

Landownership is indicative of manhood and achievement, particularly in the rural areas and in typical farming communities. It is also an index for social placement. The operator will make all kinds of economic sacrifices in order to save enough to purchase a parcel of land, to obtain the registered title for his land or to make some commendable investment such as buying livestock for rearing.

The concept 'farm' is used to identify the parcel(s) of land on which the operator cultivates and rears his animals; generally, it does not include the homestead. This may be because most rural hillside farmers live in small village communities (a kind of residential and commercial centre for the deep

rural areas) and farm lands outside of such centres. This practice is rooted in history. Even among small farmers there is a separation between place of work and place of residence. There is no perceived difficulty to change to living on the farm if improved circumstances warrant it. If, for example, some land reform programme should require setting up of house and home on a five-acre farm, no objection is envisaged. Already, settlements on flat lands have pursued that course (Oasis, Ebony Park, Clarendon and Five-Acre Lots, St. Helena, Old Harbour, St. Catherine).

III. Identifying Social Potential

A. Stratification

Vertical stratification by the application of socio-economic variables is well known and well used; what is less well considered is horizontal stratification within a relatively economically homogeneous set of people. Horizontal stratification may be defined as the transition from one column-position to another within the same social rank order. This paper will consider the implications for horizontal mobility within the watershed small farming community.

The indicators of horizontal mobility within this context are land-use and cropping outlook, attitude to change, motivation stimuli, and commitment to farm improvement and production. The following is a discussion of these indicators.

(1) Land Use and Cropping Outlook. Most, or perhaps all, of the farmers are well aware of the negative effects of their present land use and cropping patterns. They are also quite rational in their explanations of what they do and how and why. Reasonable as those explanations may be, in the interest of saving the nation from desertification and non-production in the long run, farmers will have to change the present land use and cropping pattern in order to accommodate soil conservation and land rehabilitation and promote the best land use practices. This is the direction for the future and no other effective way has been envisioned.

(2) Attitude to Change. Some land users are amenable to change and are willing to try new ideas. Hillside ditches, orchard and other terraces, drainage systems and planted forests attest to this. The use of such strategies, however, is constrained by their very long run returns.

(3) Motivation Stimuli. As in any group, some small farmers are resistant to external stimuli, but it is believed that most can be motivated to acquire and use better production skills if stimuli are applied under conducive conditions. Such stimuli come through formal agro-education programmes, group membership interaction, well-prepared literature, other communication channels and well integrated research and extension services.

(4) Commitment to Farm Improvement and Production. Commitment is a basic ingredient of success, and much of what happens on (and to) small farms is

dependent upon the measure of commitment which the operator brings to bear upon his work. Commitment is both measurable and observable. The uncommitted will stand on the farming periphery and while he waits for fortune to pull him into another type of endeavour will destroy the land, ignore the long term view, and the advice of the socially conscious.

B. Implications of Horizontal Stratfication. The small farmers of the watershed may be stratified horizontally into three strata based on the foregoing. The first stratum consists of those farmers who have begun to make some effort to improve their land use based on informed agro-advice; such farmers exhibit a positive attitude, they are amenable to change, have made some changes, and are totally committed to farming and to self-improvement through farming.

These are the farmers with whom the leaders in a watershed development programme will seek to begin to work. It is among these farmers that the success of the programme is most assured and, more important, it is these farmers who will stimulate others. The best small farmers will come from this stratum, and every effort, short of compulsion, is to be made to build on the foundations that they have laid themselves already.

The second stratum consists of farmers who, for one reason or another, have followed the traditional farming practices in terms of land use and cropping, attitude, motivation and production but who are teachable. At least two farmers in the Rio Minho watershed commented on their need to be taught how to use their land aright. Another complained that the extension officer is seen very rarely, but volunteered sympathy towards the particular officer who has so much ground to cover. The fact of these comments is that the need for information is recognized, and the willingness to accept changes and innovations is present. There is strong potential for acceptance of proper land use practices and a viable and practical farming system.

The third stratum consists of the traditional, adamant farmers who are bound to proceed as they have begun. They will continue to break up the hillsides with their digging tools and intensive root cropping, without any thought of soil treatment and regardless of the extent of the returns from their effort. They remain impervious to stimuli through direct education, example or pleadings from agro-experts. By and large, they have no commitment to farming or to improved production.

Their lands would be socially more productive if acquired by Government for forestry and public pasturing; and the farmers would probably be socially more productive if engaged in other rural occupations such as lumbering, home-fed animal rearing, bamboo basketry or trades such as carpentry and repair.

IV. Summary and Recommendations

1. Summary

The major conclusions of the study are summarized as follows:

- The condition of the roads constitutes a major problem in the watersheds. Although a very adequate network of roads exists, the roads need maintenance and in some cases total rehabilitation.

- Farmers' organizations do not seem to be able to attract a strong membership clientele; their aims and objectives do not seem to identify strongly enough with the farmer's own perception of his problem and his needs. Even the informal labour exchange grouping is becoming an institution of the past; this may be due to the decline in growing sugar cane for the factory.

- Farmers continue to farm marginal lands with digging and chopping hand tools that break up the soil and accelerate the erosion process. The poor condition of the roads and the absence of road drainage systems is also a major contributor to soil erosion in the watersheds.

- There is a grave lack of good arable lands among the hillside farmers; this is particularly felt among the young who are bubbling with energy and expectation but who are also fearful and frustrated with the prospects as they perceive them.

- The farmers cultivate as they do, for the most part, in an effort to survive rather than as a course that they would choose to follow if there were other channels open to them. The functional aspect of all this is that they are open to adapt better farming practices when the opportunity avails. Those who are resistant to change may require development of non-farm alternatives to meet their needs.

- The tendency to plant perennial crops such as fruit trees, coffee, cocoa and citrus provides a great potential for change in a positive direction.

- For the most part, farmers entertain non-farm ambitions for their children. This is primarily due to the low socio-economic status accorded to small farmers. All this is susceptible to change if small-farming can be put on a viable footing.

- Farming needs to be brought up to the status of a business and of a vocation. This responsibility rests upon the serious and implementable effort of the nation as a whole and of the responsible agencies and ministries collaborating to attack a national problem. The programme must be implementable and implemented.

2. Recommendations

In light of the findings of the study, the following recommendations are set out:

- Implement a programme of road rebuilding and maintenance. There is no need for new roads, but the rehabilitation need is urgent and improved road drainage is a priority.

- Implement a programme to develop and introduce simple low-cost mechanisms to ease and simplify work on the small farm.

- Farmers should be encouraged to support and maintain the JAS so it can represent their joint interests to others and help meet their joint needs. This is all the more crucial in light of a diminishing extension service. The JAS could be the one strong and vital farmer organization in the remote areas. Such a move is superior to development of a succession of organizations that flourish only through the period of their inauguration, particularly when they are externally-created and pressed upon the farmers.

- Encourage the Ministry of Agriculture to liaise with the Ministry of Education to select and train young people from the schools in the watershed areas to become farmers. After training, give such young people an opportunity to begin a career in farming on good farm lands which they can purchase through their own efforts.

- Give farmers access to educational and technical stimuli, and make them aware of opportunities to upgrade their holdings. Those in the first and second strata of the horizontal stratification noted above can be expected to take advantage of those opportunities. There will always be that small minority who cannot or will not act to improve their farm situation, and who will need help to shift into other occupations if they are able.

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Annex 3B

The Optimal Use of Human Resources

H. Bims

Annex 3B

THE OPTIMAL USE OF HUMAN RESOURCES

H. Bims

Introduction

Conceding the priority of economic innovations, this annex urges more concern for optimal use of human talent. In engaging such problems, project planners often start by sorting people socioeconomically, but this is not the most productive strategy in every case. Stratification by motivations, priorities, goals, and attitudes toward personal achievement, features that are relevant to many kinds of policy goals, in this case prove more fruitful. Furthermore, for rural Jamaica, images depicting farmers as peasants not able to think for themselves have undermined and weakened several past and present projects. By identifying and utilizing the talents of those who are most likely to respond best to certain kinds of agricultural opportunity, a new leadership can be forged to help farmers determine how to adjust effectively to the social and economic strains now being felt within the subject watersheds.

Past and Present Projects

Programs aimed at more judicious resource use among Jamaicans began seriously in the 1950's. The first of these were focused in the Yallahs Valley, in the east, and the uplands of Christiana in central Jamaica, following passage of the island's pivotal Land Authorities Law of 1951. (Purpose: to furnish Government the legal machinery to intervene in matters pertaining to soil erosion and watershed management). Such weaknesses as lofty goals, vast scopes of operation, and inappropriate subsidy use are more than amply catalogued. Weaknesses which emanate from sterotype and misperception are less well recognized. In Christiana the plan combined a most appropriate ecological orientation with what became an ancillary, inappropriate welfare one, involving things like home improvement, thrift, literacy, education, and sports and recreational amenities:[1] that is, "improving" people's social lives. There are few signs that urgings to identify and utilize the "better" folk as catalysts were listened to, energies being directed more at less-committed, marginal farmers who for various reasons would probably not repay this effort. These candidates for subsidies and other public benefits were instead more likely to "reduce their farming ... as soon as they find some other occupation. The idea of planning their farms for many years ahead is strange [and] they should not get farm plans."[2]

A further problem was planners' decision to expend their limited time on less-committed, short-term renters, rather than considering ways of integrating rented land in other ways into this program. As noted by a later critic, rented land is often owners' ecologically least desirable; moreover, renters have little incentive to maintain and improve such land, but view it as a short-term, expendable resource.[3] The goal of 100% participation was

unrealistic. This verity is underlined in the following critical evaluation of character and prospects of many kinds of rented parcels: "In them there are no trees, no permanent crops, no houses, no animals, no planned rotation, and no 'life', and it is upon these factors that keeping the land in fertility, and the people in good heart, depend.[4] The image of participants as a homogeneous, "equal" class precipitated other problems, like widespread production imbalances, and problems in coordinating the activities of many units on common hillsides.

Nonetheless such weaknesses appear in later development efforts, like the ill-fated, problem-ridden 2nd Integrated Rural Development Project (IRDP). A jointly sponsored project by MOA and AID (responding to a recommendation by the UN Food and Agriculture Organization), the project's ecological thrust was supplemented early on by welfare aims, all reflecting a tutelary, paternalistic view of farmers. Benefits included things from market sheds to playing fields.[5] But the project's major weakness was its short-sighted, ill-considered notion of incentives, which took the form of cash subsidies.[6] These allocations of what became a major source of "farm" earnings cannot be fully understood apart from more pragmatic issues (what Blustain calls the clientelistic nature of Jamaican policy deployment); but the patronizing attitude implied in their excessive use will underscore the image of the farmer as a welfare case. Such policies defeat their cause. As Blustain notes, soil conservation is a thing of short-term loss and long-term benefits; one study shows that "'a farmer would need 40-60 years before the benefits of averting loss [in productivity] would match the costs of undertaking the measures,'"[7] and if subsidies are generous then farmers view participation in terms of immediate cash rewards and not long-term ecological benefits.[8] More selection in identifying and recruiting participants would have enabled other kinds of incentives.

Recent studies carried out in watersheds near Kingston yielded few surprises insofar as ecological practices go. Farmers were less concerned with conservation in itself than as a means of gaining higher production and cash earnings (crops being favored over grass as erosion-reducing ground covers; slow-maturing trees being frowned on; and resistance being shown to the relocation of going crops to provide for trees[9] - attitudes consistent with the findings of our own poll). Other findings underlined the conservatism, cautiousness, and risk avoidance of small farmers - presumed "features" well-known to students of this kind of literature. But insights which are coming from this new and current exercise in watershed protection[10] show a growing new appreciation of the nature of decision making: that poor decisions are less "irrational" or peasant-like than ill-informed. Such insights challenge the notion that "culture" is the major cause of deletarious technical decisions, and it therefore becomes the burden of government to ameliorate the farmer's "conditions" (internal as well as situational).

This abstraction of consistencies in past approaches to conservation confirms the present point of view that farmers are a misperceived and underutilized minority, and that this has been a factor in the pessimism, cynicism and failure of many past initiatives.

The impression which emerges from a broad range of published sources, interviews with key officials, and the author's work among farmers amounts to this: there is much debate, and contradiction, on basic points about its character. Wage labor is alternately called contemptible (a last resort) and an accepted means of supplementing insufficient farm earnings. Some invoke the symbolism of land per se in attitudes, while others tend to view it as a resource and little else. There are other areas of disagreement. These contradictions may reflect the very strata we are positing. Fortunately there are ways of determining if this is so. Developers have recognized that groups of broadly similar culture and economic situation differ much among themselves: in goals, values, attitudes and other features of interest to development. Via innovations in opportunistic, rapid surveying, Associative Group Analysis (AGA), and other tools, it is possible and feasible to pursue these and other issues methodologically.

Rural Jamaica

But before addressing problems of methods, let us view the farmers in relationship to rural life. These farmers are concentrated in the ecologically undesirable hill country, where village names suggest a certain attitude or world view: Succeed, Endeavor, Buck Up, Industry, Industry Village, Mount Industry, Buy Land, Try See, Speculation, New Hope. While differing as individuals, they tend toward one of three discriminant groups: those who only seem to want to feed their often meager tables, and keep body and soul together; those who farm to supplement some other kind of income source; and a final group who constitute the "proper" ones: who are not afraid to lift a cutlass, who seem to know what they are doing as entrepreneurs or businessmen, and convey to one what I have called a sense of mission, or mandate, as small farmers.

A workday of a dozen hours is not at all unusual, and this does not reflect the fact that some must walk a mile or so up twisting hills to get to work. A man will often leave church to "look upon some animals". His better half will rise at dawn, transporting 60 pounds of yellow, white or Lucea yams (scrubbed and bagged the night before) nimbly balanced on her head to market-place, enduring a harsh sun till every single one is sold. There is great mystique in owning land, and while farmers often disavow this sentiment (in joking terms), they often seem intoxicated in showing off their piece of the world. This weltanschauung is aided by the scriptures of the Bible, and the injunctions of a venerated, hugely popular Dale Carnegie.

Thirty-nine percent of the nation's total labor force are in farming, forestry or fishing, far the largest number in agriculture. This includes an undetermined number of women, as official figures do not reflect the tens of thousands who unofficially work the land as farmers' wives. While "gerification" of the farming sector is often stressed, age seems to be a problem only after the 70th year.[11] Further, farms of aging men who cannot work them alone are sustained by the services of at least one able-bodied son.[12]

Small farmers populate communities with special features. These

latter are of two types: a broad, inclusive "town" community (the environs of the market towns and service centers) and a smaller, much more integrated, agricultural rural "district" (rarely over a thousand souls dispersed among the wooded hills on either side of a winding road, and represented by family names: Moore's Town", "Thompsonville"). Political life is dominated by an often narrow coterie of white, colored, black, "Syrian" (Lebanese) and Chinese merchants and service dispensers. These run the schools, the post office, and own the larger business establishments, which thrive upon the country folk on weekly or semi-weekly market days. These towns are dismal places, lacking parks, plazas and other amenities of provincial life in Latin America. May Pen is representative: a market, a police station, a rather faded Church of England, and a chaos of rough and ready offices and retail shops at a crossing of two of the island's major roads. The country parts are nucleated by smaller services and businesses---rum shops, general stores, a post office, a primary school---strung along a single road or clustered at a crossroads. Take away the Chinese merchant, the "brown" (mulatto) bartender, and the black teacher, civil servant or middle farmer, and the community is largely one of black farmers, artisans, and rural laborers. In some parts, descendants of indentured workers brought from India in the 19th and early 20th centuries share rural life and lower-class identity with blacks. But these are rarely peasants, concentrating on rural labor, as cane workers, and offshore fishing.

The sector's several ethnic groupings hardly rate the name itself; aside from some endogamy and occupational specialization, Sephardic Jews and Chinese are culturally indistinguishable from others. As happens in the U.S., the emblems of exclusion are most emphasized in ceremony, when deities and heroes of never-witnessed Mother Countries are venerated in dance and song.

Within the merchant population, one or two or half a dozen ruling families dominate, being entrenched in politics. It is out of their exclusive ranks that Members of Parliament and Parochial Councillors are often recruited. Aside from their official jobs as legislators, they exercise no small amount of executive clout, as patronage dispensers. Small farmers lean on them for all manner of dispensations, from farm subsidies to special work on parish roads at Christmas time.

Beyond the towns, in the country parts, the nabobs are a different kind---"middle" farmers (with 20 to a hundred acres, leasing most to smaller farmers); Baptist, Methodist or Anglican ministers; school principals; and storekeepers (who run bars on the side). Many middle farmers and larger merchants are returned immigrants, investing in tracts of land capital earned in Britain over ten, 15, 20 years. In speech and other features they differ slightly from stay-at-homes, though not self-consciously. Whatever leaders these aggregates of individualists tolerate are chosen from these middle farmers, especially when they are conspicuously religious. Men enjoying high esteem command the honorific Marse (diminutive of Master). They are generally older, own land, do not drink, go to church, are legally married, and are what Jamaicans see as "quiet" or sober-minded. A particularly quiet younger man will earn this honor. A truly prominent individual is further dignified as Master.

Jamaicans are distinguished by an almost pathological individualism. This startling feature may intrude on the family itself, whose members may maintain separate budgets: the husband one, the wife a second, the eldest working son a third. Kinship identification beyond this nuclear unit is weak.

Another feature relevant to ideology is religious life, often merged with attitudes on economic self-determination. Those who "have" deserve their lot, and those who do not own possessions (and what material things command: status, respect) either do not please God or have yet to gain their earthly kingdom.

No district of any size is without at least one family perceived, and perceiving itself, as aristocracy. These have often owned their land---from 50 to a thousand acres---for generations, being descended from the early English, Scotch and Irish pioneers. Most are now perceived as "brown" (colored), having intermarried, or cohabitated, with their African, Sephardic Jewish, East Indian and Chinese countrymen. These often live in towns, run businesses, and lease their land, or portions of it, to small farmers. Some other kinds of town dwellers: merchants, doctors, nurses, school teachers, bureaucrats and other often young professionals (often transients awaiting reassignment to Kingston); and parvenus whose enterprise as produce dealers, building contractors, or rural transportation magnates compensates for cultural affinities with small farmers.

Finally, beyond the towns, the "real people", the vast majority, and vertebrae, of rural Jamaica. It is among their ranks, in social space, that dwell the island's somewhat under 200,000 small farmers.[13]

The Watersheds

While both reflect the profile we have tried to trace, the Minho's denser occupancy, as the island's vaunted breadbasket, augurs better channels for the dispensation of technological knowledge, and this may account for the differences in land use. Cobre farmers, in my view, are technologically much inferior, having generally less land in crop and making less judicious use of steeper, more erosive hillsides. Growing yams on slopes exceeding 30 degrees is not uncommon. In this the farmers bring to mind the mountain folk of upper Portland and other more remote vicinities, and confirm the existence of variations in technological competence in Jamaica.[14]

Differences in social life are further notable. Rio Cobre villages are sparse, small and often dispersed, and the mood is one of isolation, separatism and individualism. The region's hilly loneliness impedes the spread of information relevant to conservation, and so on. These and other views were supported by the officers of the St. Catherine Land Authority, who arranged our field reconnaissance trip.

The Minho, by contrast, as the nucleus of small farming, has a greatly denser population and ample roads connecting towns of relatively larger size. In land use and other ways, it more resembles Christiana and southern St. Elizabeth parish, both regions of higher than average ecological and technical competence.

While differences between these systems should not be exaggerated, they are useful in the consideration of policy designs in the two areas.

Methods

Earlier it was emphasized that ranking people (vertical grouping) may not be the most productive strategy for certain goals, but that other modes of classification may be more apt. While there are many ways of grouping people, adoption of specific goals permits designs to concentrate on certain of their many features while ignoring others. If the goal is to optimize responsiveness to a program, the purpose of that program would determine the designs deployed to identify or isolate the best and most appropriate participants. AGA accomplishes this in simple ways.

By having them spontaneously associate a list of words, the method yields a graphic view of how respondents view the world: what ideas are dominant (compared with others), the strength of their associations, and the relative emotional, affective force of these ideas. Such attitudes are then assigned to broader, more inclusive "domains" (which in their turn are analyzed for relative association), describing an ultimate "map" of an individual's inner space. In probing for relationships, rather than ideas, the method has the further merit of ascertaining nonconscious attitudes, associations, meanings, etc., which determine acts.

Recommendations

In weeks of careful study, this team has isolated problems which, though recognized, have to this point defied solution: issues relating to low production, inefficient marketing structures, and deletarious use of land. Strategies of various kinds have been advanced for their redress. What recommendations can we propose toward optimal use of human resources?

It is in productivity, most of all, that responsiveness is most essential. It is here that openness to habits and priorities that are unaccustomed are most important. It is here that certain attitudes---toward commitment, work, deferred rewards---will count the most. And it is here that questions of selection should be concentrated. I recommend revival, with modifications, of the tried-and-tested Local Leader program of farm extension. It is further urged that choice of leaders---at least in earlier stages of activity---be guided by criteria that are unconventional.

Trevor Clarke, head of technical services, MOA, says the program showed potential as a means of spreading information and attitudes on farming procedures, and did not lack participation. The reasons for its demise were administrative and budgetary. But the notion of exemplar farms for radiating knowledge, skills and attitudes is a viable one. While never evaluated, the approach was deemed successful in terms of farmer participation, showing neither the factionalism nor suspiciousness so often reported. It is further widely used, to advantage, in many other countries. Experience thus supports the view that few inherent weaknesses subvert the method, but that other, external factors may intervene.

One of these is inattention (or naivete) in selection procedures. In America the "better" person for leadership is easy to find. He is educated, highly experienced and (likely as not) of middle class status. But elsewhere such criteria for leadership are not so apt. Americans tend to view the world in more or less hierarchical terms (those enjoying higher status recognized implicitly as better leaders), but Jamaicans view it more in terms of attitudes, priorities, goals, discriminating "those like us" from all the rest of humankind, regardless of class. Thus they tend to see the world as stratified in what I call a horizontal, lateral sense, discriminating "trying" folk, or more "progressive" individuals, from those who gamble, dissipate and do not look upon the Lord (advance economically). This model of the social world traces to conditions which out of Jamaicans' social forms were fashioned in the wake of slavery. Such attitudes are often viewed as complicating policy goals. But far from impeding work, they represent a rare resource. The real value of AGA, in discriminating social groups, is its focus on the way ideas and meanings are associated, in penetrating to deeper, less explicit levels of orientation. It is these that determine acts, and probing them is vital in evaluating group potential.

These remarks will serve to guide the following specific recommendations. Planners should reactivate the concept of Group Leaders, though guided by selections that are relevant in rural Jamaica. While age, status, competence and other factors should be used, criteria should not neglect those many other rural folk whose view of life and how to live is one of unremitting striving, sustained by strong beliefs. These could be identified through AGA or similar methods. If interpretations of many serious students of this group are valid,[15] a clear stratum should emerge, distinguishing them in boldest terms from other Jamaicans.

Networks of communication would probably further link them socially (common religion, personal networks), facilitating efforts to address them as distinct groups. Some of them will have resources (land, businesses, liquid assets) while others will be lacking in resources to express their talents. Whichever, they would constitute what planners call an unambiguous target group, being exemplars or catalysts in earlier, crucial stages of activity. Disaggregating aggregates identified as "small farmers" would have two merits. It would compensate pragmatically for the anemia of mechanisms (beyond the family) for coordinated, group activity among Jamaicans, and would cater to the merits of an independent, self-directed and individualistic ethos. Analyses of life accounts, performances in other roles, and other factors could be used to complement the AGA (competence is not irrelevant); but basically the person is selected for his view of life. The stratum we have posited would be defined by three features: (1) a non-fatalistic outlook (belief that life can be controlled); (2) a strong drive for personal success; and (3) confidence that he or she is competent to lead others.

Incentives could enlist their help in any one of several ways: as communicators of technical knowledge; as managers of properties which Government might set aside (for demonstration); or as Local Leaders, provided land to cultivate through loans, grants, subsidies, savings incentives or other supports. These roles will be discussed.

There are well-established precedents for utilizing the services of casually trained, paraprofessional talent in Jamaican life, exemplified to some extent in the MOA's recruitment policy, which utlizes a special corps to function as assistants to its regular staff of extension officials. Whatever rules apply in selection of this personnel, the concept of untrained (though able) dispensers of information is well entrenched. Younger persons could be enlisted to augment regular extension workers in communicating information from centers to peripheral farms, both adding to the quantity of overall extension service and exposing younger, gifted folk to practical issues in running a farm. Dedication, enthusiasm, and ability to inspire others, provided there are proper incentives, might more assist the purposes of earlier, crucial stages of work (when attitudes will be important) than would the services of formally trained, though overworked and uninspired, professional workers. They would further serve the vital role of communicating new ideas to younger people.

Highly esteemed farmers in the watersheds might be given preference in procedures for selecting farms for close participation with the proposed "clusters."

While not explicitly recommended, the Local Leader notion should be revived and readopted, at some later stage. As a student of technical change in prehistoric and tribal life, I am much aware of the vital role of often non-obvious factors. Aside from forces recognized as impeding or advancing change (economic, ecological), receptiveness to new ideas for better use of natural resources often depends on nothing more than the personal qualities of exemplars: persons whose inventiveness is augmented by attributes sufficient to legitimize a new procedure. While Jamaicans share with other groups respect for certain qualities (position, age, generosity, kinship identification), the model for emulation is the person perceived as "getting on" or "bettering" himself. Global experience further shows the effectiveness of nuclear farms as disseminators of ecological and technical knowledge, which diffuses from creative centers to a more or less receptive periphery. The literature attributes this to obvious causes: the proximity of nuclear farms, or their emphasis on applied knowledge. Less emphasized are personal features of nuclear farmers, as culture models.

These program are cost-efficient and extremely easy to implement and evaluate. With surprisingly little administrative or budgetary commitment, they could be employed as complements to economic and ecological modifications in these regions.

Footnotes

1 G.J. Kruijer, Sociological Report on the Christiana Area (The Agricultural Information Service, Ministry of Agriculture, 1956).

2 Ibid., p. 63.

3 Harvey Blustain, Resource Management and Agricultural Development in Jamaica: Lessons for a Participatory Approach (Special Series on Resource Management, Rural Development Committee, Cornell University, 1982), p. 32.

4 Christiana Land Authority, Annual Report for the Year Ending 31st December, 1957.

5 Harvey Blustain, "The Political Context of Soil Conservation Programs in Jamaica", Human Organization vol. 4 no. 2, 1985.

6 Subsidies helped to incur the cost of labor in installing ditches, terraces and other erosion-prevention treatments, totaling 75% of estimations of these costs. Farmers were further subsidized for planting material.

7 Sterling Brubaker and Emery Castle, "Alternative Policies and Strategies to Achieve Soil Conservation." Paper presented at the Workshop on Policy, Institutions and Incentives for Soil Conservation, Urbana, Ill., 1981.

8 Blustain, "The Political Context . . .", p. 127

9 Alice Carloni, "Working Paper, Jamaica: Small Hillside Farming Project." Findings of the Socioeconomic Survey, FAO/FAD. Cooperative Program Investment Center, FAO Rome, Fegruary 1984.

10 These reflect a subtle change in attitudes of planners globally, reflecting modern insights into the real nature of their decision making.

11 Carloni, 1984.

12 Ibid.,

13 Estimates based on figures presented in Yearbook of Jamaica, 1981. Preceding abstracted from Jamaican Peasants: a Study of Symbols, Hamilton Bims (in manuscript).

14 Rutty Mitchell, Five-Year Food and Agricultural Policy and Production Plan, 1983/84--1987/88. Jamaican Ministry of Agriculture, November 1984.

15 See expecially Sidney W. Mintz. Caribbean Transformations (Chicago: Aldine, 1974); and Peter Wilson, Crab Antics (Yale University Press, 1973).

Annex 4

Agroforestry
H. Kernan

Annex 4
Agroforestry

Henry Kernan

1. Definition of Scope of Agroforestry

During the agroforestry consultant's first three weeks on this assignment, he consulted about fifty references dealing with agriculture, renewable natural resources, and the various programs, both nationally and donor financed, which deal with the problems of introducing new technologies of growing trees or adapting those already existing on a less than desirable scale, into the hillside farming systems of Jamaica. He also discussed those problems with some twenty responsible and knowledgeable officials, and made six day-long field trips into the areas under consideration. As a result, he can state that agroforestry does offer important opportunities and advantages for improving the practice of hillside agriculture in Jamaica. Moreover it does have an important base in traditional practices. On the other hand the deliberate use of trees to increase productivity seldom appears as a consideration in the extensive literature on hillside farming, and in the awareness of officials who are responsible for rural development programs.

The consultant's scope of work uses the term agroforestry but does not define it. The term in fact does not have a precise meaning. It is apparently expected that a definition will be forthcoming appropriate to the circumstances encountered. In the consultant's view, the term refers to the use of trees to enhance a total farm enterprise devoted primarily to crops other than wood. The purpose is to supplement rather than to replace agriculture. The point at which a given tree species ceases to be an agroforestry component and becomes an agricultural crop is not precise and hence must be somewhat arbitrary.

One of the best definitions is the following:

"Agroforestry develops the concept of using trees as a component of the overall management of land resources to meet the needs of the people for food, fuel, shelter and income. The systems used need to be socially, culturally and economically acceptable to maximize total output at given input levels and to minimize damage to the total environment" (1).

2. Circumstances Appropriate to the Agroforestry Approach

Such definitions suggest that the concern of agroforestry is with trees contributing to the farm enterprise in the following general and overlapping ways. They are:

1) Trees that produce a direct and beneficial effect upon the productivity of agricultural crops and livestock. Trees can do so in various ways, among which the most notable is by adding nitrogen and other chemical fertilizers to the soil through leaf-fall becoming mulch and eventually humus. The resulting benefits are better quality soil for tillage, less evaporation and better penetration of water into the ground. Other examples are the use of

and better penetration of water into the ground. Other examples are the use of trees for shade to reduce the stress of sunlight upon other plants and upon livestock, the use of trees to break the force of winds, and their use for fodder and apiculture.

2) Trees that have direct on-farm use and thereby contribute to the quality of farm life, even those that may not influence the productivity of crops and livestock. The most notable example in that of firewood. Others are trees for shade and amenity, for tools, building and edible products consumed in the home.

3) In the third general and arbitrary category those trees which add to the farm income by sale. Examples are trees whose wood has a market in Jamaica. They include firewood, posts, poles and sawlogs for lumber.

It is again emphasized that the above categories are arbitrary and overlapping. Firewood, for example, can be used on the farm, given to friends and neighbors, exchanged or sold. A farmer may use fenceposts on his farm, sell or give them to neighbors, or dispose of them in the market.

The categories are placed in their order with a purpose. It is the consultant's opinion that a farmer's chief concern is with the productivity of his land and livestock. He wants his coffee trees to yield more pounds of beans and his cow to give more gallons of milk. Therefore the possibility of increasing production offers the most significant motive for promoting agroforestry among farmers. The benefits for them and for the general public are many and various, but that possibility is most likely to gain ready acceptance for the use of trees among farmers. A significant factor is that research is continually indicating more and more opportunities for trees to enter the farm enterprise in ways that enhance the total rewards.

The second category also has a traditional base in that the rural populations routinely use trees and wood in their daily lives, such as those for cooking and building. This aspect of agroforestry has closest links with home economics. It is widespread and is probably increasing as the higher cost of petroleum products gives a wider margin for wood-based fuel.

The third category may at present offer fewer opportunities because as yet markets for farm wood products are not well developed. Apparently those who manufacture charcoal do not pay for the wood they use. The households which use firewood for energy do not normally have to buy wood, or at least in the upper Rio Cobre and Rio Minho watersheds they do not. Trees are plentiful on the landscape, and the people take what they need free of charge. They also have needs for other articles of farm use which trees provide; posts, poles, and other items. Apparently such items are usually available without any special provision on the part of users. Consequently the possibilities of farmers increasing their income by growing and selling such items are not significant at present.

3. Review of Forestry in Jamaica

Jamaica's forest lands cover approximately 1.2 million acres, about half the island. The Government owns about one quarter in Forest Reserves besides an uncertain amount in unorganized Crown Lands. That figure is broad in that it includes both well stocked and understocked lands and much open savannah-type forest and second-growth brushlands known as "ruinate"(2).

For the last 30 years or more Jamaica has had schemes to subsidize tree planting on private land, mostly with Caribbean pine for sawlogs to meet the need for softwood lumber. Results have not been significant. The concern of such programs is to produce softwood logs for milling into structural lumber rather than to combine trees with agriculture. Thus they are not part of the agroforestry aspects which this Annex considers most pertinent. Moreover, experience to date with donor programs has not borne out the hope that small hillside farmers will plant trees for sawlogs to any significant extent (3). The Integrated Rural Development Projects placed great emphasis on that possibility. Phase I called for planting 1400 acres. The Phase II project called for planting 7040 acres with pine. After four years of effort and expending US $2.6 million, the project had in fact established some 1240 acres on 950 plots. The average size of the plots on private land was 1.8 acres. Such reforestation is far too costly (US $2,100 per acre) and too scattered to be of interest to Jamaica (4). Furthermore the choice of such planting as a soil conservation measure is probably not the best. Because planting trees moves soil about, it can of itself be a source of soil erosion for the first few years. The pine trees must receive weedings, and such cultural work causes further soil movement. Moreover, pine trees are not the best choice if soil conservation is the objective. Their open canopies do not intercept rainfall as well as broadleaved trees, and their leaves are slower to decay and supply less humus to the soil and hence do not contribute as much to its moisture-holding capacity.

From the point of view of the small hillside farmer, planting pine trees for sawlogs to be harvested twenty years hence is probably not attractive. Moreover because pine trees do not have as beneficial an effect upon the soil as do many other genera, they are usually not the best options as an agroforestry crop.

Jamaicans are making increasing use of the natural forest for energy because of the increasing cost of imported petroleum products. The trend is certainly logical and acceptable. Because of Jamaica's topography, about 60 per cent of the island is too steep for long-term profitable agriculture. But trees, natural or planted, grow on most of those 1.6 million acres and are furthermore a common feature of farmlands. There is no reason why they cannot supply part of Jamaica's needs for energy provided they receive the management direction which the Forestry Department should provide. With such a large proportion of the island under forest intermingled with the agricultural land, the motive for farmers to devote parts of their very small properties to growing trees specifically for firewood only does not exist on a large scale, and it is unrealistic to suppose that it does. Farmers are more likely to

plant or tolerate trees for other purposes, and to use such trees eventually and incidently for firewood.

Although a very large number of households use charcoal for cooking, data on production and consumption are not available. The general attitude appears to be that the industry is destructive and that charcoal use is somewhat socially retrogressive and degrading. A more balanced approach would consider such aspects as the employment provided, the replacement of imported petroleum products, and the contribution of charcoal to the gross national product. The employment involving charcoal is particularly significant in that it supplies a livelihood of some sort to those on the very lowest rung on the economic ladder.

Jamaica has two principal forestry agencies. One is the Department of Forestry and Soil Conservation within the Ministry of Agriculture. It is responsible for 250,000 acres of publicly owned forest reserves, and for the guidance and encouragement of forestry on private lands. Because of budgetary limitations, this agency has difficulty in meeting its legal responsibilities under the Forestry Act of 1973. The other is the Forest Industries Development Company Limited (FIDCO), founded in 1978 as a subsidiary of the Jamaica National Investment Company (JNIC) within the Ministry of Finance. It is a logging and sawmilling enterprise which has 24430 acres under lease from the Forestry Department, most of them under pine plantation dating from an unemployment relief scheme of the 1960's in the Blue Mountains. Its annual plans for reforestation call for about 2700 acres a year.

The Forestry Department hopes to increase tree-planting on private lands under a newly proposed forest law, giving emphasis to subsidies and technical assistance. The assumption is that the externalities of reforestation achieved through soil conservation, added value, and foreign exchange saving justify the subsidy and assistance (5).

The planting by FIDCO has a narrower economic base in that it plants pine trees to supply a sawmill near Kingston, using a rotation of 25 years. FIDCO has proposed joint reforestation ventures with private landowners, so far to no avail. It considers that 62500 acres of pine will be enough to operate the sawmill and meet Jamaica's annual demand for seven million board feet of softwood lumber. This program has some net significance for soil conservation in that it replants each pine plantation after harvesting, or clears already existing vegetation and replaces it with pine. The net gain comes about through the greater usefulness and productivity of the pine over the native forests, mostly second-growth, which it replaces.

There are two ways by which Jamaica's area under trees is increasing. A trend is taking place for tree crops such as coffee, cocoa, citrus and other fruit trees to spread onto new sites and also replace clean-cultivated vegetable crops, sometimes alone and sometimes with pasture underneath. For soil and water management, the trend is very desirable. The shift is a problem for the farmer for at least two reasons. First, he must endure a waiting period before the trees come into production; and, second, the net income from such trees per unit area is lower than for garden crops. The tree crops

mentioned are part of agroforestry insofar as shade trees protect them from sun and wind.

Another trend may be the decreasing area of hillside land under cultivation. The trend is difficult to quantify without comparing photographs separated by several years. The use of fallow and swidden ensures that land is always moving in and out of cultivation. Nevertheless the general trend appears to be toward more hillside land left to re-clothe itself and gradually to revert to high forest after passing through a stage called "ruinate". The trend is associated with the more intensive use of the lowlands for subsistence as well as export crops (6).

As the name implies, "ruinate" has been generally thought of as waste land of no economic or ecological value, so much so that for the most part it has received little management attention, public or private. Recent plans and recommendations have been designed to speed up the rehabilitation of such land through planting trees. (7) (8).

4. The Place of Agroforestry in Hillside Farming

The purposes of the above discussion have been to indicate the limits of what this Annex considers to be the field of agroforestry. Its principal purview is land that is part of an operating farm; and within that land, trees contributary to the principal enterprise. Thus an orange grove with an understory of pasture or vegetable crops is considered to be an example of agroforestry, whereas if only orange trees are present, the grove is not such an example. Coffee trees without shade are not examples of agroforestry. Combined with shade trees, they are. Nevertheless if the orange groves or coffee trees have a windbreak planted around them, the windbreak is an example of agroforestry. It follows that the area where the agroforestry approach is suitable encompasses many combinations of agricultural crops.

Nevertheless the concepts of agroforestry are not equally appropriate to all lands and their owners within a given district. A scheme succeeds better with a degree of selectivity. It is doubtful whether, even under Jamaican conditions, a farm of less than two acres is a good unit for introducing new concepts of agroforestry. A scheme will be more effective by giving attention to the larger farms and the better farmers. Their personal characteristics must include those of being receptive to new ideas and practices because agroforestry does call for re-organizing the farming system by using trees in innovative ways. In addition they must have land suitable for planting trees and the resources to perform or hire labor for the extra work for which agroforestry calls. Probably farmers will mostly plant trees for various purposes where they see a direct link between their presence and the productivity of their principal interests, be they tree crops such as coffee, cocoa, citrus fruit, field crops such as vegetables and corn, or livestock such as milk cows. Furthermore in the scheduling of labor, the primary activities are connected with such crops. The farmer will give attention to other trees principally when he has otherwise no opportunity cost for his labor.

At least four other circumstances have a significant bearing upon the agroforestry approach. They are:

a) That natural plant succession in the climax forest tends towards a tree structure with an efficient occupation of space;

b) That sustained crop yield is not guaranteed in the long term due to soil degradation;

c) That part or all of the population is engaged in subsistence farming. This is to say an extremely complex, interdisciplinary farming system combines the production of plant foods, animal proteins and the supply or use of all forest products (fuelwood, timber, tools and the like).

d) The substantial effort made to increase food production through intensifying agriculture could in the medium term, be nullified by a growing scarcity of fuel (9).

The above circumstances pertain to significant parts of the Rio Cobre and Rio Minho watersheds. It follows that the technologies of agroforestry have there an applicability. They can become widespread enough to affect significantly the double objectives of rural welfare and watershed management.

5. Procedures for Incorporating Trees into Farming Systems

5.1 Agroforestry trees combined with coffee and cacao. The production of coffee in Jamaica is a matter of great concern. In spite of a world over-supply of coffee, at present amounting to one quarter of a year's supply in storage, Jamaica can increase its production because of two special circumstances. First, it has not met its quota as allowed by the International Coffee Agreement; and second, because of the especially high quality of its coffee, it can expand exports into non-traditional markets not governed by the Agreement, such as Japan. Responsibility for increasing coffee production lies principally with the Coffee Industry Development Company, a parastatal organization within the Ministry of Finance.

Coffee is grown both with and without shade. Shade is a means of substituting for chemical fertilizers. It can lower the requirements for chemical fertilizer to some extent, and thereby save the foreign exchange for its purchase. Examples of leguminous genera suitable for growing over coffee are Erythrina and Inga. They can supply up to 10 per cent of the nitrogen requirements and up to 15 per cent of other elements needed. The overhead trees have the further effect of lessening the impact of rain upon soil exposed by coffee cultivation. Grasses that cover the soil completely are always detrimental to the coffee because they compete for nutrients, especially nitrogen. On the other hand bunch grasses such as lemon grass, citronelle and vertiver provide soil protection without lessening the coffee yield as much.

The Spanish elm (Cordia alliodora) commonly appears in combination with both coffee and cacao in both Central and South America. It has the advantage

of reproducing naturally and of being an excellent tree for lumber. As the trees mature they can supply a regular income to the farmer as thinnings take place. The combination provides two sources of income from the same piece of land. Furthermore the trees supply an insurance that if disease wipes out the principal tree crop, a salable alternative is present to replace the value lost.

5.2 Alley cropping. The term alley cropping refers to the technique of growingannual crops between rows of trees. Such trees serve several purposes; firewood, fertilizer, shade and poles for supporting yam vines. Between the tree rows can be row or pasture crops for livestock. The overall advantages relate to having again two crops on the same piece of land making use of different soil layers. Furthermore the trees are barriers to water and soil run-off whose efficacy increases with time as they build up the equivalent of terraces. Their overall effects upon the crops are usually beneficial because they supply leaves and therefore the soil-improving and soil-fertilizing properties of mulch. Studies now underway by the agroforestry project at CATIE in Turrialba, Costa Rica, have shown significantly increased yields of corn when combined with trees in the way described. The subject is under intensive study elsewhere in the West Indies (10).

Research done in Jamaica has pointed to a number of species useful for alley cropping that combine food crops with firewood. They are Leucaena leucocephala and Azadiracta indica (neem) for elevations up to 1000'; and above that elevation Leucaena diversifolia, Calliandra calothyrsus and, on acid soils, Acacia auriculiformis (11).

The use of trees as described has a special significance in Jamaica. The practice of shifting or swidden agriculture was apparently more widespread once than now. The change toward more stable cropping is detrimental to the land unless the farmers involved have a way of making up for the fallow period by maintaining the fertility of the soil and thus establishing permanent rather than temporary use of the land. The technique of agroforestry described offers a way of using the soil-building properties of trees simultaneously rather than sequentially to support stable rather than shifting agriculture.

5.3 Windbreaks. Probably the first and still the most widespread use of trees for aiding field crops is as windbreaks. Their ability to lessen the force of winds and thereby decrease the moisture stress on crops is well known. Bananas are particularly sensitive to high winds and therefore profit from windbreaks. They have effects similar to the rows of trees in alley cropping except that they are placed around fields instead of across them.

Hillside farms in the Rio Cobre and Rio Minho watersheds are necessarily exposed to high and continuous winds. Under such circumstances, windbreaks have a special importance.

5.4 Trees and Pasture. In line with general trends of land use in Jamaica, the two watersheds can expect an increase in livestock production

calling for both pasture and fodder for stall feeding. Many pastures there have trees scattered over them at random. Apparently their origin is natural seeding. Consequently their spacing and species mixture are more the result of chance than of care. Nevertheless their presence suggests that the owners recognize the benefits they bring.

On the other hand it appears only reasonable that the pastures would be better off with densities and species which give the best results. An outstanding example exists in the uplands of Costa Rica. The Alnus acuminata combines with kikuyo (Pennisetum claudestinum) for pasture or with elephante (P. purpureum) and imperial (Axnopus scoparius) for mowing. The spacing starts out with as many as 52 trees per acre and decreases as the trees spread their crowns and are removed for firewood or other uses. The effects are two-fold. First they supply shade and lessen the stress of the tropical sun. Second they add nitrogen and other fertilizing elements to the soils. The results are better pasture and more productive livestock (9).

5.5 Trees for fodder. The above discussion did not consider tree foliage as a direct source of nutrition for livestock. Nevertheless certain genera, notably Leucaena, have in their foliage up to 23 per cent crude protein; and, as such, are very nutritious. Research at Bernard Lodge Estate has revealed that four rows of Leucaena leucocephala set just far enough a part for cattle to get through and browse the foliage kept within their reach by coppicing can supply two to three tons of dry leaf equivalent per hectare every 10 weeks. That species is demanding of deep and fertile soil at no more than 1000' elevation. Above that elevation and on poorer soils, the Calliandra calothrysus becomes more suitable. It is a bushy tree, growing no more than 15' high, but is excellent for firewood, and grows so rapidly that it can yield 7.5 tons of dry matter per acre per year. One advantage of trees over grass is that they yield wood, fruit and leaves year after year with less regard for the annual variations in rainfall than do grasses.

5.6 Trees for soil rehabilitation. The definition of agroforestry includes the use of trees sequentially as well as simultaneously. The traditional practice of shifting or swidden agriculture has made use of trees' ability to rehabilitate worn-out soils. They do so because they have roots that go deeper than annual or grass crops. With them, the trees draw upon the nutrients in the B and C horizons and re-cycle them to the A horizon through the leaf-fall. Farmers have known intuitively of the process since time immemorial; and have used it for a system of agriculture which not only sustains their level of production but gives them a higher return for their labor than an equivalent system of stable agriculture, given the technologies available to them.

Usually the spontaneous vegetation of a fallow field's intrinsic merit is mostly re-cycling ability. If the land were planted with species chosen with purposes in addition to the re-cycling, the farmer could return to a more valuable crop of trees at the end of the fallow period. For example in the Indus valley of Pakistan, farmers plant on worn-out fields the seed of Acacia arabica a leguminous tree whose wood, leaves and pods have numerous uses. From

the second year to the end of the rotation at twelve years, farmers gather wood, pods and leaves. At twelve years, they cut and sell the standing trees for mine timbers; and the next year, they plant cereal crops on soil in condition again acceptable for agriculture.

The application of a comparable system to the Rio Cobre and Rio Minho watersheds may be significant where farmers still use fallow and swidden. Although the land is heavily used, much of the landscape appears to be in various stages of use in the agricultural cycle. The natural regrowth does not, of itself, appear to be of direct use other than for small amounts of firewood and extensive grazing by goats. Undoubtedly some planted rather than spontaneous species can make the fallow periods more productive. An example might be the use of the cinnamon tree whose bark is valuable after only a few years of growth.

5.7 Block planting for firewood and for sawlogs. The point appears above that an intense effort to increase agricultural production can result in a shortage of wood unless a special effort includes trees in the farming systems. At present a shortage of wood is not evident in either watershed, although it may generally be gathered at some inconvenience. Undoubtedly a farmer with extra land and extra time both for labor and for waiting, can be better off with a convenient nearby source of good burning material of convenient size, For example a fully stocked stand of *Caliandra calothyrsus* of just half an acre can supply the firewood needs of an average family of five. Those needs are supposedly for 35.3 cubic feet per member each year. Coppicing the tree allows it to produce firewood and small wood products indefinitely.

This Annex has not stressed the use of trees within the farming systems applicable to Jamaica for producing sawlogs except in conjunction with other crops such as pasture and coffee. To reach such size, pine requires at least 20 years and hardwoods at least 10 years longer. Such rotations appear unrealistic in view of the mobility of Jamaicans, the average age of farmers, their needs for ready cash and other factors. Furthermore logging trees of sawlog size is uneconomic unless they are of ready access and are in blocks large enough to warrant the use of equipment for moving the logs to the roadside.

5.8 Firewood and fodder trees with fruit trees. Certain fruit trees grow in full sunlight, but can profit from an understory of coppiced leguminous trees such as *Leucaena*. They are placed between the rows of fruit trees and can supply fertilizer and mulch, soil protection, firewood and fodder for small livestock. By sowing grass between the trees, the farmer can have three crops growing on the same piece of land that are complementary rather than competitive.

5.9 Planting trees for miscellaneous uses. The farmsteads observable in the Rio Cobre and Rio Minho watersheds have about them numerous trees planted or allowed to grow from seed for the various benefits they entail. They are mostly fruit trees which at the same time give shade, amenity and have flowers with nectar for bees. Ultimately they become firewood. They are evidence that Jamaican farmers appreciate trees and are receptive to their more extensive and scientific use.

6. Agroforestry's Relation to Soil and Water Conservation

It is fair to enquire as to what extent the agroforestry practices suggested contribute to the better management of soil and water resources. Their influences are both negative and positive. Trees do absorb nutrients from the soil as well as re-cycle them.

They do intercept rainfall so that water does evaporate back into the atmosphere from the leaves and stems. Their roots also draw quantities of water out of the soil and they transpire most of that water through their leaves. For this reason ground that appears firm under a canopy of trees can become water-logged after they are removed.

Agroforestry in some measure restores the natural balance found in a watershed fully-stocked with trees. Trees cannot bring a piece of farmed land back to natural conditions; but they can to an extent lessen the shock of change. Their principle influences in this regard are those of lessening the forces of wind and rain, physically obstructing the overland flow of water, and increasing the percolation of water into the soil by building up and maintaining a mantle of duff and humus. Furthermore their roots provide channels for the downward infiltration of water and they bind the soil so that it is less likely to be carried away by the gravity fall and flow of water.

Thus, aside from whatever products derived from them, trees have important influences on soil and water. In both cases they are on the whole positive. The significant measure is the extent to which they can replace other soil and water conservation practices which require masonry or the movement of dirt or both. The resulting savings can be significant.

Agroforestry trees can further help the trend toward the replacement of clean-cultivated subsistence and commercial crops by trees and pasture. Insofar as combining agroforestry trees with that trend can make both more profitable, such trees are contributing to the advantages which trees and pastures have over clean-cultivated crops.

Where such crops continue, the presence of agroforestry trees lessens but does not obviate the need for soil control works. Besides their products, trees have the advantage of being cheaper and easier to install, and of requiring less maintenance than such works.

Apparently Jamaican extentionists are not yet aware of what trees can do in that regard. For example, of the 1000 farm plans prepared and approved in the parishes of St. Catherine and Clarendon, not one has included any provision for agroforestry practices.

7. Research Needed

Research on agroforestry in Jamaica is centered in the Research and Development Unit of the Department of Forestry and Soil Conservation. The unit has one research specialist of the Overseas Development Administration of Great

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Britain, and an annual grant of the Organization of American States through the Regional Leucaena Project of $10,000 US. It has demonstrated the successful use of Leucaena leucocephala for cattle on the semi-arid coast near Kingston. Its work with hillside farming has been more concerned with sawlogs and firewood than with the effects of trees upon agricultural production.

Three possibilities for research in agroforestry are the following:

1) Identification and study of the growth and site requirements of various species suitable for agroforestry, both indigenous and exotic. Considerable knowledge exists already in the Caribbean area, as well as in Central and South America, knowledge which needs adapting to local conditions in Jamaica.

2) Study of the effects of the presence of trees upon agricultural crops and livestock. Such effects may be even more important than the trees they produce. It is particularly significant to find out the extent to which trees can replace the need to import chemical fertilizers (12).

3) Most important of all is the need to study the means whereby farmers can be motivated to make non-subsidized use of agroforestry procedures brought to their attention. Apparently Jamaican farmers did use them more widely at one time. Remnants of their procedures are said to exist in the Mocho mountains of Clarendon Parish northwest of May Pen. Research should study existing agroforestry practices among Jamaican farmers and use them as starting points for a program of reinforcement, improvment, and introduction of new species, procedures and uses. It is a fact that successful agroforestry systems almost always have a base in pre-existing practices (13).

8. Mechanisms for Encouraging Agroforestry

The indispensable elements of any scheme for encouraging agroforestry are to have a sound scientific base and to have procedures that are acceptable to the farmer. The next stage is to make sure that the extension agents, soil conservation specialists and foresters are aware of that base and those procedures. At present in Jamaica agroforestry does not appear among the subjects to which they are exposed either in their academic or their professional careers. It should therefore receive attention both as a separate discipline, and as part of the farming systems which the agents and others endeavor to promote. Their work in agroforestry becomes that of identifying with the farmer the sites appropriate for trees both biologically and economically, whether alone or in combination with agricultural crops, and advising upon species selection and management.

The consultant believes that the extension agents can be most effective by locating farmers with the resources to add agroforestry trees to their enterprises and realize the benefits therefrom. Such farmers thereby become part of the research and demonstration effort, without subsidies other than planting stock and guidance. Inevitably the spread of agroforestry is gradual but long-term, because trees have a time-span so much longer than most other farm crops.

9. Opportunities and Constraints

Important opportunities for agroforestry are those coming to light through research on the effects of trees upon agricultural crops and livestock. Many farmers know intuitively of such effects; but, careful and systematic research is now clarifying and quantifying such knowledge both as to species and as to management.

Probably the most significant opportunities for combining agricultural crops and trees will occur on Class III lands where farmers already grow several crops together. On the steeper and generally poorer Class IV lands, agroforestry offers opportunities to combine trees and grasses for livestock production. Use of trees and grasses can help retire from clean cultivated annual crops land which is sub-marginal for such use, but can help retain it as part of the farm resource. Fortunately climatic and soil conditions in the uplands of Jamaica are such that most Class IV and even most steeper lands re-vegetate themselves spontaneously without the expense of planting trees.

At present the principal constraints upon the spread of agroforestry are the lack of demonstrated effects upon agricultural crops, and of available planting stock. Both can be overcome. The time constraint is of less importance in that the effects of trees begin as soon as planted and have the advantage of continuing over a long period.

10. Conclusions and Recommendations

The upper watersheds of the Rio Cobre and the Rio Minho are not competitive with the lowlands in producing most clean-cultivated annual crops, either for export or for domestic consumption. The inevitable trends are toward the management of tree crops, livestock, water and forests, and toward a population less dependent upon small-scale hillside farming with hand tools. Such trends inevitably create some social tension; but they are long-term and gradual rather than abrupt.

Insofar as those trends are seen as authentic and desirable, agroforestry can help in several important ways. For example it can help in the management of commercial tree crops such as coffee, cacao, guava and mango. Agroforestry trees can enter livestock management as a source of fodder, of fertilizer and of protection. Although trees do not add to the total water supply, they help control the fall and flow of water in ways beneficial to watershed management. Although not strictly within the purview of agroforesty, the spontaneous re-growth of the natural forest has important implications for the trends noted above. Such natural forests help bring the water regime into balance; and increasingly contribute employment and forest products to the local economy.

The recommendations which follow reflect the above conclusions.

<u>6.1 Research</u>. The Department of Forestry and Soil Conservation has had a Research and Development Unit under the direction of an expatriate research

specialist for the last five years. It has had the usual problems of shortage of funds and staff. Because the Department is about to receive responsibility for watershed management as well, this R & D Unit will be an important factor in plans for the Rio Cobre and Rio Minho watersheds.

The 1984-1985 Annual Report of this Unit lists eight areas of research, including that of how to grow upland yams without creating problems of soil erosion. The combining of trees with agricultural crops does not appear as a separate subject of research.

It is therefore strongly recommended that agroforestry enter more into this Unit's program of work, both as a separate area and as part of each of the others. For example the yam research compared individual with continuous mounds, and the influence of ditches and grass strips. The use of live trees for support to the vines does not appear among the subjects studied. In each case the important questions are both the productivity of the trees as well as their influence upon the concurrent crops and livestock.

The addition of agroforestry to the present programs requires not only the strengthening of the Unit in respect to staff, equipment and operating funds, but also in providing opportunities for the professional staff to learn about the subject from other countries with ecological and social conditions comparable to those of Jamaica. It is also recommended that the use of trees be included in the Crop Research Unit and the Livestock Research Unit of the Research and Development Department of the Ministry of Agriculture, the National Agricultural Research Institute and the Farm Systems Research Project of the AID mission in contract with the University of Florida.

6.2 Training and Extension. As this Annex has pointed out, evidence is lacking that the extension agents working in the two watersheds are aware of the ways by which trees help better farming and soil conservation. Earlier this year a training course exposed extension agents to such ideas, but their response was not encouraging. Evidently most of them feel already saturated and need new inducements to take on a new subject.

To overcome such constraints, it is recommended that in each watershed a number (say five) of extension agents be designated as agroforestry agents. They would receive special training, equipment and program inducements, and be placed under the leadership of a program coordinator. The first phase of their field work would be to set up research and demonstrations on operating farms somewhat larger, better managed and more productive than the average, but with actual or incipient problems of soil erosion. Suitable farms are most likely to occur on Class III lands where slopes of 10-20 degrees are most common.

6.3 Patterns and Policies of Land Use. Agroforestry as defined will probably find most appropriate and extensive opportunities on Class III lands, of which St. Catherine and Clarendon Parishes have 85000 and 91000 acres respectively.

They have also 45000 acres and 38000 acres of Class IV lands. Such lands are designated as marginal for cultivation due to the extreme danger of erosion. Recommended are improved grasslands and tree crops (14).

The last recommendation needs further consideration to put it in the overall Jamaican context. The country has in all 263,000 acres of such lands. In converting Class IV lands to tree crops and improved pasture, Clarendon and St. Catherine must compete for capital and markets with eleven other parishes. It is unlikely that in St. Catherine and Clarendon all the Class IV lands will come under tree crops and pasture within the next few decades. If they are no to remain under cultivation, large amounts of Class IV land must revert to forest. The externalities of watershed control become quickly apparent, but reversion to high forest even by planting is too slow to retain private investment capital which could be put to more active use (14).

It is therefore recommended that the Government of Jamaica, in addition to applying the provisions of sections 14-19 of the proposed Forestry Act, be prepared to acquire through negotiated purchase sub-marginal lands which it judges were better out of cultivation and retained as part of the permanent public forest estate (15).

11. Summary of Agroforestry Annex

1) There are significant opportunities to expand the use of trees on hillside farms in the Rio Cobre and Rio Minho watersheds. The purposes of sucl expansion are primarily to increase crop production, to lessen soil erosion, and to enhance the delivery of high-quality water; secondarily, to provide wooc and other tree products.

2) Agroforestry in Jamaica has a traditional base, but needs up-grading and extension through more appropriate species, combinations and management.

3) The knowledge needed for such up-grading and extension exists, but mostly outside of Jamaica. Transfer and adaptation to Jamaican conditions are needed.

4) The most important agency for such transfer and adaptation is the Research and Development Unit of the Department of Forestry, Soil Conservation and Watershed Management within the Ministry of Agriculture.

5) The most appropriate agents to transmit agroforestry knowledge to farmers are the extension agents of the Land Authorities. Among them specialists should be designated for agroforestry and be given support with training, equipment and program incentives.

6) An important aspect of the problem of land use is the extent to which the Government uses the jurisdiction given the Ministry of Agriculture under the Land Authorities Act (1951), the Watershed Protection Act (1963) and the Forest Act (1973) to control land use and take out of cultivation lands unsuitable for such use. The proposed "Act to Repeal the Forest Act and to make new provisions in lieu thereof" strengthens and expands such jurisdiction (15).

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APPENDICES

ACRONYMS USED IN THIS REPORT

AMC	Agricultural Marketing Corporation
CBI	Caribbean Basin Initiative
CRIES	Comprehensive Resource Inventory and Evaluation System Project
DFSC	Division of Forestry and Soil Conservation
FAO	Food and Agriculture Organization of the United Nations
FIDCO	Forestry Industries Development Company, Limited
GDP	Gross Domestic Product
IDB	Inter-American Development Bank
IFAD	International Fund for Agricultural Development
IICA	Instituto Interamericano de Ciencias Agricolas
IRDP	Integrated Rural Development Project
JAS	Jamaica Agricultural Society
JLP	Jamaica Labor Party
JNIC	Jamaica National Investment Company
MOA	Ministry of Agriculture
ODA	Overseas Development Administration of Great Britain
PCB	Peoples' Cooperative Bank
PLL	Project Land Lease
PMO	Producer Marketing Organization
PNP	Peoples' National Party
PTA	Parent-Teachers Association
PVO	Private Voluntary Organization
SCD	Soil Conversation Division, Department of Forestry and Soil Conservation, Ministry of Agriculture
UNDP	United Nations Development Program
USLE	Universal Soil Loss Equation

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