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PROCEEDINGS OF THE SEMINAR

SUSTAINABLE AGRICULTURAL DEVELOPMENT

AND THE

ENVIRONMFNT: FOCUS ON WATERSHEDS

JAMAICA CONFERENCE CENTRE

KINGSTON, JAMAICA

June 21-23, 1994

The Natural Resources Conservation Authority (NRCA)

The German Technical Cooperation Agency (GTZ)

The Inter-American Institute for Cooperation on Agriculture (IICA)

Sustainable Agricultural Development and the Environment: Focus on Watersheds

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PREFACE

The Seminar on SUSTAINABLE AGRICULTURAL DEVELOPMENT AND THE ENVIRONMENT: FOCUS ON WATERSHEDS was held at the Jamaica Conference Center on June 21-23, 1994. The Natural Resources Conservation Authority, the German Technical Cooperation Agency and the Inter-American Institute for Cooperation on Agriculture sponsored the seminar.

The purpose of the seminar was to exchange experiences and information about the environmental problems affecting the agricultural sector in Jamaica and to analyze possible solutions to the problems. The presentations provided abundant material for a productive exchange of ideas. This document includes first a summary of the ideas presented during the panel discussions and the focal points of the presentations. The full text of the presentations is included in the Annex.

The IICA office in Jamaica is pleased to have participated with the NRCA and the GTZ in the accomplishments of this seminar. Our Institution is committed to the promotion of sustainable agricultural development. We expect to make a contribution to this process by helping to disseminate the information presented in the seminar.

Armando Reyes Pacheco
Representative

Seminar Sponsored by the Natural Resources Conservation Authority, the German Technical Cooperation Agency and the Inter-American Institute for Cooperation on Agriculture (NRCA-GTZ/IICA)

Conference Center
June 21-23, 1994

PROGRAM

Tuesday, June 21

8.30 A.M. Registration

8.45 Opening Ceremony
Mr. Franklyn McDonald, Director, NRCA
Dr. Armando Reyes, Representative, IICA
Hon. Easton Douglas, Minister, Ministry of Public Service and the Environment.

9.30 Sustainable Development, Terrence W. Thomas, Environmental Foundation of Jamaica.

10.15 Coffee Break

10.30 Sustainable Development, Ronnie de Camino, GTZ.

11.00 A Review of Jamaica's Attempt to Practice Sustainable Agriculture in the Upper Watershed, Dunbar Wright, NRCA.

12.00 P.M. Panel Discussion, Chairperson: Ms. Jacqueline Dacosta

12.30 Adjourn

Wednesday, June 22

9.00 A.M. Sustainability of Rural Development Projects, Ronnie de Camino, GTZ.

10.15 Coffee Break

10.30 Jamaica's Hillside Agriculture: an Environmental Endowment, Armando Reyes, IICA.

11.00 Agroforestry Development in the Yam Growing Region of Central Jamaica, Patrick Evans, FAO.

11.30 Rio Grande Dutch Project, Barrington Hall.

12.00 P.M. Panel Discussion, Chairperson: Armando Reyes

12.30 Adjourn

Thursday, June 23

9.00 A.M. Natural Resources and Watershed Management, Marikes Alvarez, CATIE

9.45 Case Study, Grant R. Scott, Trees for Tomorrow, MINAG/CIDA Forestry Department.

10.15 Coffee Break

10.30 Case Study, Denis Parchment, UNDP Project.

11.00 Small Farming System and Watershed Management, Marikes Alvarez, CATIE.

11.45 Sustainable Agricultural Development and the Environment, The Hillside Agricultural Project, Joe Suah, MINAG/USAID Hillside Agricultural Project.

12.30 P.M. Lunch

2.00 Hillside Agriculture and the Environment, Joseph Lindsay, CARDI.

2.45 Coffee Break

3.00 Environmental Impact of Present Land Use, The Rio Cobre Case Study, Tomas Mulleady, IICA, Jamaica.

3.30 Panel Discussion, Chairperson: Keats Hall

4.00 General Conclusions and Recommendations

5.00 Cocktail

JUNE 21, 1994

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40	PORTER, Keith	DIRECTOR, PROJECTS	MLGYS	12 OCEAN BLVD	KINGSTON
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43	SEINBERGER	GERMAN EMBASSY			
44	SPRATT, E.D.	COORD. SNAP PROJECT	53 KNUTS BLVD	KINGSTON 5	
45	THOMAS, Terrence	EFJ			
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TUESDAY, JUNE 21

1. OPENING CEREMONY

Mr. Franklyn McDonald Director of the Natural Resources Conservation Authority chaired the opening ceremony. He welcomed the participants to the meeting and addressed the meeting by stating that NRCA was responsible for watershed management since 1986 when they passed the Act. He further stressed that there was overlapping responsibility for watershed management and hoped that over the three days, the seminar would lead to the identification of all the players in watershed management.

The IICA representative, Dr. Armando Reyes, brought greetings and highlighted the fact that for Jamaica the agricultural sector plays a crucial part in sustainable development. The physical layout of mountainous terrain and the farmers on the hillsides make it relevant to focus on watershed management. He further stressed the need to consider the following:

- *The future and place less emphasis on the short run*
- *To develop a systematic approach as to what happens in the watershed*
- *To establish institutional linkages to avoid overlapping and duplication of efforts*
- *To adapt more environmental friendly technologies*

The Opening Address by The Hon. Easton Douglas, Minister of The Public Service and The Environment. In his address, the Honorable Easton Douglas, stated that the seminar focused on an important area: if we do not manage our watersheds there will be grave consequences for our future existence. The Minister further stated that the seminar was timely as it follows closely on the World Environment Day with its theme of "One Earth, One Family" which underscored both the finite nature of our resources and the interdependence of our activities. The full text of this paper is attached as Annex I.

The Chairman thanked the Minister and stressed the view that a community-based approach to farming which involved farmers at the community level was desirable.

The Chairman introduced Ms. Jacqueline Dacosta as the new chairperson and she introduced Dr. Terrence Thomas from the Environmental Foundation of Jamaica.

GENERAL SUMMARY OF PRESENTATIONS

PRESENTATION ON SUSTAINABLE DEVELOPMENT BY DR. TERRENCE W. THOMAS

Dr. Thomas' presentation focused on SUSTAINABLE DEVELOPMENT and stated that the traditional definition was contradictory as it implied that the earth's ecosystem could be developed to its fullest to pass on for future generations. He proposed an operational definition which acknowledged that there is a finite ability of the ecosystem to produce/reproduce.

Dr. Thomas further proposed the following solutions and approaches:

- To adjust the Education System to emphasize "the problem solving approach";
- To promote niche farming - produce plants where they naturally grow;
- Change our diets;
- Promote further development of Extension Services;
- Promote meaningful working relationships between Government and NGOs;

PRESENTATION ON SUSTAINABLE DEVELOPMENT BY MR. RONNIE DE CAMINO, GTZ.

Dr. Ronnie de Camino, presentation on Sustainable Development consisted of the following topics:

- Central Problems in Relation with Environment and Natural Resources
- Population, Poverty and Changes in Land Use
- The Ecological Debt and Opportunities for Action.

PRESENTATION ON A REVIEW OF JAMAICA'S ATTEMPT TO PRACTICE SUSTAINABLE AGRICULTURE IN THE UPPER WATERSHED BY MR DUNBAR WRIGHT, NRCA.

Mr. Wright said that the paper was an attempt to review Jamaica's competence in sustaining "Watershed Management." The paper highlighted the fact that since 1930, the problem of Watershed Management in Jamaica was studied. The suggested recommendations then focused on the following areas:

- unsuitable agricultural practice
- unsuitable land being used for agriculture
- loss of soil fertility

The paper also cited as a vast omission the fact of the lack of involvement of the farming communities.

Mr. Wright made the following suggestions:

- We should start with the farmers
- The need for more monitoring and investigation
- The need for more collaboration and education of farmers regarding "Sustainability"

The following suggestions were also made for the involvement of Government and NGOs:

- To determine priority "watersheds" as all of Jamaica is a "watershed"
- The need to find out the details of what is happening in the watershed areas
- The need for a plan for these critical areas
- To investigate the relationship between political boundaries and watershed boundaries

The paper is attached at Annex I.

PANEL DISCUSSION, CHAIRED BY MS. JACQUELINE DACOSTA.

Dr. Reyes started the discussion by expressing that the presenters projected the view that consumption patterns needed to be changed, and that the market system has not provided the signals for equitable development. He further questioned that in the absence of an "open market system" what was the alternative?

Dr. Thomas answered by stating that from an economist point of view the "free market system" was important, however, while we should try to influence values and proposed a human multifaceted approach as this approach is more manageable.

Dr. Ronnie de Camino responded by suggesting that the "free market system" with its distortions only represented the ECONOMIC TRUTH, while the ECOLOGICAL TRUTH was not portrayed. To elaborate this point he drew on the example of the price of water in our countries, where the price only included the cost to produce the water and does not include the price of watershed management.

Mr. McDonald referred to the question of who should pay for the cost of for example, the production of water in Negril, which is more than the production of water in another area. He also said that in Jamaica, we had not yet developed a MODEL for WATERSHED MANAGEMENT. He continued by stating the following:

- We have not carried out the recommendations of the past (cited in Mr. Wright's paper)

- Finding a new approach is important for us and to learn from the lessons of the past

- We should try to promote NGOs interest in WATERSHED MANAGEMENT

- Watershed boundaries in Jamaica were not based on the actual watershed boundaries but on the political interest.

The representative from the College of Agriculture, Mr. Jonathan Lamey, suggested that the Educational Institutions such as the Teacher Colleges, High Schools and Youths needed to be sensitized.

Hyacinth Chin Sue from IICA, proposed that, the time was right for NGOs and the Private Sector to become involved in watershed protection. She also added that the agencies presently involved should provide the guidelines and obligate the NGOs to participate.

Dr. Terrence Thomas from the Environmental Foundation of Jamaica said his Agency is aware of the following:

- local community groups are fragmented and not organized

- It will take time for the environmental NGOs to become active

Hyacinth Chin Sue, IICA, responded that the grass-root approach with emphasis on how to communicate with communities was missing.

The representative from NRCA, Mr. Franklyn McDonald proposed that finding operational models to use in these groups was necessary.

The Representative of IICA stated that his Agency's experience in Jamaica regarding watershed management suggests that we are still operating at point zero. He continued by stating that, the absence of a systematic institutionalized approach to solving problems of watershed management needs to be addressed.

Mr. Wright responded by stating that, Jamaica can solve the problem but what is lacking, is institutional **continuity.**

Concerning the non institutional continuity in regards to soil degradation, the representative from MINAG, Mr. Vincent Campbell suggested the following:

- Soon after receiving training in this area, the staff usually leaves the Ministry of Agriculture

- Farmers need to be subsidized to encourage them to practice the correct approach to reduce the problems of soil degradation.

In response to this suggestion, Dr. Terrence Thomas suggested that there is the need to understand how the topic of subsidies could be implemented. He further proposed that, the people in the watershed areas can be educated, but it will take a prolonged period.

Dr. Ronnie de Camino the representative from GTZ reminded the group that, if incentives are used as an approach, one has to also have the MONEY and the PRIORITY.

In summarizing, the chairperson for the panel discussion, reminded the group that the seminar should undertake a decision regarding watershed planning and management.

WEDNESDAY, JUNE 22

PRESENTATION ON SUSTAINABILITY OF RURAL DEVELOPMENT PROJECTS BY DR. RONNIE DE CAMINO THE REPRESENTATIVE FROM GTZ.

The presentation on Sustainable Rural Development consisted of the following areas:

- Main components of sustainable rural development projects
- Effects of project non-sustainability
- Factors determining sustainability
- Mechanisms to achieve sustainability
- Sustainable Project Formulation phases

The paper is attached at Annex I.

PRESENTATION ON JAMAICA'S HILLSIDE AGRICULTURE: AN ENVIRONMENTAL ENDOWMENT BY DR. ARMANDO REYES, THE IICA REPRESENTATIVE

In his introduction, Dr. Reyes said this was an attempt to present a conceptual argument for Hillside Agriculture in Jamaica. The paper also discusses how Jamaica's "Hillside Agriculture" conceptually interlaces development and sustainability issues. It is anticipated that the conceptual framework evoked would incite debate to enhance the understanding of Jamaica's "Hillside Agriculture." The content of the paper was broken down as follows:

- Introduction
- The Conceptual Challenge
- Jamaica's Hillside Agriculture a Sustainable Strategy
- Final Comments

The entire text of this paper is attached at Annex I.

PRESENTATION OF A CASE STUDY ON AGROFORESTRY DEVELOPMENT IN THE YAM GROWING REGION OF CENTRAL JAMAICA BY MR. PATRICK EVANS REPRESENTATIVE FROM FAO.

The paper discussed the rationale behind the project's implementation was the high demand for yam sticks and the subsequent environmental degradation resulting from their harvesting. The decreasing supply and increasing costs in getting yam sticks are resulting in environmental degradation in the region and threaten the long-term sustainability of yam cultivation in central Jamaica. The entire text of this paper is found in Annex I.

PRESENTATION OF A CASE STUDY ON THE RIO GRANDE DUTCH PROJECT by MR. BARRINGTON HALL.

Mr. Hall started his presentation by saying that the Rio Grande Valley Project is a GOJ/Netherlands project to improve the standard of living of the communities in the Rio Grande Valley. He emphasized that the Phase Two segment of the project shifted from an economic project to an Integrated Rural Development project with emphasis on Community Development. Environment, eco-tourism, women in development and youth empowerment and research were also important components. The project also demonstrated that development must first begin with the person, and in order for sustainable development to succeed, the culture and development have to be established. He also reinforced the following points:

- The experience in the Rio Grande Valley has taught that the "Agency" of development, should be the PEOPLE
- The importance of integration and coordination with other agencies at the project level - coordination also contributes to pooled contribution from the community as showed by the eco-tourism component of the project
- The need to change the expectation of the people at the village level to counter unfilled hopes
- The need to build the confidence of the project beneficiaries
- The need to conduct ongoing research

Mr. Hall also indicated that the following "common approaches" were important in project development:

- community Participation
- beneficiary contribution
- inter-agency cooperation and coordination

- divestment of the project to the community

- flexibility of the developer to realize that an activity may be redundant.

PANEL DISCUSSION - CHAIRPERSON DR. ARMANDO REYES

In relation to Dr. Reyes' paper, the Representative from NRCA questioned whether the effects of hillside farming on the environment were not as detrimental as we believed.

Dr. Reyes replied by stating that indicators are needed to conclude that hillside farmers are existing below the "poverty line." He further indicated that if this statement was factual, we could be approaching "a poverty life cycle." He further proposed that there could be two outcomes with reference to land use and potential use:

1. Over use of resources - not sustainable to watershed management and

2. Underutilization

He stated that he cannot substantiate that the watersheds in Jamaica were underutilized. However, the situation seems to suggest that there is the need to promote a balance land use, and it would be preferred that the hillsides in Jamaica were underutilized than overutilized. He further stated that, "the society is at a technological and environmental imbalance, and the question is, how does the society pays for this balance.

Mr. Wright questioned whether the hillside farmers recognized that they had the responsibility to help with watershed management.

Dr. Reyes replied that, evidence suggests that "Quilt Farmers" are existing below the poverty line and that their farming system is relatively environmental friendly, but poverty is not sustainable to the environment. The country must decide the degree of environmental amenities and poverty among hillside farmers.

In response to the above, the Representative from GTZ, Dr. Ronnie de Camino indicated that, the LESSONS OF THE PAST, should be used to evaluate the situation of the "quilt farmers" and poverty.

The representative from CATIE, Mr. Alvarez proposed that the group should examine past policies that might be negating the present environmental policies. He further suggested that institutional conflicts should also be examined as mechanisms should be put in place to harmonize these conflicts.

Mr. Hall gave an example of a situation where Government's policy regarding divestment of lands to coffee farmers resulted in the objection of environmental groups and subsequent review of the policy by Government. He further suggested that steering committees at the village level could be also used to resolve similar conflicts.

The GTZ representative proposed that the community is the most important entity in conflict resolutions when there are competition between agencies.

Presenters were asked to give their ideas regarding suggestions for concrete resolutions from the meeting. They made the following suggestions:

1. There is need to document the agencies involved in research

2. Needs for education at the national and local levels, to be placed on the agenda

3. The issue of NWC's being accountable for the ecological cost of producing ecologically safe water.

4. Need for collaboration at all levels, especially with NGOs and big businesses

THURSDAY, JUNE 23

PRESENTATION TROPICAL CROPS AND AGRICULTURAL SUSTAINABILITY, A STRATEGY TOWARDS THE 21ST CENTURY BY DR. MARIKES ALVAREZ FROM CATIE.

The topic of his presentation was, and was presented in two sections. First a slide's presentation followed by a 15 minute video presentation on a Latin American model. A summary of the video presentation is presented below:

1. Costa Rica was selected as the demonstration area suffers from deforestation and pollution;

2. The area shows the migration of people to areas surrounding the city and invading land that does not belong to them, thus creating further social problems in the cities;

3. 90 percent of farmers in the watershed area are growing coffee. Waste disposal is very high, with a high proportion of coliform in the water. Coffee farms provide work for people in the area;

5. Coffee processing plants pollute and contaminate rivers. Use of fuel foods by processing plants is also high;

6. High level of rain also contributes to land slides and changing landscape;

7. Underground water, as an alternative resource, is also threatened by contamination. River water is in need of treatment. Type of garbage found in the water is both chemical and physical.

8. Conservation methods are now being used and soil conservation techniques such as contour cropping and terraces are used. Educational campaigns are in place to educate school age children.

PRESENTATION OF A CASE STUDY ON THE TREES FOR TOMORROW PROJECT BY MR. GRANT SCOTT.

Mr. Scott noted that the goal of the overall Tree's for Tomorrow Project is to improve the management and conservation of forests and trees for the sustainable benefit of the people of Jamaica.

He used overheads to present his paper, and indicated that the watershed area was chosen as a pilot project and that use of the top-down and bottom-up approaches were part of the management plan. This report is attached at the annex I.

DISCUSSION

Mr. Keith Hall, Consultant with Forestry and Water Management made the following points:

- Jamaica already had a Forest department and the management plan involves NGOs and environmental education;

- Agroforestry is totally integrated into the watershed units of Jamaica. Pencar and Buff Bay are used as pilot area;

- The proposed objective of the pilot project will ensure that NGOs, Government, Farmers and schools are involved in environmental education programmes;

- Ruined forest should be returned to their natural forest state and agro-coffee system is better than the micro-coffee farming in the watershed areas;

- A socioeconomic study using a sample of 706 respondents, looked at what people were doing and how they could improve on what they were doing;

- Some issues include the fact that 80 percent of the people in the area are using firewood for fuel;

- Coffee production is benefitting people from outside the coffee producing areas, while people in the areas are getting the wages.

QUESTION AND ANSWERS:

Mr. Michael White from NRCA questioned whether the Trees for Tomorrow project can sustain itself?

Mr. Scott responded by stating that the Government of Jamaica and CIDA fully support the project.

Dr. Alvarez, the representative from CATIE, suggested to the group that they should not only look at one project in isolation, but it would be better to take a holistic approach and look at other sectors.

Mr. Louis Campbell from the Coffee Industry Board questioned the role of the Community in the development of the project?

Mr. Scott replied by stating that the project will be developed with the people in the area. The pilot area had used a top-down approach. However, the management of the project intends to use other approaches.

Mr. David Desai suggested that what we needed were fast growing trees as having one species taking over was dangerous, and if native plants, animals and birds will return.

The representative from NRCA questioned whether NGOs could provide advocacy in this area.

PRESENTATION OF A CASE STUDY BY MR. DENNIS PARCHMENT

His presentation drew on the impediments of the present system and focused on the following:

- The gaps in the system;

- The Individuals who are involved in Watershed Management;

- Involvement of NGOs;

- How to obtain funding;

- The Role of the University;

- How to resolve the impediments;

PRESENTATION OF A PAPER ON TROPICAL CROPS AND AGRICULTURAL SUSTAINABILITY, A STRATEGY TOWARDS THE 21ST CENTURY FOR SMALL FARMING SYSTEMS AND WATERSHED MANAGEMENT BY DR. MARIKES ALVAREZ FROM CATIE.

Slide presentations were used to present this paper and the paper is attached at the annex I.

PRESENTATION OF A CASE STUDY ON SUSTAINABLE AGRICULTURAL DEVELOPMENT AND THE ENVIRONMENT FROM THE HILLSIDE AGRICULTURAL PROJECT BY MR. JOE SUAH.

The paper focused on the Hillside Agriculture Project (HAP) which is regarded as the best watershed agricultural development initiative in Jamaica and is a joint undertaking between the USAID, the GOJ, NGOs and private agencies with interest in hillside farming, and small farmers. A copy of this paper is attached at the annex I.

QUESTION AND ANSWERS:

Question: Regarding the presentation from the representative from CATIE, Mr. John Campbell from the Ministry of Agriculture wanted to know the predominant land tenure.

Answer: Dr. Alvarez replied that the land was privately owned.

Question: Regarding the HAP, Mr. Cunningham asked whether there were plans within HAP to revitalize the breadfruit;

Answer: Mr. Suah said that plans were in place to bring down the size of the breadfruit to a reaping size so that they can reap the full 100%;

Question: Mr. John Lamey from the School of Agriculture asked whether HAP offered any assistance to young farmers;

Answer: In his reply, Mr. Suah stated that the project helped both the adult farmer and youths from 18-25 years.

Question: How many HAP farmers are women?

Answer: Mr. Suah stated that the gender breakdown was about 50-50.

PRESENTATION ON HILLSIDE AGRICULTURE AND THE ENVIRONMENT BY DR. JOSEPH LINDSAY FROM CARDI.

The paper attempted to review some major environmental problems associated with hillside agriculture. In addition, experience and successes from countries in a similar agro-ecological zone were cited and proposals for local/regional hillside management and current work related to environmental issues at CARDI related were proposed. A copy of the paper is seen at the annex I.

PRESENTATION ON ENVIRONMENTAL IMPACT OF PRESENT LAND USE, THE RIO COBRE CASE STUDY BY DR. TOMAS MULLEADY FROM IICA JAMAICA OFFICE.

Dr. Mulleady informed the seminar that this case study presentation includes several studies done in collaboration with IICA, the GTZ, Costa Rica and the Ministry of Agriculture. The paper is attached at Annex I.

GENERAL CONCLUSIONS AND RECOMMENDATIONS:

Emphasis on Policy, Research and Education were the suggested areas of focus for this section of the meeting. Suggested also was that the recommendations to be considered were linked to action to be carried out over the next 12-18 months.

The meeting considered the following issues relating to Education, Research, and Policy:

Education

1. Concern was expressed by the participants that children were not exposed to adequate information and an alternative focus for teaching them had not been addressed.

2. The view was also expressed that the Community should have more participation in watershed management. Suggested for consideration was the fact that NGOs could take the lead role and begin with education.

3. Existing and potential farmers were suggested as the two areas for a focus in Education.

4. Environmental Education should be incorporated within the school curriculum.

5. Educating farmers should be considered as a priority.

6. **NRCA will continue to be the focal point agency for this area of education as they have in the past been networking with related organizations.**

7. **Educational programmes should be holistic and the Jack's Hill programme could be used as a model.**

Policy:

1. **NRCA should take the lead in ensuring consistency and continuity in the policy area;**

2. **A national Soil Policy is needed. FAO had already done some work in this area and there is an existing Soil Policy Committee.**

3. **Emphasis should also be placed on land use as it relates to the construction industry.**

4. **There is the need to develop a strong information base;**

5. **Networking at the local, regional and international levels will be needed.**

Research:

1. **There is need to build up the research base at the Ministry of Agriculture as it now suffers from an inadequate data base.**

2. **All new projects should have a research component;**

3. **The need exists for the strengthening of zoning in watershed management, and participation at the community level should be encouraged in this area.**

4. **The need exists for Local participation at all levels in the community.**

5. **Indigenous knowledge in the watershed communities should be sought and then tested.**

6. **There is need for indicators to assess the status of watershed management.**

7. **There is need for an accounting of the ecological advantages of the environment and at the watershed level there is need to assess what is lost.**

8. **Soil Nutrients should be area of focus in research;**

9. The representative from the Hillside Project indicated that they would be willing to share information on their research with other agencies.

In closing, the chairperson thanked both the local and overseas participants and the sponsors.

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ANNEX I

LIST OF PRESENTATIONS

The Opening Address
The Hon.. Easton Douglas
Minister
Minister of Public Service and The Environment.

Sustainable Development in Agriculture - The Jamaican Perspective
Dr. Terrence W. Thomas.
Director
Environmental Foundation of Jamaica

Review of Jamaica's Attempt to Practice Sustainable Agriculture in the Upper Watershed
Mr. Dunbar Wright.
The Natural Resources Conservation Authority

Sustainability of Rural Development Projects
Dr. Ronnie de Camino
GTZ

Jamaica's Hillside Agriculture: An Environmental Endowment
Dr. Armando Reyes Pacheco.
Representative
Inter-American Institute for Cooperation on Agriculture

Agroforestry Development in the Yam Growing Region of Central Jamaica
Mr. Patrick Evans.
Food and Agricultural Organization of the United Nations

LIST OF PRESENTATIONS cont'd

Tropical Crops and Agricultural Sustainability, A Strategy Towards the 21st Century
Mr. Marikes Alvarez.
CATIE

The Tree for Tomorrow Project
Mr. Grant Scott.
MINAG/CIDA Forestry Department

A Case Study on Sustainable Agricultural Development and The Environment
Mr. Joe Suah.
MINAG/USAID Hillside Agricultural Project

Hillside Agriculture and the Environment
Mr. Joseph Lindsay
Caribbean Agricultural Research and Development Institute

Environmental Impact of Present Land Use, the Rio Cobre Case Study
Dr. Tomas Mulleady.
Inter-American Institute for Cooperation on Agriculture

ADDRESS BY THE HON. EASTON DOUGALAS, MINISTER OF THE PUBLIC SERVICE AND THE ENVIRONMENT AT THE OPENING CEREMONY OF THE SEMINAR ON SUSTAINABLE DEVELOPMENT: FOCUS ON WATERSHEDS, JUNE 21, 1994.

GREETINGS

This seminar focuses on an area of great importance: if our watersheds are not properly managed, there will be grave consequences for our future existence.

It is timely that the seminar follows closely on World Environment Day with its theme "one earth, one family" which underscored both the finite nature of our resources and the interdependence of our activities.

Last week, the seventh Caribbean Forestry meeting was held in Kingston on the topic "Economics in Forestry". Officers from the Natural Resources Conservation Authority (NRCA) and other Government agencies were able to join foresters from the Forest Department and other Caribbean countries in discussion of issue relevant to this seminar.

Over half of our total land area is used for agricultural purposes this fact coupled with the country's physical configuration and the distribution of our rural population means that our watersheds are extremely vulnerable to destruction.

While it is true that the majority of our farmers have survived and supported their families under extremely difficult circumstances and, in some cases, with minimal environmental disturbances, nevertheless, the increase in population and the overall developmental pressures, have had a significant impact on our watershed areas. In most cases there have been negative consequences for both upland and lowlands areas - for example, deforestation with the consequential soil erosion; damage from the extensive use of fires which often get out of control during land clearing; loss of soil fertility and agricultural productivity; destruction of habitat; flooding that occurs even after mild rainfall; siltation of downstream areas such as reservoirs; aquifers not being recharged and pollution from squatting in inappropriate areas.

The United Nations (UN) through the Food and Agricultural Organization (FAO) has made periodic assessments of forests around the world. In a recent report the FAO states the following:

- Between 1980 and 1990, tropical forest areas have been shrinking an average of 15.4 million hectares per year.

- Over the last decade 154 million hectares of tropical forest, equivalent to almost three times the land area of France, have been converted to other land use.

- Global loss of above-ground biomass from deforestation in tropical countries is estimated at 2.5 gigatons annually during the past 10 years.

- Degradation and fragmentation of remaining forestland continues to threaten the diversity of plant and animal life.

The government over the years has not been insensitive to the importance of watersheds in our life - for examples, in 1993 the Watersheds Protection Act was passed. Unfortunately, the accompanying regulations were not promulgated and so the Act has not been as effective as it could be. The Natural Resources Conservation Authority (NRCA) during the course of this year, be turning its attention to the effective administration of the Act, including the development of regulations.

There have also been several projects with varying levels of effectiveness which have sought to manage and protect watersheds. The Hillside Agricultural Project, for example, demonstrated increased production of cocoa without additional degradation and soil loss.

Under the "Trees For Tomorrow Project" the Buff Bay Watershed has been selected for a project which will seek to demonstrate how to carry on coffee production while maintaining the integrity of the watershed.

The case studies that will conducted throughout the seminar should be fascinating and should give insights into what are the most effective means of managing and protecting our watersheds.

One of the approaches that I am sure you will endorse is that watershed protection is a task not only for the Government, but also for Non-Governmental Organizations.

Even the best efforts at coordination between Government Agencies are not sufficient to reduce the level of degradation taking place.

It is clear that communities which are close to or are an integral part of our watershed areas must play a greater role in protecting and managing these areas. They need to exhibit a greater stewardship over this resource base. This, to my way of thinking can only be achieved through the combined efforts of the Government, the Communities, and the Non-Governmental Organizations. If we can show others that we all have a stake in protecting the watershed areas then the task at hand would be easier to carry out.

In some cases community management groups have had better results than government agencies acting on their own and the environmental and economic benefits of community participation can be startling. For example, according to "World Resources 1994-95", Government leaders in India in the 1970's became concerned about the heavy siltation of a lake in a particular district.

A survey of the watershed found that the problem was mainly caused by overgrazing, illicit tree removal and poor agricultural practices in the surrounding ecosystems. All efforts by the Forest Department to stop grazing in the woods were unsuccessful, until by working with Local Leaders, the Forest Department was able to mobilize interest in rehabilitating the hills by focusing on water. A small dam was built in 1976-77 above a gully head and grass was planted to stabilize the sides of the gully. Some of the water irrigated marginal agricultural fields which tripled crop yields. The improved harvest reduced the dependence on fodder from forestland.

Aware of the economic benefits of rehabilitating the hills, members of the community planted grass and prohibited grazing there thus supplying themselves with a harvestable fodder crop and reducing soil erosion.

Similarly communities in Jamaica should be guided by advice from the relevant Government Agencies, such as the Forest Department in terms of quick growing species for fuel wood or the NRCA on guidance on captive breeding programmed for wild life or for the collection of the medicinal plants.

This approach must have components of sustained utilization along with a collective responsibility to preserve and protect our watersheds. In addition, there has to be marked shift in agricultural land use as it relates to encouraging farmers to grow more food trees as against relying on short term crops. This is expected to serve a two fold purpose, firstly preservation of the environment through the reduction of soil loss and erosion that would normally result from the intensive cropping on the hillsides without supporting conservation practices and secondly securing a more source of income for farmers.

These initiatives will have to be supported by Re-afforestation Programmes where feasible and by a vigorous Public Education Programme to sensitize the people as to the role that watersheds play in national development and the need to protect the resource.

I would like to commend the organizers of this seminar sponsored by the German Technical Cooperation Agency (GTZ), the Inter-American Institute for Cooperation on Agriculture (IICA) and the Natural Resources Conservation Authority (NRCA).

It is clear that the time has come to review our approaches to Watershed Development and Management in Jamaica and I am sure that this seminar is a valuable and practical means of carrying out such a review, in the context of the experiences of other countries. I wish you luck in your deliberations and look forward to seeing the recommendations that will be made. It is expected that we will be better informed as we implement programmes for the management of watersheds in Jamaica.

Thank you.

SUSTAINABLE DEVELOPMENT IN AGRICULTURE - THE JAMAICAN PERSPECTIVE

THERE ARE SEVERAL SCHOLARLY DEFINITIONS OF SUSTAINABLE DEVELOPMENT MANY OF WHICH IMPLY INCREASING THE QUANTITY AND QUALITY OF GOODS AND SERVICES IN ORDER TO SATISFY THE NEEDS OF PRESENT AND FUTURE GENERATIONS.

THE BASIC ASSUMPTION OF THESE DEFINITIONS IMPLIES THAT DEVELOPMENT MEANS PRODUCING MORE GOODS AND SERVICES UTILIZING MORE AND MORE OF EARTH'S RESOURCES. E.G. THE WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT (1987) DEFINED SUSTAINABLE DEVELOPMENT AS " DEVELOPMENT WHICH MEETS THE NEEDS OF THE PRESENT WITHOUT COMPRISING THE NEEDS OF FUTURE GENERATIONS TO MEET THEIR OWN NEEDS." ANOTHER EXAMPLE, THE BRUNDTLAND COMMISSION DEFINES IT AS " THE NECESSITY TO ENSURE THE SATISFACTION OF PRESENT AND FUTURE GENERATIONS

TO PUT IT ANOTHER WAY, AN ECOSYSTEM WHICH IS IN A STEADY STATE OF DYNAMIC EQUILIBRIUM PRODUCES A CONSTANT QUANTITY OF RENEWABLE AND NON RENEWABLE RESOURCES. IT IS FROM THIS CONSTANT SUPPLY OF RESOURCES THAT HUMAN BEINGS SEEK TO MEET THEIR IMMEDIATE AND FUTURE NEEDS. THIS MEANS THAT A POPULATION'S RATE OF CONSUMPTION OF NATURES GOODS AND SERVICES SHOULD NOT EXCEED THE RATE AT WHICH THESE GOODS AND SERVICES ARE PRODUCED BY THE ECOSYSTEM IN WHICH THE CONSUMING POPULATION EXIST. THE AIM OF SUSTAINABLE DEVELOPMENT THEN IS TO MATCH CONSUMPTION PATTERNS OF POPULATIONS WITH THE PRODUCTION PATTERN OF THE ECOSYSTEM SUPPORTING THE PARTICULAR POPULATION. THE WORLD CONSERVATION STRATEGIES INTERPRETATION OF SUSTAINABLE DEVELOPMENT CAPTURES THE NOTION OF MATCHING CONSUMPTION WITH PRODUCTION, THEY BELIEVE THAT SUSTAINABLE DEVELOPMENT IS IMPROVING THE CAPACITY OF POPULATIONS TO CONVERT A CONSTANT LEVEL OF RESOURCE USE INTO THE INCREASED SATISFACTION OF

HUMAN NEEDS. THE OTHER DEFINITIONS MAKE SENSE WHEN REFERRING TO ACTIVITIES THAT UTILIZE ONLY RENEWABLE RESOURCES, BUT IS OBVIOUSLY SELF CONTRADICTORY WHEN REFERRING TO NON-RENEWABLE RESOURCES, AND, IF WE GO FURTHER, THEY DO NOT FIT VERY WELL WITH THE IDEA OF AN ECO-SYSTEM IN EQUILIBRIUM PRODUCING A FINITE OR CONSTANT AMOUNT OF RESOURCES AT A PARTICULAR TIME.

IF WE ACCEPT THE PROPOSITION THAT ECOSYSTEMS IN A STEADY STATE OF DYNAMIC EQUILIBRIUM PRODUCE A FINITE AMOUNT OF GOODS AND SERVICES, THEN, ACCEPTING THIS PROPOSITION MEANS THAT DEVELOPMENT CANNOT PROCEED IN A LINEAR FASHION WHERE GROWTH PROCEEDS WITH OUT REGARD FOR THE LIMITS OF THE ECOSYSTEM TO SUPPORT IT. DEVELOPMENT IN THE SENSE OF SUSTAINABLE DEVELOPMENT IS NOT THE SAME AS GROWTH. IT IS MORE THAN THAT, DEVELOPMENT IN THIS SENSE INCLUDES THE NOTION OF DIFFERENTIATION. THE CONCEPT OF DIFFERENTIATION IN THIS CONTEXT REFERS TO AUGMENTING OR AMPLIFYING EXISTING PRODUCTION

PROCESSES SO THAT THE SAME AMOUNT OR LESS INPUT PRODUCES GREATER QUANTITIES OF GOODS AND SERVICES. THE PROCESS OF AMPLIFICATION IMPLIES MORE THAN WHAT SEEMS TO BE GOOD OLD FASHIONED EFFICIENCY . THE CONCEPT ALSO EMBRACES THE NOTION OF SYNERGY, WHICH MEANS THAT THE EFFECT OF THE WHOLE IS GREATER THAN THE SUM OF THE EFFECT THE PARTS.

EXAMPLES OF DIFFERENTIATION IN DEVELOPMENT AND THE USE OF RESOURCES WOULD INCLUDE COMPUTER CHIP TECHNOLOGY WHICH ALLOWS THE PROCESSING OF LARGE QUANTITIES OF INFORMATION WITH SMALLER AND SMALLER COMPUTERS WHICH CONSUMED LESS RESOURCES IN THEIR CONSTRUCTION, THE USE OF BST TO AUGMENT THE PRODUCTION OF MILK AND THE IMPROVEMENT IN SKILL AND INSIGHT OF INDIVIDUALS THROUGH LEARNING AND MATURATION ARE OTHER EXAMPLES. FOR DEVELOPMENT TO PERSIST THROUGH TIME THE ADDED DIMENSION OF DIFFERENTIATION MUST REMAIN A VIABLE OPTION IN ORDER TO MEET THE NEEDS OF A BURGEONING POPULATION DEMANDING MORE GOODS AND SERVICES IN A

SITUATION WHERE THERE IS A LIMIT TO THE AMOUNT OF GOODS AND SERVICES WHICH CAN BE PRODUCED. THE MAJOR CHALLENGE OF SUSTAINABLE DEVELOPMENT IN AGRICULTURE IS TO PRODUCE ADEQUATE AND RELIABLE SUPPLY OF FOOD AT REASONABLE PRICES AT THE LOWEST POSSIBLE ECOLOGICAL L COST IN THE FACE OF PROGRESSIVELY INCREASING POPULATION.

LONG AGO MALTHUS, (1878) POSTULATED THAT "THE POWER OF POPULATION IS DEFINITELY GREATER THAN THE POWER OF THE EARTH TO PRODUCE SUBSISTENCE FOR MAN". THE COMMON INTERPRETATION OF THIS IS THAT , THE RATE OF POPULATION GROWTH INCREASES GEOMETRICALLY, WHILE FOOD PRODUCTION AT BEST, INCREASES ARITHMETICALLY. SO THAT IN A SHORT WHILE, OR BEFORE LONG, HUMANITY WILL BE ON THE BRINK OF STARVATION.

FOUR YEARS BEFORE MALTHUS, THE FRENCH PHILOSOPHER, CONDORCET REASONED THAT WHEN HUNGER THREATENS , NEW INSTRUMENTS (TECHNOLOGY) WILL BE DEVELOPED

WHICH PROVIDES MAN WITH THE TECHNOLOGY TO SOLVE WHAT EVER PROBLEM HE ENCOUNTERS.

THERE IS MUCH EVIDENCE TO SUPPORT THIS POSITION SINCE FROM THE TIME OF MALTHUS' PREDICTION, MANKIND HAS BEEN ABLE TO AVERT MASS STARVATION BY RAISING THE LEVEL OF AGRICULTURAL PRODUCTION TO MEET THE DEMANDS OF EARTH'S POPULATION FOR FOOD.

AVAILABLE DATA SHOWS THAT FARMERS DID NOT ONLY KEEP PACE WITH POPULATION GROWTH, GLOBAL PER CAPITA FOOD PRODUCTION GREW MORE THAN 10% FROM 1968 TO 1990. ALSO, THE NUMBER OF SEVERELY MAL NOURISHED PEOPLE, FELL MORE THAN 16%.

THIS AND OTHER PIECES OF EVIDENCE WOULD SEEM TO SUPPORT THE ECONOMISTS' VIEW, IT WOULD APPEAR THAT MAN IS ABLE TO AVERT STARVATION REGARDLESS OF THE NATURAL CONSTRAINTS WHICH ARISE FROM TIME TO TIME. THIS IS ONLY SO THOUGH, IF ONE NEGLECTS TO TAKE INTO

WHICH WILL ALLOW A SMALL AMOUNT OF GROUND TO PRODUCE LARGE QUANTITIES OF FOOD.

THESE TWO SCHOLARS THROUGH THEIR RESPECTIVE PROPOSITIONS HAD ALREADY STAKED OUT THE TWO EXTREMES OF THE DEBATE THAT CONTINUES UP TO THIS DAY. AS A MATTER OF FACT, THE DEBATE HAS BEEN TRANSLATED INTO TWO VIEWS, THE NATURAL EARTH VIEW, SUPPORTED BY BIOLOGISTS, WHICH STATES THAT EARTH'S RESOURCES ARE FINITE IN TERMS OF LAND, MINERAL RESOURCES AND ENERGY. THE FINITENESS OF RESOURCE PLACES A CAP ON THE ABILITY OF THE EARTH TO PRODUCE TO SUPPORT AN INFINITELY INCREASING POPULATION. THAT IS THE EARTH HAS A LIMITED CARRYING CAPACITY. THE OTHER VIEW WHICH IS THE SOCIO-ECONOMIC VIEW, DEFENDED BY ECONOMISTS PROMOTES THE BELIEF THAT THE FUTURE OF MAN IS OPEN ENDED. THAT IS, MAN IS INGENIOUS AND WILL DEVELOP WAYS AND MEANS TO REMOVE THE CONSTRAINTS ON HIS ABILITY TO DEVELOP AND SUPPORT HIMSELF USING EARTH'S LIMITED RESOURCES. THIS VIEW SEES SCIENCE AS AN AMPLIFYING INSTRUMENT

ACCOUNT THE ADVERSE IMPACTS ON THE ENVIRONMENT. FOR EXAMPLE, THE VAUNTED GREEN REVOLUTION TECHNOLOGIES WHICH INCREASED FOOD PRODUCTION DRAMATICALLY THROUGH THE INTENSIVE USE OF ENERGY (FOSSIL FUEL DERIVED FERTILISERS, INSECTICIDES AND OTHER AGRO CHEMICALS AND HIGH YIELDING STRAINS OF GRAIN) HAS LED ENVIRONMENTAL DECAY AND IN SOME INSTANCES SOCIAL DISLOCATION. EVEN BEFORE THE GREEN REVOLUTION, RACHAEL CARSON'S WORK BROUGHT TO OUR ATTENTION THE DOWNSIDE OF MODERN AGRICULTURE, AND MORE RECENTLY, COMMONER SPOKE OF AN INDUSTRIAL TECHNOLOGY GONE WRONG. THE WORK OF THESE TWO SCIENTISTS ALERTED US TO THE ADVERSE EFFECTS OF TECHNOLOGY, WE WERE PRODUCING SUFFICIENT FOOD, BUT NOT COUNTING THE COST OF ITS IMPACT ON THE QUALITY OF THE ENVIRONMENT. WE ARE NOW AWAKENED TO THIS NEGATIVE SIDE OF MODERN AGRICULTURE. TO PROGRESS BEYOND THIS, THE CLASSICAL PRODUCTION FUNCTION MODEL WHICH HAS GUIDED THE ANALYSIS OF ECONOMIC ACTIVITIES MUST BE REDEFINED. IN THE FIRST

INSTANCE THE MODEL WAS NOT ADEQUATELY SPECIFIED, BECAUSE IT DID NOT TAKE INTO ACCOUNT THE VALUE OF CONTRIBUTION MADE BY ECOLOGICAL CAPITAL TO THE PRODUCTION OF GOODS AND SERVICES.

ECOLOGICAL CAPITAL WAS DEALT WITH IN A SUPERFICIAL MANNER AS EXTERNALITIES AND TENDED ONLY TO ENTER INTO CONSIDERATION WHEN THEY BECAME SCARCE.

ADJUSTING THIS DOMINANT MODEL USED IN DEVELOPMENT ANALYSIS IS JUST A SMALL STEP TOWARDS ACHIEVING SUSTAINABLE DEVELOPMENT. TO MOVE FORWARD IN A SIGNIFICANT WAY TOWARDS SUSTAINABLE DEVELOPMENT WILL REQUIRE A CULTURAL REVOLUTION. THIS MEANS A COMPLETE 'REJIGGERING' OF THE WAY WE MAKE OUR LIVING. CULTURE IS HERE USED TO MEAN THE SUM OF OUR REACTIONS AND INTER-ACTIONS WITH OUR ENVIRONMENT. THIS REVOLUTION ENTAILS THE COMPLETE OVERHAUL OF HOW WE ORGANISM TO CONDUCT ECONOMIC ACTIVITY, STRUCTURE SOCIAL RELATIONSHIPS, EDUCATE, APPLY

SCIENCE AND DEVELOP TECHNOLOGY, THAT IS MAN'S TOTAL RELATIONSHIP WITH MAN AND WITH HIS ENVIRONMENT.

CULTURALLY, MAN IN HIS RELATIONSHIP WITH NATURE HAS EVOLVED THROUGH FOUR STAGES. THESE ARE HUNTER GATHERER, ADVANCED HUNTER GATHERER , SHEPHERD/ FARMER AND INDUSTRIAL MAN. IN THE FIRST TWO STAGES, MAN HAD A VERY MINIMAL AND BENIGN IMPACT ON THE ENVIRONMENT. OF COURSE, HIS ACTIVITIES RESULTED IN SOME DEGRADATION, BUT THIS WAS WITHIN THE CAPACITY OF THE ENVIRONMENT TO ABSORB AND RECTIFY. (IT IS USEFUL TO NOTE TOO, THAT HIS DIET, DURING THE TWO EARLY STAGES WAS RICHER AND MUCH MORE VARIED THAN THAT OF AGRICULTURAL AND INDUSTRIAL MAN. FOR EXAMPLE, THE BUSHMAN'S DIETS INCLUDED 23 SPECIES OF VEGETABLES AND 17 SPECIES OF MEAT.)

MAN AS SHEPHERD AND FARMER BEGAN TO HAVE PROGRESSIVELY GREATER IMPACT ON THE ENVIRONMENT - AT THIS STAGE HE BEGAN TO TRANSFORM FORREST TO OPEN

DOWNFALL.

INDUSTRIAL MAN ATTEMPTED TO CONTROL THE ENVIRONMENT EVEN MORE THAN THE AGRICULTURAL MAN. AGRICULTURAL MAN MADE USE OF ANIMAL POWER IN ADDITION TO HIS MUSCLE POWER, BUT INDUSTRIAL MAN WAS ABLE TO UNLOCK CHEMICAL ENERGY, IN COAL , OIL AND NATURAL GAS AND EXTRACT ORES FROM THE EARTH. THIS USHERED IN THE ERA OF AIR POLLUTION, WATER POLLUTION STRIP MINING AND THE WASTE DISPOSAL PROBLEMS ASSOCIATED WITH URBAN LIVING. HE LEARNED TO USE CHEMICALS AS AN AID IN THE PRODUCTION OF USEFUL PRODUCTS E.G. PESTICIDES, FERTILIZERS, ADDITIVES AND GROWTH STIMULANTS WHICH LED TO THE NEW LITANY OF ECOLOGICAL PROBLEMS WE ARE FAMILIAR WITH TODAY.

ADVANCES IN TECHNOLOGY ARE NECESSARY AND INDISPENSABLE TO PROGRESS. THE CULTURAL ADAPTATION WE MUST UNDERGO TO ACHIEVE SUSTAINABLE DEVELOPMENT MUST EVOLVE BEYOND THE STAGE OF INDUSTRIAL MAN. IT PRIMARILY CONCERNS THE WAY WE USE

OR APPLY THE SCIENTIFIC METHOD TO ACHIEVE SUSTAINABLE DEVELOPMENT IN AGRICULTURE. WE HAVE RELIED ON SCIENCE AND THE TECHNOLOGIES IT SPAWNS TO INCREASE PRODUCTIVITY AND TO MAKE FOOD AVAILABLE AT REASONABLE PRICES TO LARGE NUMBERS OF PEOPLE. WHEN THERE IS AN INCREASE IN PRODUCTIVITY SMALLER QUANTITIES OF RESOURCES ARE EMPLOYED IN THE PRODUCTION OF GOODS AND SERVICES OR THE SAME QUANTITY OF RESOURCES ARE USED TO PRODUCE MORE GOODS AND SERVICES. RESOURCES SAVED CAN BE DEFERRED FOR FUTURE USE OR BE ALLOCATED FOR USE IN OTHER AREAS OF CRITICAL NEED STAINABLE DEVELOPMENT BY CONSERVING RESOURCES THE TECHNOLOGIES WE HAVE EMPLOYED IN OUR PRODUCTIVE PROCESS HAVE MADE THEIR CONTRIBUTION TO SUSTAINABLE DEVELOPMENT USING SMALLER AND SMALLER AMOUNTS OF INPUT. OUR FAILING HERE IS THAT WE HAVE TAKEN A REDUCTIONIST APPROACH TO THE FORMULATION OF TECHNOLOGY FROM SCIENCE. WE TEND TO REDUCE PROBLEMS TO ITS SIMPLEST FORMS IN SEARCHING FOR SOLUTIONS. THIS HAS PROVEN EFFECTIVE,

BUT WE HAVE NEGLECTED TO RE-ESTABLISH THE CONNECTIONS TO THE COMPLEX WORLD IN FORMULATING THE TECHNOLOGY. AS A RESULT WE HAVE LOST SIGHT OF VALUABLE INTERACTIONS AND OPPORTUNITIES TO TAKE ADVANTAGE OF SYNERGY.

BUT, WORSE THAN THIS WE HAVE BEEN UNABLE TO RECOGNIZE THE HARMFUL EFFECTS OF OUR WELL INTENDED ACTIONS, AND SO THE NEW TECHNOLOGY WAS NOT PROPERLY INTEGRATED IN THE EXISTING ECOLOGY.

THIS IS ONLY ONE SIDE OF THE COIN THOUGH, THE OTHER SIDE OF THE COIN IS THE MODIFICATION WE NEED TO MAKE TO THE SET OF RULES AND PROCEDURES WE USE TO STRUCTURE RELATIONSHIPS AND GUIDE THE WIDE RANGE OF SOCIAL BEHAVIOR AROUND WHICH MODERN SOCIETY IS ORGANIZED.

EVEN THOUGH SCIENCE HAS THE CAPACITY TO SOLVE A WIDE RANGE OF PROBLEMS DERIVING FROM MAN'S INTERACTION WITH THE ENVIRONMENT, MAN AS A SOCIAL BEING, MUST BE

WILLING TO APPLY HIS VALUES TO SELECT FROM THAT WHICH SCIENCE SAYS IS POSSIBLE TECHNICALLY, TO THAT WHICH IS ETHICAL, MORAL , EQUITABLE AND SOCIALLY ACCEPTABLE. SINCE TECHNOLOGY WILL HAVE A PERVASIVE EFFECT, SOCIALLY AND ECOLOGICALLY, IT IS CRITICAL THAT THE SOCIAL SYSTEM DEVELOPS A MEANS TO MAKE THESE JUDGEMENTS. UNDERSTANDING OF THE ISSUES INVOLVED WILL DETERMINE THE QUALITY OF THE JUDGEMENT.

ONCE A CHOICE IS MADE, THE SUCCESSFUL APPLICATION AND THE INTEGRATION OF TECHNOLOGY INTO THE CULTURE, WILL DEPEND ON THE COMMITMENT AND ACCEPTANCE OF THESE PRINCIPLES BY THOSE WHO WILL BE MATERIALLY AFFECTED. ACCEPTANCE AND COMMITMENT ARE ONLY ASSURED WHEN THERE HAS BEEN MEANINGFUL PARTICIPATION IN THE PROCESS OF ARRIVING AT A DECISION. SUSTAINABLE DEVELOPMENT IN AGRICULTURE IN THE FUTURE HINGES ON FOUR PILLARS - THE QUALITY OF THE SOCIAL PROCESSES INVOLVED IN MAKING CHOICES - THE QUALITY OF THE HUMAN RESOURCES EMPLOYED IN THIS

PROCESS - THE SET OF TECHNOLOGIES WE CHOOSE TO DRIVE THE PRODUCTIVE PROCESS AND THE METHODS WE EMPLOY TO ORGANISM OURSELVES TO ACCOMPLISH THE TASK OF SUSTAINABLE DEVELOPMENT.

FOOD SECURITY OR MAKING FOOD AVAILABLE AT REASONABLE PRICES TO THE ENTIRE POPULATION, MUST BE ONE OF THE PRIMARY GOALS OF SUSTAINABLE DEVELOPMENT.

HOW CAN WE ACHIEVE SUSTAINABLE DEVELOPMENT? WE ALLUDED TO FOUR FACTORS ABOVE WHICH NEED CONSIDERATION. OPERATIONALLY, THESE IMPLY -

-1- REDESIGNING OUR EDUCATIONAL SYSTEM -

TO PROVIDE TEACHING STUDENTS AND ADULTS TO LEARN, PROCESS INFORMATION, PRINCIPLES OF CONSERVATION, EQUITY AND TOLERANCE, AND TO ACCEPT THAT EDUCATION IS A LIFE LONG PROCESS.

TO MODIFY OUR EXTENSION SERVICES TO OFFER A NEW PORTFOLIO OF SERVICE TO RURAL AND URBAN PEOPLE AND TO CATER FOR THE ADULT POPULATION WHICH

CANNOT GO TO SCHOOL IN THE CONVENTIONAL SENSE.

-2- ENCOURAGE REAL PARTICIPATION IN DECISION MAKING.

-3- DEVELOP OUR CAPACITY TO APPLY THE NEW EMERGING BIO-TECHNOLOGIES FOR APPLYING MODERN TECHNIQUES

-4- TO THE STRUCTURING OF ROLES AND PROCESSES INTO RESPONSIVE AND EFFICIENT ORGANISATIONS.

-5- CREATE AN INTEGRATED RESEARCH EXTENSION AND EDUCATION SYSTEM

-6- CREATE A MEANINGFUL WORKING RELATIONSHIP AMONG GOVERNMENT, PRIVATE SECTOR AND THE NGO COMMUNITY. IN THIS RELATIONSHIP, GOVERNMENT SHOULD ADOPT AN ENTREPRENEURIAL POSTURE.

A REVIEW OF JAMAICA'S ATTEMPT TO PRACTICE SUSTAINABLE AGRICULTURE IN THE UPPER WATERSHED

A. HISTORICAL EVALUATION

In any effort to move forward and develop strategies for improvement it is important that past activities be highlighted. In this instance, it is important to realize that an awareness of the ills of watershed degradation is not a recent development but that in the early part of this century the authorities saw the necessity of appointing a Soil Conservation Officer. Despite the appointment of an Officer and the establishment of a Soil Conservation Division in 1944, no large-scale work was done. Simple measures such as mulching, cultivation along contours, contour drains or trenches, were recommended and put in the field. This continued until 1947 when the Soil Conservation Officer left the Island.

Today we all hear the various views being expressed about the seriousness of the degradation in our watersheds. Some of the views expressed before 1947 include;

1. Croucher and Swaby. 1937. In their article `SOIL EROSION AND SOIL CONSERVATION IN JAMAICA, 1937., it was pointed out that the chief causes of soil erosion in Jamaica resulted from unsuitable agricultural practices, unwise selection of land for agriculture, and a lack of appreciation of the problem. They suggested that people should be made aware of the problem and that the relevant Government Agencies should start coordinating their effort on research, proper landuse etc., if a solution was to be found.

2) A. J. Wakefield, Agricultural Adviser, in his report `MEMORANDUM OF AGRICULTURAL DEVELOPMENT IN JAMAICA' stated that "until the present decline in land fertility is arrested in Jamaica, the problems of an excessive birth rate, under-employment and unemployment, inadequacy of medical and educational facilities will ever remain. Their principal single root cause is undoubtedly soil erosion." This recommendation implies an integrated approach to solving the problem. He further suggested the use of a Watershed Management unit approach as the basis on which the problem should be tackled.

Other reports during this period highlighted the urgency of the problem, the need for appropriate landuse practices, and the need for legal instruments to ensure a reversal of the trend of degradation.

Between 1947 and 1963 when the Government promulgated the "WATERSHED PROTECTION ACT", and established the Watershed Protection Commission, various programmes and initiatives were undertaken. Chief among these were the;

a) Farm Improvement Scheme(1947-1951) aimed at soil conservation improvement on individual farms islandwide.

b) Passing of the LAND AUTHORITY law in 1951 and the establishment of the Yallahs Valley and Christiana Area Land Authorities over the next two years. These Authorities were concerned with the rehabilitation of badly eroded areas and to intervene to prevent further soil erosion in the designated areas.

Then, as is the case now, various experts from the FAO and other aid Agencies came to advise and implement projects and initiatives. An evaluation of their reports would indicate that the problems and conclusions drawn are exactly those as we have them today. Some comments and observations were;

1) Engineering structures were not producing the desired results due to lack of maintenance and improper use.

2) The level of intensity on soil conservation is such that it will only slow down the process but not stop it since the extension services does not have soil conservation works integrated into it's mandate.

3) Soil conservation works undertaken was not done on a comprehensive basis but done on individual areas on parcels of land.

4) Soil conservation works were sometimes attempted on slopes which are inappropriate for both the treatment and agriculture.

5) The level of extension services for soil conservation being offered is totally inadequate and based on the present policy cannot make soil conservation produce the necessary impact.

Again we see that various projects were undertaken in an effort to reverse the trend of soil loss while allowing farmers in the upper watersheds an opportunity to continue making a living from the land they own. However, all reports of the period conclude that the systems being used were unsustainable without some major effort to change the farming systems being practiced.

March 1963 saw the development of a new strategy towards treating the degradation of the upper watersheds. This was the passing of the Watershed Protection Act 1963 and the appointment of a Commissioner to administer the Act.

The main objective of the commission were to conserve the soil and water resources of critical watersheds, then identified, as well as, investigate and identify additional areas in need of protection. The operations of the commission focussed on:-

1. Engineering repair and conservation works such as, river and gully training, construction of groynes, checkdams, retaining walls, waterways and access road construction and maintenance.

2. Assisted improvement schemes which included (1) above, provided subsidy to farmers within the declared watersheds to do corrective and conservational works on farm holdings, including the establishment of forest and permanent crops.

3. Degraded lands were acquired for rehabilitation and a farm re-settlement programme implemented along with the World Food Programme. This was to assist the farmers over the transitional period and the loss of income while he invested labour, at his holding, on conservation and repair work.

While these activities provided short-term solutions, social and

indirect economic benefits, the causative problems were not sufficiently addressed viz deforestation and improper farming practices among other things. Some of the very access roads that were created later become avenues to increase deforestation.

During the period 1964 - 1975, 48,498 acres (19634.8 hectares) were physically treated by the commission, but only 2,473 acres (1001.2 hectares) or 5.1% of the total area was established and maintained in permanent crops and afforestation. While these activities were well intentioned they did not provide for sustainable protection and conservation.

The low keyed activities and investment in afforestation and related on farm conservation under the Watershed Protection Commission was apparently a deliberate course of action. The pilot land authorities (Y.V.L.A. and C.A.L.A.) and subsequently, the additional eleven (11) were charged with the mandate for rehabilitative and preventive management of soil erosion on farm holdings.

Work of the pilot land authorities just prior to 1969 was considered far too slow to make significant difference in the time that will elapse before further large areas go completely out of production, through soil erosion and yields will fall to uneconomic levels that people will be forced off the land, however, unwillingly (Chapman 1966). The adoption of simple conservational measures without lasting benefits, the lack of close supervision especially for maintenance work, and land use without due consideration of land capability were some review analytical criticism conclusion levied.

It was the failure of these simple conservation methods and an attempt to solve the problem of farmers neglect in follow-up maintenance for assisted scheme benefits which motivated and propelled undertakings in expensive, elaborate methods of soil conservation on hill-slope and intensively farmed holdings. In this regard budgetary allocation was substantially increased between 1969 and 1975.

With the growing environmental awareness and the need for the coordination of environmental management and natural resources, the Watershed Protection Commission's role and functions were transferred and amalgamated with the Natural Resources Conservation Department in 1975.

Under the merger, all present and future projects or programmes with agrarian implications were transferred to the commission of the Ministry of Agriculture. It was then that watershed management became more involved in investigations.

Starting with the Cave River/Patoo Gully Watershed to study immediate and long term solutions to the correct serious soil erosion/siltation problems in that area and the water supply system for Christiana.

The institutional charge and transfer of some technical (agronomy and conservation officer) staff to the Ministry of Agriculture perhaps initial the long fragmentation of responsibilities for watershed management, and a weakening of the humah resource base at the NRCA's Watershed Branch.

The commission in 1975 recognize the need for an increase in management personnel, a more technical and scientific approach to management with greater involvement of community members in watershed management.

Further shifts and adjustments in governments and policies created some administrative difficulties and confusion.

In the new system engineering works and assisted programmes continued on nine (9) watersheds as before, but with greater emphasis on flood prevention - (river and gully training) and increased use of vegetation alongside the relevant engineering structures.

Perhaps the greatest accomplishment of the NRCD in watershed management was the investigation and sating of boundaries for watershed, and the declaration of Jamaica's 33 watersheds. Included in this period were the First Rural Integrated Development Project in Western Jamaica and the Second Integrated Rural Development in Central Jamaica.

.B. SOIL CONSERVATION

As stated in the introduction Jamaica's watershed programmes developed out of a number of activities and experiences. This chapter will deal with the soil conservation effort as a means of reversing the trend of degradation in watersheds.

The Yallahs Valley and Christiana Area Land Authorities were the first deliberate effort to tackle the problem on a locality basis. It was thought that if these badly degraded, intensively farmed areas could be successfully tackled then it would serve as a model for future work.

It has been estimated that over 60% of the Island's farming activities, producing most of the foodstuff for local consumption, occur on slopes between 20% to 60%. With the porous nature of many of these soil types, coupled with the frequent heavy rainfall, soil erosion and nutrient loss is a companion of farmers.Therefore the decision to use soil conservation methodology as a primary tool was taken.It should be noted that although work was done on the levels of soil loss none has yet been done on the loss of nutrients as a result of soil erosion. Best estimates are that nutrient losses are significant thus causing the consistently low levels of production that is common to most Jamaican farmers.

Since the late 1960's various studies/investigations have been done by Sheng et al, Woo et al, and Armstrong et al to determine actual levels of soil loss and some of the factors which directly influence soil erosion and runoff losses. It was determined that gradient(slope), soil texture and depth, rainfall incidence and intensity, and crop type and management are the major influencing erosion and runoff. A loss of 179 tonnes oven- dried soil/ha/yr from single mound yam cultivations on a 20 degree slope was obtained on Wait-A-Bit clay. At Smithfield average reported soil loss over a four period from yams grown in single mounds on a 31 degree slope was found to be 121 tonnes/ha/ yr.. This compares with losses of 16 tonnes/ha/yr. over the same period from bench terraces with contour mounds at the same location. Therefore, it is obvious that soil conservation treatments work to prevent soil loss. Further to this, it can be concluded that soil conservation works better to maintain soil fertility than the present farming systems. Why then wont Jamaican farmers adopt and use the recommended soil conservation treatments?

Before attempting to provide some of the reasons, it is necessary to highlight the soil conservation systems provided in the past. These were:-

- Bench terraces with roads and run-off ways

- Hillside ditches, orchard terraces, individual basins

- Mini convertible terrain

All these systems are very expensive and in most instances would need an infusion of capital to the farmer before he could attempt to build, and need additional money for maintenance.

It is an accepted fact that most Jamaican farmers do not use the

above mentioned treatments as part of their farming system, despite the obvious benefits. Some reasons given by farmers are:-

1. the erosion effect can be overcome by leaving the land idle for 2-4 years. After the land is covered with grass for this period, the fertility of the soil seems to be restored;

2. after the building of terraces, production is still limited by capital, labour etc. therefore, he/she does not receive any additional income form using soil conservation structures;

3. Terraces, in most cases, allow for some level of mechanization and most farmers cannot or are unwilling to invest in tractors, therefore the benefits of mechanization are lost.

4. Hillside farmers find it physically less taxing to work facing a slope than bending on level ground, and;

5. The socio-cultural conditions in which he operates does not put any great importance on the use of fertilizers or new more productive varieties.

All these and other factors combined, reduce the economic and environmental attractions of soil conservation works.

Therefore where do we as a nation go, if we want to reduce soil loss, practice sustainable agriculture, and increase productivity?

C. FORESTRY

As is the case with the development of Soil Conservation, Jamaica's forestry development was born out the concern that forest resource depletion was occurring without any structured effort being made to replace the loss of trees. Thus the between 1937 and 1944 the Government passed into law the FOREST ACT, established the FOREST DEPARTMENT, and started declaring some parcels of land as FOREST RESERVES.

The development of forestry was however given more importance based on the level of continuity of its' programme over the years. At the outset of the forestry programme, work was done to provide protection, conservation and employment. Starting in the 1960's, some plantations were established to exploit the commercial potential of wood products. This process was accelerated during the 1970's under a USAID project which sought to establish large acreage of Carib Pines to allow the Jamaican forest sector an opportunity to become commercial. The thinking at the time was that with large acreage of sloping land available that were unsuitable for commercial agriculture, forest plantations would provide a viable economic alternative. Coupling this with the rapid growth of Carib Pine, all financial and economic analyses showed a positive rate of return.

After successfully implementing the USAID project, the Forest Department then sought to commercial some activities by forming the FOREST INDUSTRIES DEVELOPMENT COMPANY. Hurricane Gilbert along with other factors such as high transportation and road building costs has resulted in this venture failing.

At about this same time coffee production again became an attractive venture in the Blue Mountains and lands that were logged were replanted in Coffee instead of forest plantations. Some of these Plantations were established on very steep slopes without adequate soil conservation measures so that we now find the upper watersheds again being degraded because of the use of improper farming systems.

Despite increased pressure for land for farming, no matter how steep the slope, the forest sector through its National Forestry Action Plan is making an effort to somehow influence the amount of forest cover especially in upper watersheds.

Conclusion

Jamaica's watershed problems are complex embodying the economy, social factors, and sheer human survival. To solve even some of these problems there needs to be agreement between the various agencies about:-

- Objectives of an integrated Watershed Management Plan i.e. water resources, land resources and human resources.
- Agreement on the need for a plan.
- The need for a single authority to ensure that the plan is respected.
- The need for monitoring and evaluation.
- Methodology for implementing an integrated watershed management project.

As the Jamaican experience has shown, implementation of integrated watershed projects often meet with serious difficulties because:-

- Government agencies are centralized while the responsibility for work is fragmented.
- Political and administrative boundaries do not coincide with watershed boundaries.
- Upper and lower watershed populations have differing and sometimes conflicting interest.
- The best watershed programmes are those that prevent rather than do repair work.

As the years of experience shows, there are no easy solutions to watershed problems. Each situation should be treated as being unique, but there are a series of steps which can be taken to facilitate implementation. These include:-

1. Determine important watersheds and watershed values on a national scale.
2. Determine areas to be protected from further degradation.
3. Make a realistic plan for the protection of critical areas and make sure it is known and respected.
4. Determine who are the parties involved in watershed management.
5. Create awareness of watershed management issues and solutions.
6. Appoint a lead agency for watershed protection and management.
7. Prepare master plans by lead agency for priority watersheds with the participation of interested and affected parties.

8. Decide who has responsibility for each part of the implementation as well as for monitoring and evaluation.

9. Ensure continuity of funding, human resources development and maintenance of achieved results.

10. Adjust legislation, create incentive programmes, etc., in order to facilitate derived changes.

SUSTAINABLE RURAL DEVELOPMENT IMPORTANT ELEMENTS

- SUSTAINABLE AND EQUITABLE GROWTH OF THE QUANTITY AND QUALITY OF GOODS, SERVICES AND RESOURCES OF RURAL PEOPLE IN A PARTICULAR REGION
- INCREASE IN THE CAPACITY OF RURAL PEOPLE TO MANAGE AND FOSTER ITS OWN DEVELOPMENT
- DEVELOPMENT UNDER THE CONDITION OF PERMANENTLY EVOLVING STRUCTURES - SUSTAINABLE DEVELOPMENT IS DINAMIC
- RURAL DEVELOPMENT EVOLVES UNDER CONDITIONS THAT INFLUENCE ITS SUSTAINABILITY: BIOPHYSICAL, SOCIO-CULTURAL ,ECONOMICAL AND INSTITUTIONAL CONDITIONS.

SUSTAINABLE RURAL DEVELOPMENT

SUSTAINABILITY DIMENSIONS IN RURAL DEVELOPMENT

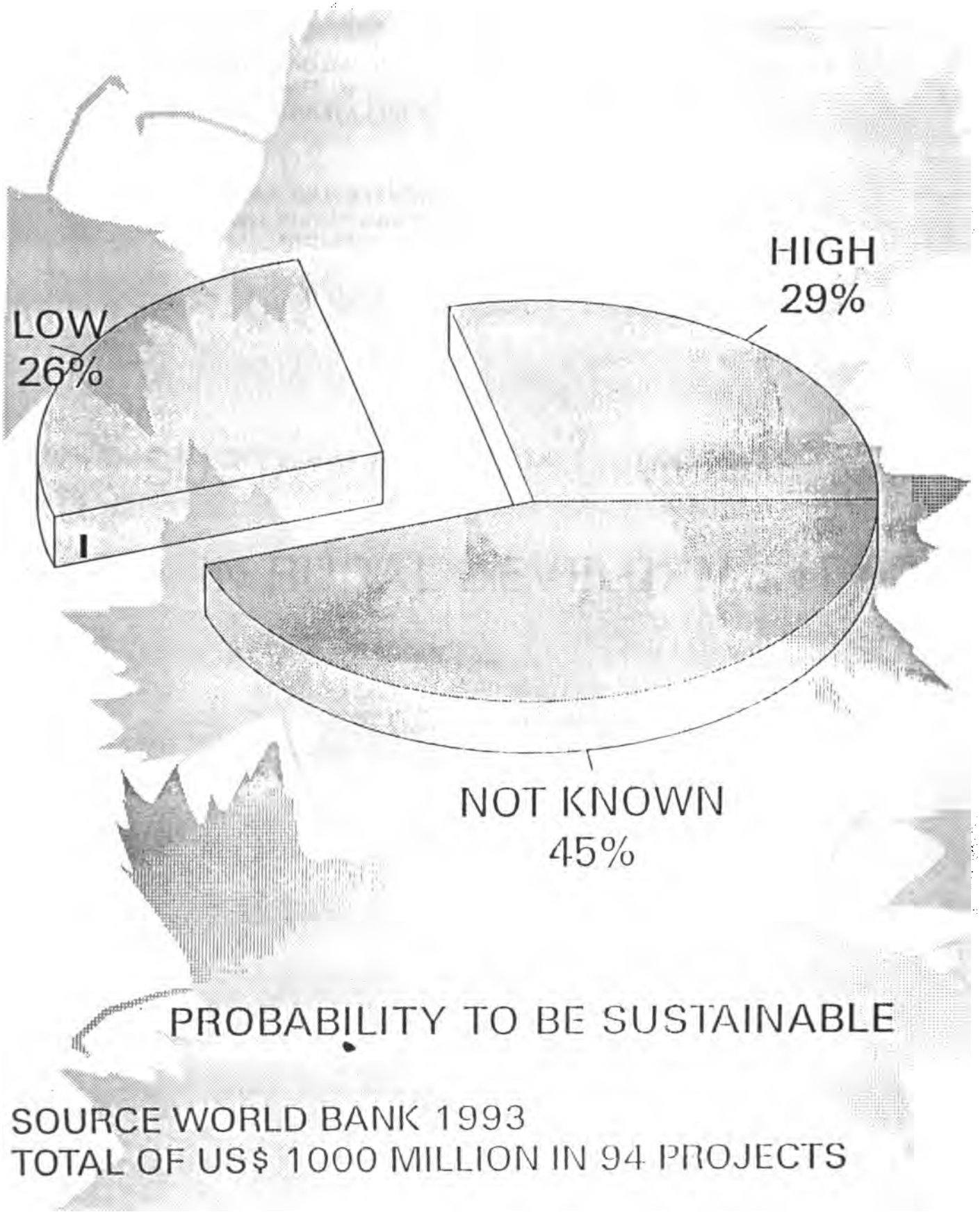
SUSTAINABILITY OF PROJECTS IMPORTANT ELEMENTS

- CAPACITY TO YIELD AN APPROPRIATE LEVEL OF BENEFITS FOR A LONG PERIOD AFTER THE TECHNICAL ,FINANTIAL AND MANAGEMENT SUPPORT FROM AN EXTERNAL SOURCE STOPS

- MAINTAINS OR IMPROVE THE RENEWABLE NATURAL RESOURCES BASE(IN QUALITY AND QUANTITY) IN THE PRESENT AND FUTURE,INSIDE AND OUTSIDE THE SPATIAL AND TEMPORAL LIMITS OF A PROJECT.

- EQUITABLE DISTRIBUTION OF COSTS AND BENEFITS AMONG ACTORS.

THE NON SUSTAINABILITY OF RURAL DEVELOPMENT AN AGRICULTURAL PROJECTS.



SOURCE WORLD BANK 1993
TOTAL OF US$ 1000 MILLION IN 94 PROJECTS

EFFECTS OF PROJECT NON-SUSTAINABILITY

AT NATIONAL LEVEL

- INCREMENT IN EXTERNAL DEBT
- WASTE OF AVAILABLE RESOURCES FOR RURAL DEVELOPMENT AND OPPORTUNITIES GONE

AT LOCAL LEVEL

- LOOSE OF CONFIDENCE IN DEVELOPMENT AGENCIES
- INCREASE IN FARMERS DEBT
- INEFFECTIVE USE OF PEOPLE RESOURCES
- DECREASE IN WELFARE OF RURAL PEOPLE

PROJECT PHASES
TRADITIONAL PATH

PHASE I

- EXOGENOUS SUPPORT BY EXTERNAL ASSISTANCE
- NATIONAL COUNTERPARTS,NORMALLY GOVERNMENT
- ADVISORS HIRED BY THE ASSISTANCE AGENCY

PHASE II

- NO EXOGENOUS SUPPORT
- FOLLOW-UP AND MONITORING RESPONSABILITY OF THE NATIONAL CONTERPART

PROJECTS SUSTAINABILITY
IMPORTANT ISSUES

TIME

- EFFECTS AND IMPACTS DURING AND AFTER THE PROJECT
- CONTINUING SUPPORT DURING AND AFTER THE PROJECT TIME HORIZON

SPACE

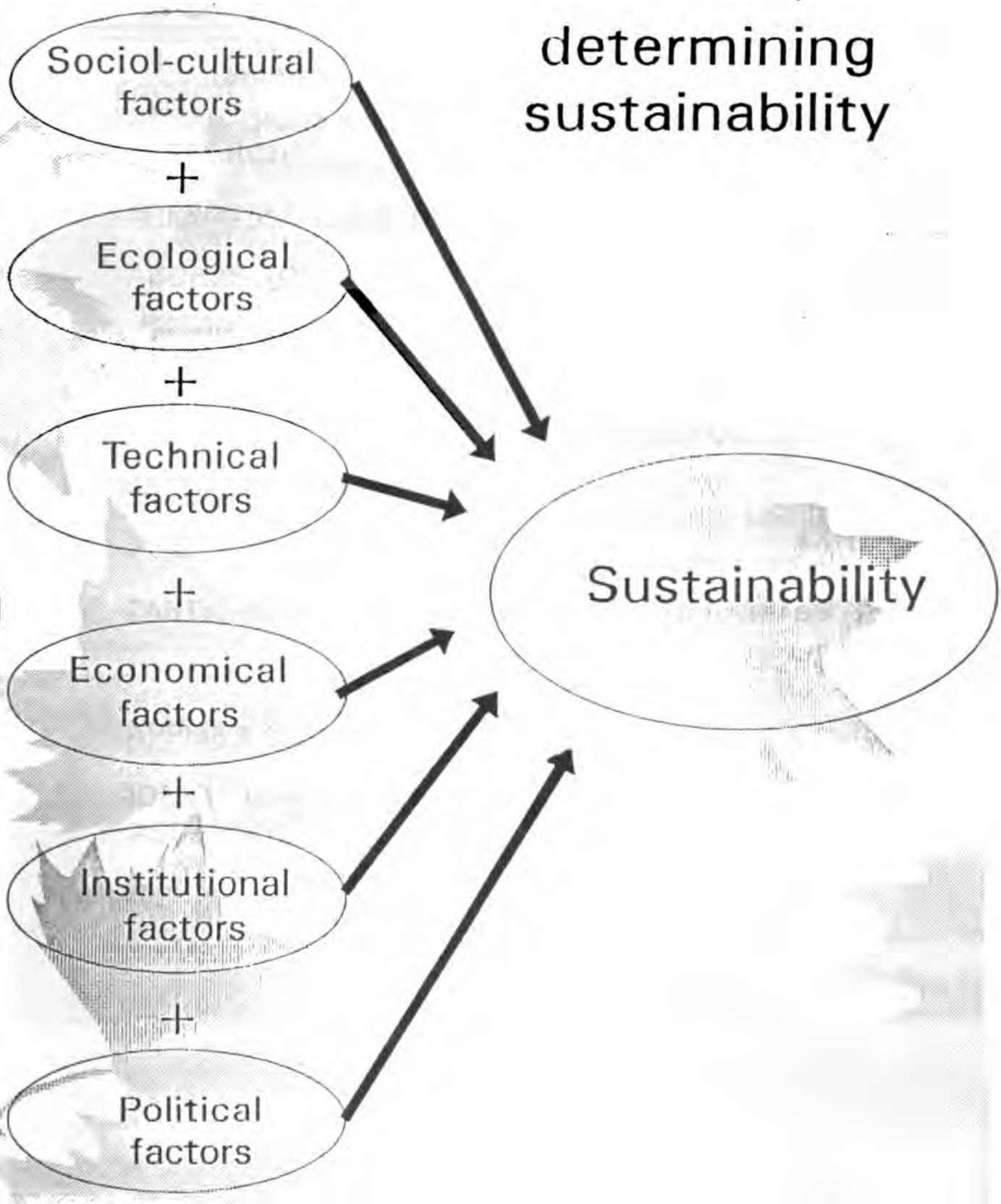
- EFFECTS AND IMPACTS IN AND OUTSIDE THE PROJECT LIMITS
- DIFUSION OF BENEFITS

ENVIRONMENT

- ENVIRONMENTAL IMPACTS IN AND OUTSIDE THE LIMITS OF THE PROJECT
- PRESENT AND FUTURE ENVIRONMENTAL IMPACTS

SUSTAINABILITY OF PROJECTS DEPENDS ON:

- ADOPTION OF CHANGE BY BENEFICIARIES
- CONTINUITY OF SUPPORT NEEDED TO FEED CHANGE IN THE FUTURE (TECHNICAL, INSTITUTIONAL, FINANCIAL,ETC)
- CONTROLED OR NON-EXISTENT EXTERNALITIES IN THE SPACE AND TIME FRAMEWORK OF THE PROJECT
- EQUITY IN DISTRIBUTING COSTS AND BENEFITS


Factors
determining
sustainability
Sociol-cultural
factors
+
Ecological
factors
+
Technical
factors
+
Economical
factors
+
Institutional
factors
+
Political
factors
Sustainability

SOCIO-CULTURAL SUSTAINABILITY

FACTORS

-PARTICIPATION OF THE TARGET POPULATION

-DEVELOPMENT OF LOCAL INSTITUTIONS

-TECHNOLOGIES ARE SOCIO-CULTURALLY ACCEPTABLE

MECHANISMS

-PARTICIPATION IN DIAGNOSIS , DESIGN,IMPLEMENTATION MONITORING AND EVALUATION

-ON FARM RESEARCH

-PARTICIPATIVE VALIDATION AND ADAPTION OF RESEARCH RESULTS

-WORK WITH LOCAL INSTITUTIONS

-TRAINING OF PROJECT PERSONNEL

TECHNICAL SUSTAINABILITY

FACTORS

-RESEARCH

-APPROPRIATE TECHNOLOGY THAT IS VALIDATED

-ACCESS TO SUFFICIENT RESOURCES

-TRAINING - KNOWLEDGE

-ACCESS TO TECHNICAL ASSISTANCE

MECHANISMS

-PILOT PROJECTS

-PARTICIPATIVE VALIDATION AND ADAPTION

-ON FARM RESEARCH

-APPLIED AND IN SERVICE TRAINING

-IDENTIFICATION AND STRENGTHENING TECHNICAL ASSISTANCE SOURCES

ECONOMICAL SUSTAINABILITY

FACTORS

-RELATIVE RENTABILITY OF TECHNOLOGY

-MARKETS

-CASHFLOW - FINANCIAL RESOURCES REQUIREMENTS

-RISK

-ACCESS TO FINANCIAL RESOURCES

MECHANISMS

-MARKET KNOWLEDGE(STUDIES)

-IMPROVING CASHFLOW BY DIVERSIFYING.MIX OF ACTIVITIES WITH COMPLEMENTARY CASHFLOWS

-MINIMIZING INITIAL INVESTMENT

-KNOWING RENTABILITY CONCEPT AND PERCEPTION OF FARMERS

-DIVERSIFICATION

ECOLOGICAL SUSTAINABILITY

FACTORS

-TECHNOLOGY APPROPRIATE TO THE NATURAL RESOURCES BASE

-APPROPRIATE RESOURCE MANAGEMENT

MECHANISMS

-ENVIRONMENTAL IMPACT ANALYSIS IN AND OUTSIDE THE PROJECT LIMITS

-INCLUDE ACTIONS AND COMPONENTS THAT PROTECT THE ENVIRONMENTY

-INCLUDE ACTIONS AND COMPONENTS THAT MAKE PROPER USE OF ALL AVAILABLE RESOURCES

-TRAINING-TECHNICAL KNOWLEDGE TO PROPER SITE SELECTION AND MANAGEMENT

-MONITORING AND EVALUATION

INSTITUTIONAL SUSTAINABILITY

FACTORS

-LOGISTIC AND FINANCIAL CAPACITY

-INSTITUTIONAL ARRANGEMENTS

-COORDINATION WITH AND DEVELOPMENT OF LOCAL INSTITUTIONS

-CONTINUITY OF TECHNICAL ASSISTANCE

MECHANISMS

-WORK WITH LOCAL ORGANIZATIONS

-PAYING ATTENTION IN SUBSIDIES APPLICATION

-MANAGEMENT TRAINING

-REAL PARTICIPATION

-PROJECT DESIGN CONSISTENT WITH ABSORPTION CAPACITY SPECIALLY WITH THE END OF EXTERNAL SUPPORT

-STRENGTHEN AND REGULATE THE OPERATION OF NGO'S

POLITICAL SUSTAINABILITY

FACTORS

-LAND TENURE

-INCLUSION OF NATURAL RESOURCES IN POLICY AND PLANNING

-LEGAL ISSUES THAT REGULATE USE AND HARVEST OF NATURAL RESOURCES

-INCENTIVES POLICY

-POLICY REFORM

MECHANISMS

-DEVELOPMENT OF LOCAL ORGANIZATIONS

-DEVELOPMENT OF LOCAL GOVERNMENTS

-ACCESS TO POLITICAL PROCESS

-ADJUST PROJECTS TO POLITICAL REALITY

-INTER-SECTORIAL COORDINATION

ADDITIONAL CONSIDERATIONS

IMPORTANT ISSUES

-RURAL DEVELOPMENT AND SUBSISTANCE

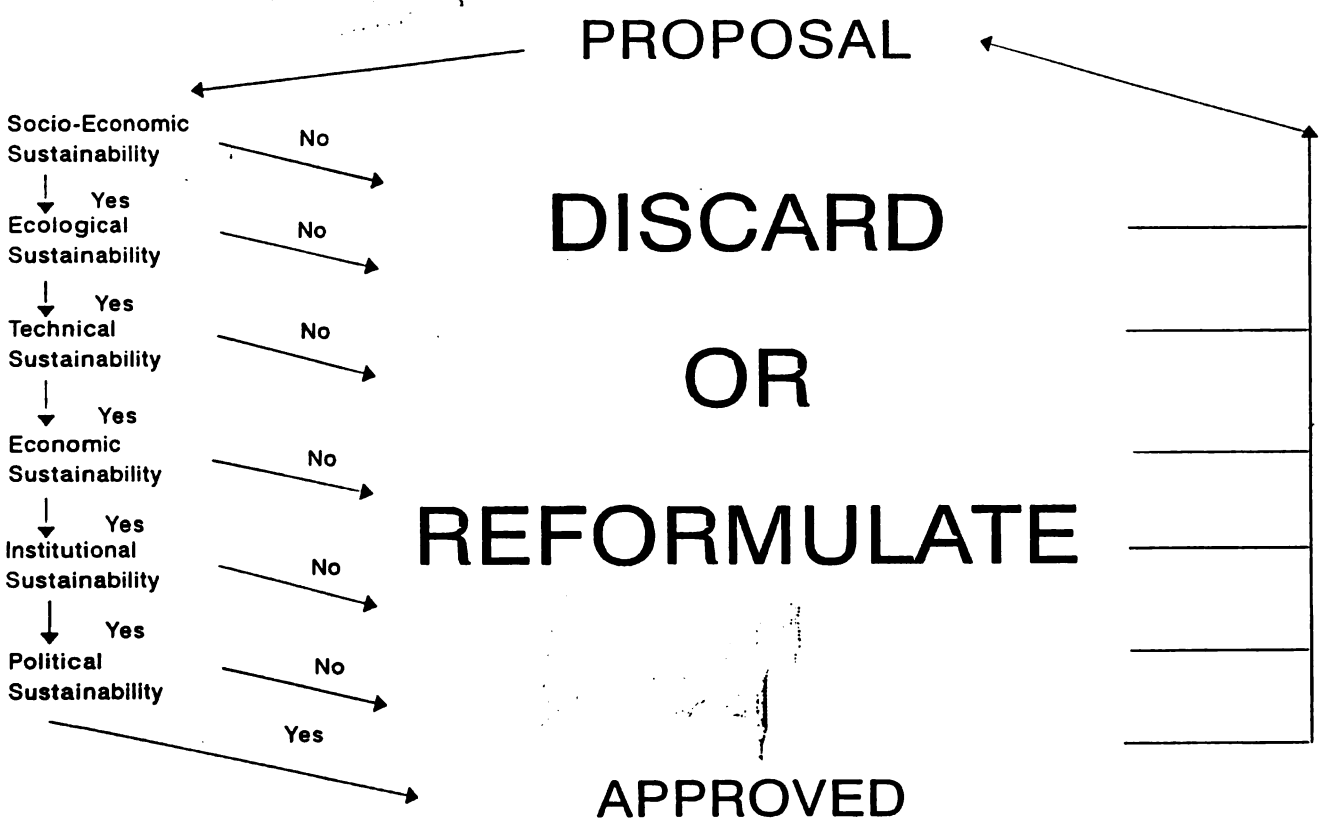
-PROBLEMS ARAISING WITH THE "PROJECT" CONCEPT

MECHANISMS

-TO FOSTER THE SELF-ADMINISTRATION CAPACITY IN THE GRASSROOT ORGANIZATIONS. COMMUNITY EMPOWERMENT

-ADJUSTING THE PROJECT HORIZON TO THE MATURITY PERIOD OF PROJECT COMPONENTS

Evaluating Sustainability in the Formulation of Projects



PROJECT PHASES
SUSTAINABLE PATH

PHASE I

- EXOGENOUS SUPPORT BY EXTERNAL ASSISTANCE
- IMPROVING ORGANIZATION OF COMMUNITIES
- NATIONAL COUNTERPARTS (GOVERNMENT AND COMMUNITIES)
- TRAINING OF ORGANIZATIONS AND FARMERS (INCLUDING AWARENESS ON NATURAL RESOURCES AND ECOLOGICAL ISSUES)
- ADVISORS HIRED BY THE ASSISTANCE AGENCY
- PARTICIPATORY PLANNING OF NEXT PHASES

PHASE II

- DEVELOPMENT PHASE
- LOCAL ORGANIZATIONS AND COMMUNITIES AS COUNTERPARTS
- NATIONAL AND EXTERNAL ADVISORS
- WIDE INCLUSION OF COMPONENTS IN ORDER TO MAKE SUSTAINABLE USE OF ALL AVAILABLE RESOURCES
- NOT ONLY PRODUCTION , ALSO MARKET ORGANIZATION
- DEVELOPING AND FINANCING HORIZONTAL AND VERTICAL INTEGRATION
- VENTURES WITH OTHER GROUPS WITH DIFFERENT COMPARATIVE ADVANTAGES
- COMPENSATING PRODUCTION OF ENVIRONMENTAL SERVICES
- SOFT LENDING AND NON REIMBURSABLE FUNDING FOR SOCIAL AND ENVIRONMENTAL COMPONENTS

PROJECT PHASES SUSTAINABLE PATH

PHASE III

- SUPPORT BY LOCAL AND NATIONAL ORGANIZATIONS
- COMMUNITIES AS COUNTERPARTS
- GOVERNMENT AS FACILITATOR
- NATIONAL ADVISORS HIRED FROM PRIVATE EXTENTION GROUPS
- PLANNING OF INDUSTRIAL AND MARKETING COMPONENTS
- **GROWING IMPORTANCE OF ENVIRONMENTAL COMPONENTS**
- **IMPROVING AND EXPANDING STRATEGIC VENTURES**
- **LENDING FROM THE COMMERCIAL BANKING SYSTEM**
- **SOFT LENDING FOR ENVIRONMENTAL ISSUES**
- **COMPENSATION SYSTEM FOR FINANCING THE ENVIRONMENTAL SERVICES**

JAMAICA'S HILLSIDE AGRICULTURE: AN ENVIRONMENTAL ENDOWMENT.[1]

A. Reyes-Pacheco.[2]

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[1] Paper presented at the Seminar: "Sustainable Agricultural Development and The Environment: Focus on Watersheds". NRCA/GTZ/IICA, Jamaica Conference Center; Kingston, Jamaica. June 21-23, 1994

[2] Representative of the IICA Office in Jamaica.

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JAMAICA'S HILLSIDE AGRICULTURE: AN ENVIRONMENTAL ENDOWMENT.

I. INTRODUCTION

As a new century borders; seemingly at a faster rate due to the "Global Village," natural resource conservation, environmental protection and sustainable development, are compelling challenges on the world and national agendas. This ample allegation highlights the topics' complex nature and preludes the limited scope of this paper.

The aforesaid is conceivably important to Jamaica, specifically when linked to agriculture; bestowed by the direct relationship between its frail natural resource base and agricultural activities, and economic development. Indeed, the rational exploitation of the country's natural resources, without altering the ecological balance has become an evident need. Soil erosion, degradation, fertility loss, and deforestation, impact food production capabilities, water shortages, biodiversity losses, malnutrition and impel general poverty. These are many of the intensifying threats that the country withstands.

This paper discusses how Jamaica's "Hillside Agriculture" conceptually interlaces development and sustainability issues. And additionally, adduce how this fragile ecosystem is an environmental endowment. It is anticipated that the conceptual framework evoked would incite debate to enhance the understanding of this country's "Hillside Agriculture." Maybe a common national policy agenda to deal with this type of agricultural farming system might be envision, and ensure a sustainable agricultural hillside farming in Jamaica.

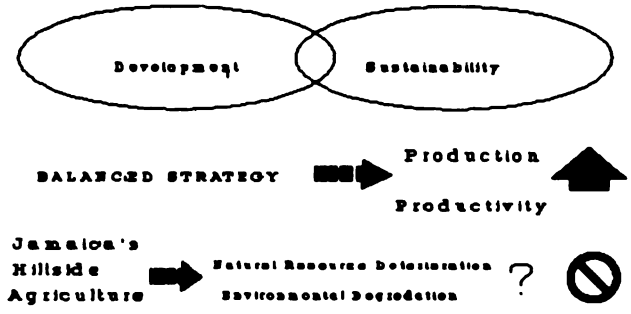
II. THE CONCEPTUAL CHALLENGE

Since the early 1980's Jamaica has been through a substantial economic structural adjustment program, to set the country in a path for growth and development. The economic environment has evolved towards a liberalize market economy; as the government intensified its adjustment program and implemented important policy actions. Principally those policy instruments geared to have market determined interest rates, removal of price controls, and the elimination of subsidies. Thus, the basic strategy can be summarized as one of economic stability to propel economic growth within an open market, export led, and private sector dominated. (Reyes, 1994).

Economic growth is essential if sustainable development is to thriven. And the management of renewable natural resources within a sustainable development perspective is a complex issue and a continual thrust. Not to mentioned that the structural adjustment program to facilitate growth is a process not without considerable social costs.

The interdependence between development and sustainability in the agricultural sector, enacts a challenge and an obligation. To design strategies to improve the living standard of the population, and also to ensure the survival of future generations is a challenge. Surely, development takes place if those strategies can balance natural resource use and sustainability needs. The obligation requires to increase agricultural production and productivity without natural resource deterioration and environmental degradation.

Diagram # 1



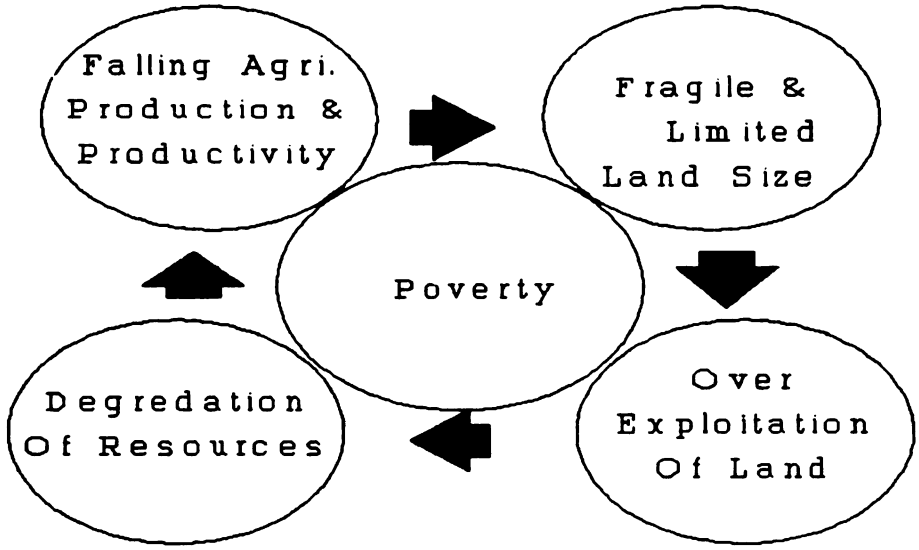
The above diagram illustrates the issues raised; and in Jamaica economic development would append agricultural growth and in itself on the productive use of the natural resources. In this process, the agricultural sector plays a strategic role; e.g., a sector supplier of food stuffs, raw materials, generator of employment and foreign exchange. And within it "Hillside Agriculture."

Rural poverty in Jamaica is a growing problem that merits urgent attention. The widening impoverishment of the rural population is intensified on the hillsides. Many low income population lives in the rural areas, and derive their income from domestic agriculture. Their socioeconomic systems are fragile with poor production systems. This encumber production strategies that simultaneously would improve income, and be somewhat harmless to the national resource base. (IFAD/IICA. 1994).

Thus, options and possibilities to alleviate rural poverty in the hillsides are meager, as these are small farming systems on fragile and poor lands, laced to a poverty vicious cycle, as illustrated:

Diagram # 2

The Vicious Cycle of Agricultural Poverty.



The heightening inability of the rural population to cope and change their socioeconomic environment; due to the level of poverty itself, is a major structural element of rural poverty in Jamaica. And second, the crescendo degradation of the natural resources.

Whether poverty moves parallel with land and forests degradation, scarcity of water, declining productivity levels and thus shortages of food, malnutrition and quality of life (Sachs, 1989); evidently the conceptual challenge is to achieve development that would encompass: alleviation of rural poverty, rational resource management, and an environmental balance to ensure well being of present and future generations.

III. JAMAICA'S HILLSIDE AGRICULTURE A SUSTAINABLE STRATEGY.

Sustainable agricultural development requires a multidimensional framework that combines ecological, technological, socioeconomic and institutional aspects. The ideal is attest a farming system or a technological pattern that would consider said framework. Jamaica's Hillside Agriculture farming system resembles a sustainable agricultural system with environmental merits, that ought to be scrutinized.

In this vein, "Sustainable agriculture can provide opportunities to address productivity and environmental goals simultaneously. By adopting alternative land use practices that can reduce the need to abandon established farmland and that can restore degraded land to economic and biological productivity, farmers can meet their food needs and make an adequate living without contributing to the further depletion of forests and other natural resources."[3]

Similar to any other agricultural systems, "Hillside Agriculture" abdicate to natural and non natural factors; e.g., climate, pest and diseases, prices, and praedial larceny.[4] But in Jamaica, its multi cropping and farming system evolved to spread production and economic risks. Thus, contrary to general assertion, this farming system as is a calculated low and/or somewhat risk free activity.

Understandably, the small hillside farmers in Jamaica exhibit a system of mix cropping in marginal lands --characterized by large degree of plant diversity; to minimize production and economic risks associated with farming, and thus insure food availability and cash throughout the year. Thus, surprisenly land use in some watersheds is underutilized. (Mulleady/1994). See the following diagram as an illustration of the idea.

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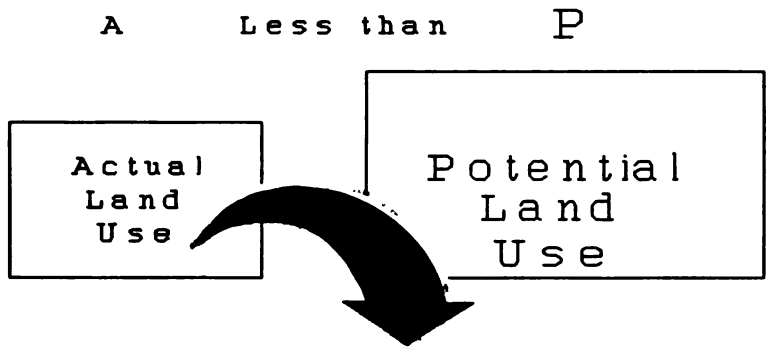
[3] National Research Council. 1993 Sustainable Agriculture and the Environment in the Humid Tropics. Washington, D.C..: National Academy of Sciences. page 52.

[4] For a detailed description of different land use options &/or farming systems see Idem. Part One Chapt. 2.

Diagram # 3

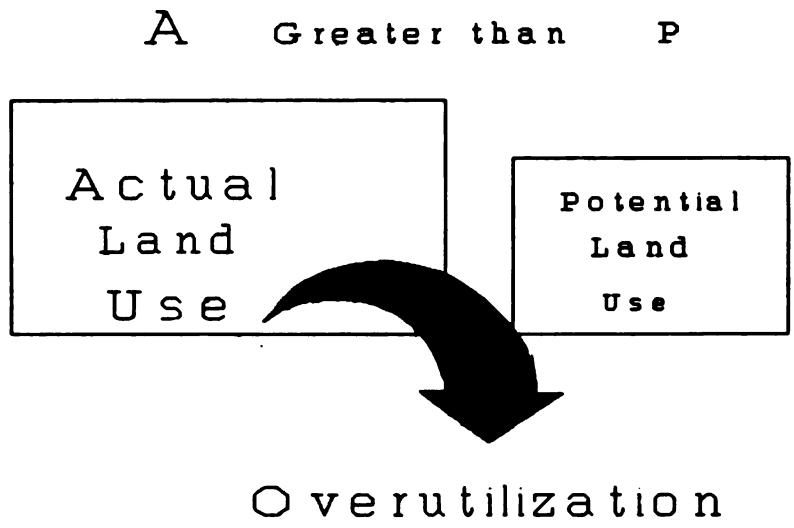


Jamaica's "Hillside Agriculture" afar from being modern, has unfolded into a highly diverse multi-crop mix system that reduces the effects of adverse climatic conditions, pest and diseases, prices, and market variability. Minimizing risk is the prevailing economic denominator to ensure a continuous flow of subsistence foodstuffs and income, rather than a profit maximizing function. One could suggest that its underutilization could reflect a reasonable sustainability, given its relative environmental amicability.

Divergent from said system, agricultural modernization lessens production risks, is very productive, but increasingly questionable with regard to its environmental sustainability and safety. Modern agriculture incorporates production practices within high technological packages; e.g., inclusive of irrigation, fertilizers, pesticides and other chemical inputs, that diminish if not eliminate climatic and other risks such as pest and diseases, that could have a devastating effect in the environment. This vis-a-vis traditional practices --determined to be low input and environmentally consequent.

An unbalance growth of agriculture, specially in fragile ecosystems like the hillsides could lead to overutilization of the natural resources available, and its degradation. See the following diagram for an illustration.

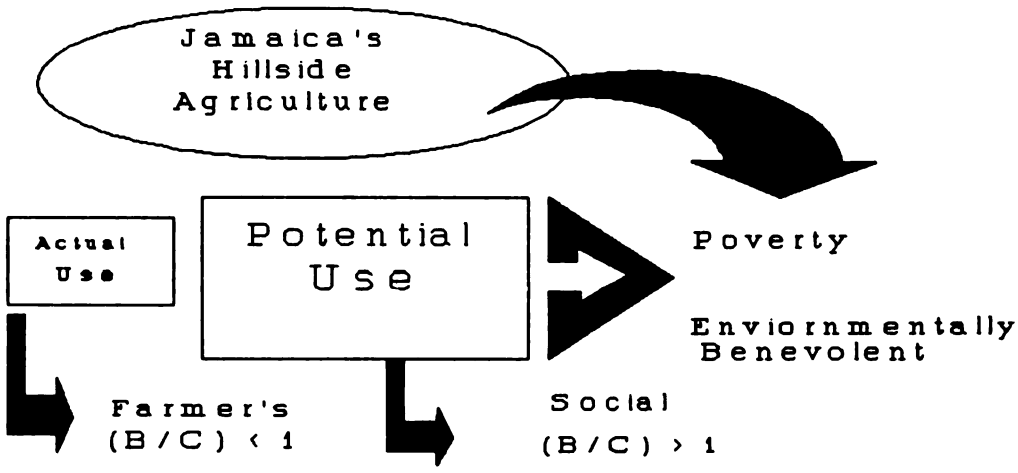
Diagram # 4



The mixed cropping pattern developed by the small hillside farmers involved in traditional agriculture has diffused the production farming risks, if not livelihood. In Jamaica the "Hillside Agriculture" system, not only incorporates a cropping pattern that includes several different crops at various stages of growth; to spread production risks and minimizes adverse effects of market price variability, but also an arrayed of other non-agricultural activities that stabilizes cash flow and minimizes economic risks.

The agricultural practices and social structures evolved in the hillsides of Jamaica, have guaranteed up to now farmer's subsistence, not to mentioned sustainability of the natural resources available. But this has been not without a high cost --their poverty. Low income and below the poverty line are the economic and social indicators of the hillside farmers. Yet there are environmental benefits accrued from their farming system practices. Thus, hillside farmers are confronted with a conflicting scenario as illustrated in the following diagram.

Diagram # 5



Despite that the "Hillside Farming" system in Jamaica guarantees some degree of food and income security --made possible by their intricate agricultural crop-mix, and other non-farm activities, and thus diminishing natural and economic vulnerability; the economic rationale of Jamaica's "Hillside Agriculture" implies that the farming units show a private Benefit/Cost relationship to be less than one, but the social Benefit/Cost ratio greater than one. The dilemma presented is:

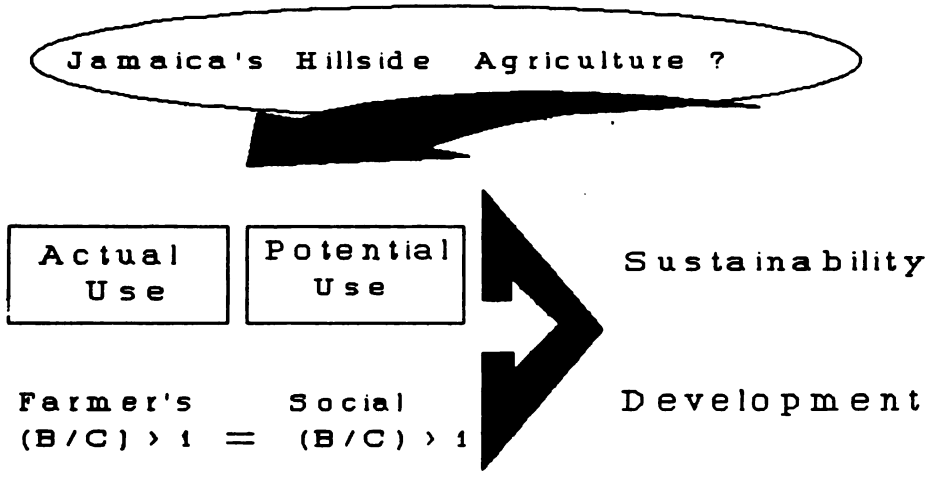
Group	Time Frame	Economic Indicator	
Farmers	Present	Private Benefit/Cost Relationship	< 1
Society	"	Social " " "	> 1

Whether "Hillside Agriculture" can be transformed from traditional to a modernized system; to increased production and productivity, taking into account the issues of sustainability and equitable development it remains to be seen. The issue then is one of policy and investment to attain a private and social benefit cost relationship greater than one.

Group	Time Frame	Economic Indicator	
Farmers	Future	Private Benefit/Cost Relationship	> 1
Society	"	Social " " "	> 1

As illustrated in the following diagram # 6, this is possible if social benefits and costs are valued and allotted accordingly, for the "Hillside Agriculture" farming system to be sustainable.

Diagram # 6



Traditional farmers reveal their understanding for the agricultural environment in several ways. There are aspirations, cultural practices, economic and physical considerations, that contribute to comprehend the deterrents and stimulus to affect their farming system. Only with this knowledge may agricultural changes be feasible and compatible with the hillside farming community and the environment. Now, the same understanding is required from the rest of the society.

IV. FINAL COMMENTS

Small hillside farmers operate under a social, economic and natural complex environment. Characterized by diverse risk-prone conditions, usually located on fragile, or marginal lands. The resource base upon which these farmers depend could rapidly diminish through environmental degradation, nutrient depletion, and erosion. Thus, increasing concerns for sustainability and resource conservation call especially upon the hillside farmers for changes in land use patterns and watershed management. Suggesting that their agricultural production systems; currently in use, may not be sustainable because they deplete the natural resource base and impose unacceptable high environmental costs. Up to now, their farming system seems relative benevolent as evidence by its lasting.

Assessing the sustainability of "Hillside Agriculture" as a farming system is not an easy task. Quantification of sustainability is complicated by the shear number of elements involved -- environmental factors; such as climate, land and water resources, and economic and social considerations-- and the often difficulty to predict interactions among the various elements. Yet, poverty alleviation responses ought to be expected, and one could speculate that agricultural production would have to increase to keep up with increasing demand for food and fiber.

As hillside farmers strive to increase their agricultural production and income, hopefully, these increases ought to be sustainable; but with minimum exposure to additional risk. The question and the appropriate answers to be addressed is how to do this without higher risks involved, than those already prevailing? e.g., an erroneous technological recommendation might endangered the livelihood if not survival of farmers. After all, "Hillside Farming" as a system has endured by incorporating technological practices through calculated risks to deal with socioeconomic, production and climatic conditions.

Whether "Hillside Farming" in Jamaica is sustainable and the subsistence level of the hillside farming communities can be improved; given the new external and economic milieu, are some issues to be addressed. For this system to be improved, it warrants a broader perspective and beyond technological considerations; for the dominant objective is more often to ensure survival and income security than to maximize profits.

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AGROFORESTRY DEVELOPMENT IN THE YAM GROWING REGION OF CENTRAL JAMAICA

Patrick T. Evans

June 1994

1. INTRODUCTION

A project entitled "Agroforestry activities in yam growing areas" was initiated in October 1991 in northern Manchester, southern Trelawny, and western Clarendon parishes of central Jamaica. The rationale behind its implementation was the high demand for yam sticks (hardwood sticks of 3 to 4 meters length - used for supporting yam plants) in this region and the subsequent environmental degradation resulting from their harvesting. This region, considered to be the breadbasket of Jamaica, produces the bulk of traditional crops (yams, Irish potatoes, sweet potato, coco yam, dasheen, red beans, etc.) for both domestic consumption and export. Most of these crops are cultivated by small to medium size farmers utilizing, primarily, hilly terrain with slopes up to 40 degrees. Soil erosion is a very serious problem which threatens long-term productivity of the area. Local wood product demand centers mainly around the need for yam sticks with an estimated demand of some 8 million sticks per year. Yam sticks are primarily harvested from the remaining forested lands outside the yam growing region, as most accessible sticks within this area have already been harvested. The decreasing supply and increasing costs in procuring yam sticks is resulting in environmental degradation in the region and threatens the long-term sustainability of yam cultivation in central Jamaica.

The project "Agroforestry activities in yam growing areas" was conceived during the formulation of the Government of Jamaica's (GOJ) National Forestry Action Plan (NFAP) in 1988. The NFAP has been prepared in accordance with the Food and Agriculture Organization's Tropical Forestry Action Plan and is in the process of implementation. A key concern of the NFAP is the need to generate benefits for the rural people and thereby increase their involvement in the conservation and management of forest resources. The strategy proposed is the introduction of agroforestry systems among farming communities in critical hillside areas. Due to the shortage of yam sticks in central Jamaica, the Forestry and Soil Conservation Department (FSCD) under the Ministry of Agriculture elaborated the project "Agroforestry activities in yam growing areas" with assistance from the local FAO Representative's Office.

The project was initiated in October 1991 with support from FAO under TCP/JAM/0152 and with support in-kind from the GOJ. The project was for a 12 month duration but was subsequently extended until March 1993 for a total period of 17 months. The overall objectives of the project were:

- to strengthen the technical capability of the Department of Forestry and Soil Conservation in managing district forests for supplying yam sticks and other minor forest products;

- to assist in introducing agroforestry concepts to yam farmers on a community basis in order to encourage better land use and self-sufficiency in their wood product requirements; and

- to develop promotional materials and skills to enable forestry and extension field personnel to introduce and support agroforestry activities in other farming communities.

2. PROJECT IMPLEMENTATION

2.1 Project Strategy

The project, headquartered in Christiana, strove to develop and implement agroforestry activities throughout the central region of Jamaica with particular emphasis on northern Manchester and southern Trelawny parishes. The strategy adopted by the project was to interface forestry within the existing farming systems to increase the overall productivity of the farming systems on a sustainable basis while addressing local needs for forest products.

The overall emphasis of the project was to "move trees", i.e., get them out of the nursery and into the ground with as many farmers as possible. The strategy was to maximize the exposure of tree planting / farm forestry within the farming community, thereby increasing the interest and demand for farm forestry activities and environmental awareness in general. Being a pilot project of limited duration, the project worked to create a demand-driven situation whereby the activities initiated would develop a momentum of their own and continue indefinitely into the future.

2.2 Socio-economic assessment

The project initiated activities based on rapid rural appraisal of the ecological and socio-economic situation in the area. As time permitted, a structured survey on basic land-use patterns was conducted with 200 farmers in the project area with a focus on the issue of yam sticks. The survey determined that 197 of these farmers are currently using 310,788 yam sticks and need an additional 176,500 new sticks each year for replacement of old sticks which are then burned as fuelwood. This is an average of 1,578 sticks per farmer in current use and 900 sticks per farmer needed annually for replacement. It's a considerable demand and due to lack of other options, 145 or 74% of these 200 farmers are forced to buy all their yam sticks from the trucks which transport the sticks in from surrounding parishes. The price per stick keeps increasing, the quality of the stick keeps decreasing as good quality trees become scarce, and the environment suffers under the current system of primarily unauthorized cutting from any available source by the yam stick dealers.

The results of this survey show the average land holding in the area to be 1.6 hectares with two thirds of the farmers actually owning their land. Nearly half of all the farmers surveyed expressed an interest in planting timber and/or yam stick tree species on their lands. The potential for continued development of farm forestry / agroforestry in this central region is excellent.

2.3 Agroforestry extension

During the short life span of this project, the most effective extension approach proved to be face to face contact with farmers. The project staff travelled throughout the project area and generated interest in agroforestry activities by meeting and talking with the people. In the final months of the project, a weekly extension approach was utilized by project staff whereby they spent two days meeting with farmers and planning farm forestry activities. On

the 3rd day, tree seedlings would be transported from the centralized government nursery and delivered to the farmers, and the following two days would be spent in follow-up technical support for those farmers planting trees. This approach has been very effective and by March 1993 the project had initiated a total of 562 plantation activities utilizing a total of more than 85,000 tree seedlings.

The project has worked primarily with small farmers but has also worked with 27 local schools in the area to promote tree planting and environmental awareness among the youth. In addition to tree planting, the project initiated direct sowing of fast growing leguminous tree species (*Leucaena leucocephala, Calliandra calothyrsus*) along the contours on steep slopes for erosion control, soil fertility enhancement, and yam stick production. With the serious soil erosion problems in the area, direct seeding for hedgerow establishment along the contours appears to have outstanding potential as a low cost approach for soil conservation and warrants further development and promotion.

The project initially supplied trees free of cost to the farmers with the objective of developing agroforestry strategies and establishing demonstration trials. As systems evolved and interest in tree planting increased, the project adopted a policy of selling the seedlings to the farmers at the government rate. It is the project's experience that seedlings must be sold to farmers to increase their responsibility towards proper planting and follow-up care for the seedlings. The considerable level of interest in tree planting and willingness on the part of the farmers to purchase seedlings confirms that seedlings should continue to be sold at the official government rate. The most effective approach has been to take orders for tree seedlings and to collect the money prior to delivery of the seedlings.

2.4 Demonstration trials established

The project established a variety of trials with farmers throughout the project area to develop and/or determine agroforestry strategies most appropriate to the overall physical and social situation. Trials which are currently being monitored are:

1) Live tree support systems for yam plants
   Objective: to establish trees to serve as living supports for yam plants and to manage these trees so as to provide long term support - thereby reducing the need to buy yam sticks

2) Live yam stick systems
   Objective: to have yam sticks which remain green and alive year after year but do not increase in diameter or size - again reducing the need for new sticks

3) High density plantations for yam stick production
   Objective: to establish fast growing species in dense plantations (1 x 1 meter) which can be coppice managed for yam stick production

4) Contour planting
   Objective: soil conservation, soil fertility enhancement, and yam stick production on steep slopes

5) Direct seeding for soil conservation
Objective: to develop an easy and inexpensive approach for hedgerow establishment on steep slopes (similar to contour planting)

6) Mixed plantations with cedar or mahogany and leguminous species
Objective: to combine cedar or mahogany with fast growing leguminous tree species which will provide partial shading to improve timber production while providing secondary products such as yam sticks, fuelwood, etc.

7) Block plantations with agricultural intercropping
Objective: combination of forestry with agriculture to enhance the overall productivity of the land while satisfying the farmer's stated needs (timber, yam sticks, etc.)

8) Border plantings
Objectives: include live fences, windbreaks, and property demarcation, forest product production, etc.

9) Timber trees as coffee shade
Objective: to increase the overall value of coffee plantations by using high value timber trees as long term coffee shade

2.5 Extension material development

The project developed and used 4 different brochures for extension purposes. A farm forestry brochure and yam stick production systems brochure were used in day-to-day extension activities. A tree planting brochure was given to prospective tree planters, while a fourth brochure on tree management was distributed during follow-up activities among farmers who had planted trees. All of these brochures proved useful and have been distributed to other organizations and agencies in the country.

In addition to the brochures, the project prepared and utilized: fliers on yam sticks, posters, photo display boards, and a slide series on the project. All of these materials remain in the project office in Christiana for continued use by the government staff.

2.6 Current Status

A review is currently being conducted of the project's farm forestry / agroforestry activities. The main trials are being analyzed with regards to system function, species performance, and farmer's perceptions. Initial observations are as follows:

2.6.1 Tree survival

The results are mixed with some plantation survival rates at 90% or greater and other plantations at 10% or less. The overall survival of trees planted, for the plantations visited, is greater than 50%. In general, the farmers who purchased their seedlings are providing greater care than those who received the seedlings for free.

The two principal causes of seedling mortality are: (1) livestock grazing, and (2) careless laborers who destroy young trees while cleaning the agricultural fields.

2.6.2 Tree growth

Trees are growing better when planted among agricultural crops. They benefit from regular weeding and can take advantage of the fertilizers used on the crops. When planted on marginal, non-agricultural land, weed competition is a problem as well as the more serious problem of livestock grazing.

Tree growth is a function of species, site, and cultural practices. Most sites throughout the central region are well suited for wood product production. Tree growth is impressive with species such as *Swietenia macrophylla* commonly found at 4 meters height in 18 month old plantations and up to 6 meters height in some of the 2 year old plantations. One species, *Acrocarpus fraxinifolius*, has reached 10 meters in height after only 2 years. Some of the fast growing species such as *Calliandra calothyrsus*, *Leucaena leucocephala*, and *Eucalyptus robusta* are now being coppice managed for yam sticks.

2.6.3 Trials

In addressing the need for yam sticks, the live support system and live stick system were introduced to reduce the annual need for yam sticks. Both these systems are still functioning with the live yam stick system showing the greater potential for continued use and expansion. The problem with the live support system (trees within yam fields to serve as living supports) is the need for continual management, i.e., lopping, pollarding, and root pruning to control growth. This is a problem for farmers when they rotate their fields and yet have to continually manage the trees. The live stick system (sticks which remain green, sprout, and are stripped of leaves and roots annually) is functioning in its second season and these sticks can be moved to new locations as required.

High density plantations have potential and more effort is needed in developing this approach. *Eucalyptus robusta* appears to be the best suited species as it grows straight, coppices, and produces a good quality yam stick in only 18 months.

Direct seeding along the contours for soil conservation has great potential. *Calliandra calothyrsus* and *Leucaena leucocephala* have both been successfully established although *Leucaena* growth rates appear retarded due to the presence of the psyllid insect and also due to soil acidity on certain sites. The *Calliandra* is preforming very well and in addition to soil conservation is currently being managed for yam sticks with the foliage being used as fodder and/or green manuring.

A total of 28 different tree species were outplanted in mixed plantations on marginal sites, interplanted with a variety of agricultural crops, and used in border plantings around agricultural fields. Among the timber

species, *Swietenia macrophylla* and *Hibiscus elatus* are developing well and have real potential. *Pinus caribaea* is in demand and is the best suited species for the higher elevation, drier, more exposed sites. *Cedrela odorata* was used extensively and in nearly all plantations there is some insect damage from the shoot borer which appears manageable by controlling shade and stocking levels. A variety of fast growing leguminous tree species were mixed with timber species to provide early return from the plantations. Among these, *Calliandra calothyrsus*, *Leucaena leucocephala*, *Gliricidia sepium*, *Indigofera teysmanii*, *Cassia siamea*, and *Acacia auriculiformis* are developing well and are currently being managed for yam sticks, fuelwood, fodder, and green manuring.

3. CONCLUSIONS

There is an extremely high demand for yam sticks and lesser, yet significant, demand for timber, fuelwood and other forest products in the yam growing region of central Jamaica. Soil erosion is a serious problem as cultivation expands onto steeper slopes. Through the field level extension efforts of this project, a significant demand has been identified and/or developed for farm forestry / agroforestry activities with the three main objectives of the farmers being timber production, yam stick production, and soil conservation.

Farm forestry development can have a significant impact on the long-term sustainability of agriculture in the region and the socio-economic situation of the farm family. Prices for wood products continue to increase and many farmers are now interested in planting timber trees for economic return in the future. Yam stick prices continue to rise while the quality of sticks decreases. As a result, a significant demand now exists for fast growing yam stick species to plant near the yam fields, which with coppice management can significantly reduce the need to purchase yam sticks and will reduce the illegal exploitation and degradation of Government forest lands. Soil conservation and soil fertility are a problem on the steep slopes in the yam growing region. Contour planting, either with seedlings or direct seeding, can stabilize the slopes while the trees provide yam sticks and the foliage is used for green manuring to boost soil fertility. Trees planted by the project, which are now two years of age or less, are currently being harvested to provide yam sticks, fuelwood, fodder, and green manure. Some farmers are now collecting seed and expanding their plantations on their own. With the extensive amount of land in private ownership in Jamaica, private forestry / farm forestry is the key to long-term economic development in the forestry sector.

The main obstacles to farm forestry development are access to tree seedlings and technical advice for the farmers. The demand for additional tree seedlings, from those farmers who have planted trees and from other farmers, is very high. These people are willing to purchase the seedlings but lack the means to transport seedlings from the centralized Government tree nursery, which lies some 15 to 30 miles from the main yam producing region. To achieve a long-term, significant impact on forest product supply and demand in the region, a continued extension effort is needed to assist farmers, transport and sell seedlings, and to provide follow-up technical advice on tree management and utilization.

YAM STICK FACTS

A survey of 200 farmers was conducted by the **Agroforestry Development Project** in Christiana between June and August of 1992. Ten locations were selected in northern Manchester and southern Trelawny. At each of the ten locations, 20 farmers were randomly selected and interviewed. Of these 200 farmers, 197 are currently cultivating yam and what follows is a summary of the information they provided with regards to yam sticks.

1. Yam sticks in use

Of the 197 farmers currently cultivating yams, they reportedly are using a total of 310,788 sticks at present or an average of 1,578 sticks per farmer.

2. Yam sticks needed this year

Of the farmers surveyed, they are in need of an additional 176,500 yam sticks this year or an average of 900 / farmer. These sticks are needed annually to replace older sticks which have become weak or broken.

3. Most common yam sticks reported to be in use

Common name	Botanical name	# of farmers using it
sweetwood	*Ocotea sp.*	125
rodwood	*Eugenia sp.*	93
brazil macca	*Mimosa bimucronata*	80
bamboo	*Bambusa sp.*	66
cantoo	*Peltostigma pteleoides*	24
wild grape	*Coccoloba diversifolia*	22
eucalyptus	*Eucalyptus robusta*	14
burn eye	*Sapium jamaicense*	10
bitter wood	*Picrasma excelsa*	9
fig	*Ficus sp.*	8

4. Yam stick durability

Of the yam sticks in use, burn eye is the most durable providing 25 years of use. Cantoo is also very durable and can last up to 15 years. Eucalyptus is the next most durable species providing 5 to 10 years of use. The majority of the other species used last between 1 and 3 years before they are replaced.

5. Source of yam sticks

Of the 197 yam farmers surveyed, 145 or 74% are forced to buy all their yam sticks from trucks transporting the sticks in from other areas (St. Ann, Clarendon, St. Elizabeth, southern Manchester). The current price is $4.00 J per stick. Thirty-six of the farmers or 18% cut sticks locally

as well as purchase from the trucks. Only 16 farmers or 8% are self-sufficient in that they meet their entire need for yam sticks by cutting bamboo and Brazil macca from their own lands.

5. Best yam stick species

The tree species reported to be best for yam sticks are:

Common name	Botanical name	# of farmers naming it
cantoo	*Peltostigma pteleoides*	156
burn eye	*Sapium jamaicense*	126
rodwood	*Eugenia sp.*	44
logwood	*Haematoxylum campechianum*	43
eucalyptus	*Eucalyptus robusta*	43
sinconia	?	41
sweetwood	*Ocotea sp.*	24
brazil macca	*Mimosa bimucronata*	8
grape	*Coccoloba sp.*	6
ebony	*Brya ebenus*	3

7. Yam sticks as fuel

Of the 200 farmers surveyed, 125 or 62.5% rely exclusively on fuelwood for cooking. Forty-four of the farmers use fuelwood in combination with gas, charcoal, and/or kerosene. This totals 169 farmers or 84% who use fuelwood and this fuelwood comes from old yam sticks.

* yam sticks not only serve as the physical support for the production of yams but as the sticks weaken or break they are recycled as the fuel with which to cook the yam.

DISCUSSION

Traditional yam cultivation involves the digging of an average of 1,000 hills per acre of land with each hill requiring one yam stick. As sticks weaken, the hills are double staked to prevent breakage which further increases the number of sticks in-use per acre. Standard practice is to replace 50 to 60% of the sticks with new ones each year. According to the Inter-American Institute for Cooperation in Agriculture (IICA), for the period 1984 to 1988 - the average annual area under yam production in Jamaica was 31,272 acres. Yam cultivation appears to be increasing in the country, but if only the 1988 average area cultivated is used - this translates into a minimum of 31,272,000 yam sticks in active use and an annual replacement need of 15,636,000 to 18,763,000 sticks. These are the facts - if IICA's figures are correct, the actual annual demand for yam sticks is in the area of 15 to 19 million yam sticks needed each year.

* a yam stick is a stick 3 to 4 meters in length and 5 to 8 centimeters in diameter which is used to support the aerial biomass of a yam plant (*Dioscorea sp.*). The yam plant is a climber and produces an edible tuber - size of which is determined by the amount of aerial biomass. Yam sticks are used to increase aerial biomass and hence production.

TROPICAL CROPS AND AGRICULTURAL SUSTAINABILITY
A STRATEGY TOWARDS THE 21ST CENTURY FOR SMALL FARMING SYSTEMS AND WATERSHED MANAGEMENT

M.N. ALVAREZ

INTRODUCTION

To come to CATIE on the year of the 20th anniversary is indeed pleasing to me. There is no doubt that this anniversary will be a period of reflection and analysis to see how the past two decades can best contribute to our development efforts into the 21st century.

There is no doubt that the past 20 years would have been productive and rewarding, but at the same time underscored by areas that will need more attention and strengthening as we move ahead with a long-term strategy towards further growth. This is a time to examine our models and techniques in addressing our developemnt targets. This is also a time to reflect on the changes that affect our outlook, concepts and philosophy about agricultural research.

Some of these changes which certainly are factors for consideration in agricultural research especially for small scale farmers are:

* **SUSTAINABILITY**
* **ECOREGIONAL RESEARCH**
* **BIOTECHNOLOGY**

CONCEPTUAL EVOLUTION

Sustainable Agriculture:

An IDRC report stated that sustainability has become the most obvious aspect of planetary interdependence, irrespective of geographical position or wealth (1). There is now hardly a day that passes without a conference or paper on agricultural research and development which reflects on some aspect of sustainability in agriculture. The philosophy that we must master and dominate nature has given way to a new philosophy which leads towards the mastering of science and technology to enshrine the sovereinity of nature and to secure the benefits there from all of mankind (10).

This thinking was pushed into action by Rio Summit of June, 1992. What came out of Rio was notable. The Agenda 21: an action plan to safeguard the environment and promote sustainable development was adopted (9). For our research purpose, "sustainable agriculture should encompass not only the use of ecological agriculture practices, but also sound socio-economic policies and practices to sustain communities, the family farm and the farm family" (3). A definition used by the CG system suggest that: "A sustainable Agriculture is one that, over long term, enhances environmental quality and the resource base on which agriculture depends; provides for basic human food and fibre needs; is economically viable and enhances the quality of life for farmers and society as a whole" (TAC, 1988).

Importance of sustainable agriculture:

As populations increase and demand for food increases, more intensive form of cultivation will be needed. At the same time, conservation practices must be put in place. Sustainable agriculture cannot be achieved unless production systems are well suited to land use capability (5). It requires a combination of cultural,biological and integrated pest management system that minimize environmental degradation. It is, therefore, imperative that our research must capture the Universals of science in existing indigenous, agricultural technologies. In turn, such new technologies must be consistent with the rapidly increasing demands of existing and future societies, in the diverse environments of this region.

Ecoregional Research

The ecoregional concept is gaining momentum and is still being defined, however, I believe that CATIE does lend itself to ecoregional research. The center has a framework for and indeed comparative advantage for this activity. It is already within the mandate to work on tropical crops, pastures and animals, agroforestry and sustainability. The challenge for CATIE will be to forge comprehensive and coherent programs of action that will continue to attract support for this broad based activity. Donors and governments are concerned about the need to assure coherence and how the ecoregional concept could be worked out and expansion of research related to management of natural resources.

This approach consists of:

1. Characterization of the biophysical and socio-economic environment
   - identify the principal components of the agro-system.
   - quantify the constraints to sustainable and increase food production in the system.

2. Technology development
   - improvement of germplasm.

   - process studies of the resource management, plant health and other components contributing to sustainability and productivity.

3. Integrate component technologies designed to manage the natural resources into the cropping system.

This center is already integrating crops, livestock and forestry to diversify production and adapt food production to specific environments. The conscious and rational combination of crop, livestock and forestry sub-systems will result in sustainable food and income supply and the regeneration of soil productivity. I think that CATIE has the experience and can champion this idea forward.

Biotechnology:

For the next twenty years, development in crop improvement will need to involve biotechnology because it increases precision and shortens time to produce results (7). Entry to modern biotechnology is relatively easy, particularly if efforts are focused on tissue culture, embryo rescue and micro-propagation rather than molecular biology. This is high-input research and the centers involvement in this might be minimal. However, this is an avenue for cooperation with other institutions such as CGIAR centers, public and private sectors so that this region can capitalize on the results of biotechnology in the short run. CATIE'S strategy of crop improvement will be a logical channel for the application of bio-technology findings.

To reflect these concepts in our strategy as the center strides towards its objectives, it will be necessary to participate actively in multi-disciplinary research aimed at designing new and more effective combinations of improved practices and genotypes. The product of this work should be of special relevance to our small-scale farmers. Furthermore, there will be need for specialized training in these areas so as to ensure that these specific skills are adapted by our NARS partners.

OBJECTIVES AND PRIORITIES

Before I go into strategies, I would like to draw your attention to the characteristic of our region.

* Agriculture is an important economic stay of the region.

* Small holder farming systems predominate.

* Population pressure is high.

* Need to address the issue of sustainability.

CATIE, having the kind of mandate that it now has and a 20 years experience with ecoregional, commodity and animal improvement responsibilities and with strong emphasis on agricultural sustainability, there is no doubt that a clear cut research agenda will need to be followed.

I would like to highlight some guiding principles in evolving our strategy:

* Focus on crops that have high impact potential in farmers' fields especially for those previously neglected.

* Implement project-based type management with built in monitoring and evaluation design to sustain strong commodity focus.

Overall goal

Increasing the productivity of the crops of resource poor farmers through improvement and adoption of technologies, which stabilize production and sustain the resource base.

OBJECTIVES:

* Improvement of the selected crops for yield, host plant resistance and along with integrated pest management introduce these into improved and sustainable production.

* Integrate the post-production to consumption to consumption system research to our commodity improvement in order to ensure the more complete utilization of the food crops within the system.

* Develop systems for the management and conservation of natural resources for sustainable agriculture.

* Promote and strengthen live linkages with our collaborating national program partners.

PRIORITIES FOR SUSTAINABLE AGRICULTURE

Much attention has been given to the problems that arise in the generating and adaption of new production technologies designed to sustain agricultural productivity. However, post-production to consumption activities relating to food processing, storage and marketing are frequently overlooked. Sustainable agriculture calls for more comprehensive approaches to integrate policy formulation, agricultural research planning and natural resource conservation. Attention must be given to the need to provide productive employment in rural areas and to food security. Both applied and adaptive agricultural research must be sensitive to the potential impact of new technologies on the farm environment. There is also a need for greater understanding of natural use under different production systems and socioeconomic pressures. This calls for effective linkage of research, training, extension and farm participation in the research process (6).

These priorities must consider the past research achievements of CATIE, the projected food production needs of smallholder farmers and the likely impact of research undertaken by the center, working in the region.

STRATEGY

The strategy to achieve these objectives is to focus on selected commodities and themes relevant to the smallholder farmers through a participatory approach. The center's broad mandate of generating appropriate technology for small-scale farmer will have crop improvement as a major component. Besides the focus on a few commodities, it will also have to deal with the shortcomings of the cropping systems.

Crop Improvement

This will entail the supply of new genotypes that will adapt to a wide range of biotic and abiotic stresses, perform well in intercrops and compatible with improve management practices. This activity will require active multidisciplinary research aimed at designing effective combinations of improved practices and genotypes. This thrust of our activity will be the linkage point for harnessing the advances in biotechnology. Collaboration with our national program colleagues for the

germplasm evaluation and adaption will also be an important component of this activity. They should be partners in the efforts to realize the underutilized potential in the genetic improvement of tropical crops and introduction of more germplasm.

Another important component of this strategy is integrated Crop/Pest Management. In areas where reliance on resistance breeding alone will not be feasible, other kinds of interventions will be necessary. Combinations of resistant germplasm, habitat management and biological control of pests, diseases and weeds. Improved techniques for the minimal application of pesticides will also be worthy of consideration. This especially important when the use of a pesticide is justified by a population or risk assessment coupled with established action threshold"levels. This is the point when damage is severe enough to warrant control measures (2).

Post-production to consumption system

The Production to Consumption System (PCS) is constituted by groups of people, the resources and processes they command and the interactions among themselves and with the environment that affect the production, processing, movement, trade and final utilization of a commodity (4). The purpose is to achieve greater effectiveness and resource use efficiency in research.

The system includes diverse activities such as processing, storage, and marketing. Understanding the structure, performance and behaviour of the system will help to better target our research interventions with special attention to the problems of women.

Natural resource management & conservation

Careful diagnosis of the target ecology is an important starting point of technology development. This ensures that the needs of farmers are taken into account in the work on crop management and crop improvement. It also delineate particular zones and sub-zones or macro-habitats (8) which become target groups for the research, based on information about the cropping systems and the agroclimatic and socioeconomic environment.

The principal activities involved in this strategy are:

1. Inventory and classification

2. Quantification and constraints

3. Design, evaluation and testing of improved technologies.

INVENTORY AND CLASSIFICATION

- Identify the major areas and determine their distribution and land use patterns and relate these to ecological and economic factors.

QUANTIFICATION AND CONSTRAINTS

- Identify the principal components and functions of the area and quantify constraints to sustainable increases in food production.

- Use interdisciplinary approach to build models for different areas.

DESIGN, EVALUATE & TEST OF IMPROVED TECHNOLOGIES

- Identify potential improvements that are economically and ecologically sustainable and congruent with farmers' objectives.

- Evaluate the improvements - Ex-ante & Ex-post at the macro habitat level to determine their implications for farmers' welfare and for the systems' ecological and economic sustainability.

LINKAGES

Linkages are needed in order to:

- Augment the science and technology establishment.

- Expand the technologies so developed to the various ecosystems in the region.

- Secure sustainability and equity in agricultural development.

This agenda requires carefully considered collaborative linkages between international, regional and national research and training systems. The challenge is to stimulate such linkages and to participate in them whenever possible. The kinds of linkages needed to meet this goal can be categorized as:

- Policy research linkages
- Sustainability research linkages
- Research and training linkages

To achieve these we will need to forge collaboration with institutions involved in policy research on production and utilization strategies both internationally and within the national system.

Sustainability research linkages for agricultural development will aim at capturing advances in technologies such as host plant, pest and disease resistance, biological control, post harvest technologies for collaborative application and backstopping of national systems. In resource management areas, collaborative efforts with other institutes having strength that will complement the centers' activity in identifying and meeting the small holder farmer demands should be encouraged.

Quantitative and qualitative enhancement of the socio-economic and science and technology establishments in the national systems is the central purpose of research and training linkages (10).

Mechanisms for such linkages include:

- Visiting scientists
- Networks
- Group Trainings
- Post-graduate Degree Training
- Seminar & Workshops

The center must seek to build living linkages in a continuing community of scholars and dedicated to development of sustainable agricultural systems.

Conclusion:

Regional center such as CATIE has a critical role to play in meeting the agricultural sustainable research needs for the region. It has a comparative advantage for the ecoregional concept in that it addresses a broad mandate as well as acquired two decades of existence in this area.

Focus on technology development for small farmer requires a long term research and development efforts that produce improved technologies and systems that fit local situations. New and improved technologies will be the driving force for sustainable agriculture systems that provide more food while protecting the environment.

There are several examples from all over the world that can be used in restructuring the approach toward sustainable agriculture. The essential step is to recognize the need and act accordingly. However, it must be realized that sometimes the solutions to these challenges are not always in our hands. It is at times in the hands of the policy makers inside and outside of agriculture. It is our collective commitment to deal with these issues that will give us the capacity to meet the challenges of sustainable agriculture for the decade ahead.

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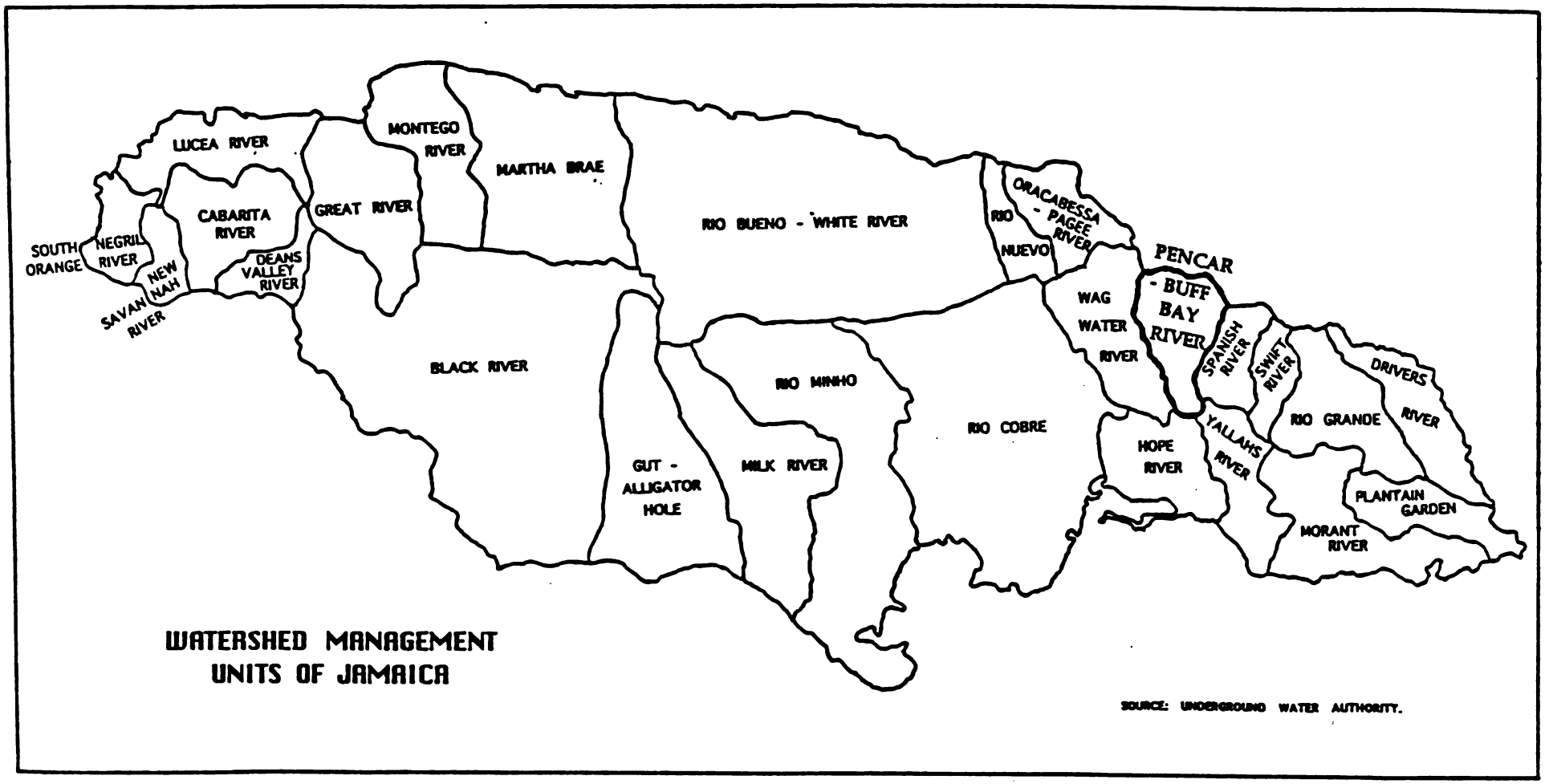


WATERSHED MANAGEMENT UNITS OF JAMAICA

SOURCE: UNDERGROUND WATER AUTHORITY.

TREES FOR TOMORROW

GOAL: The goal of the overall Trees for Tomorrow project is to improve the management and conservation of forests and trees for the sustainable benefit of the people of Jamaica.

ACTIVITIES:

Stage 1

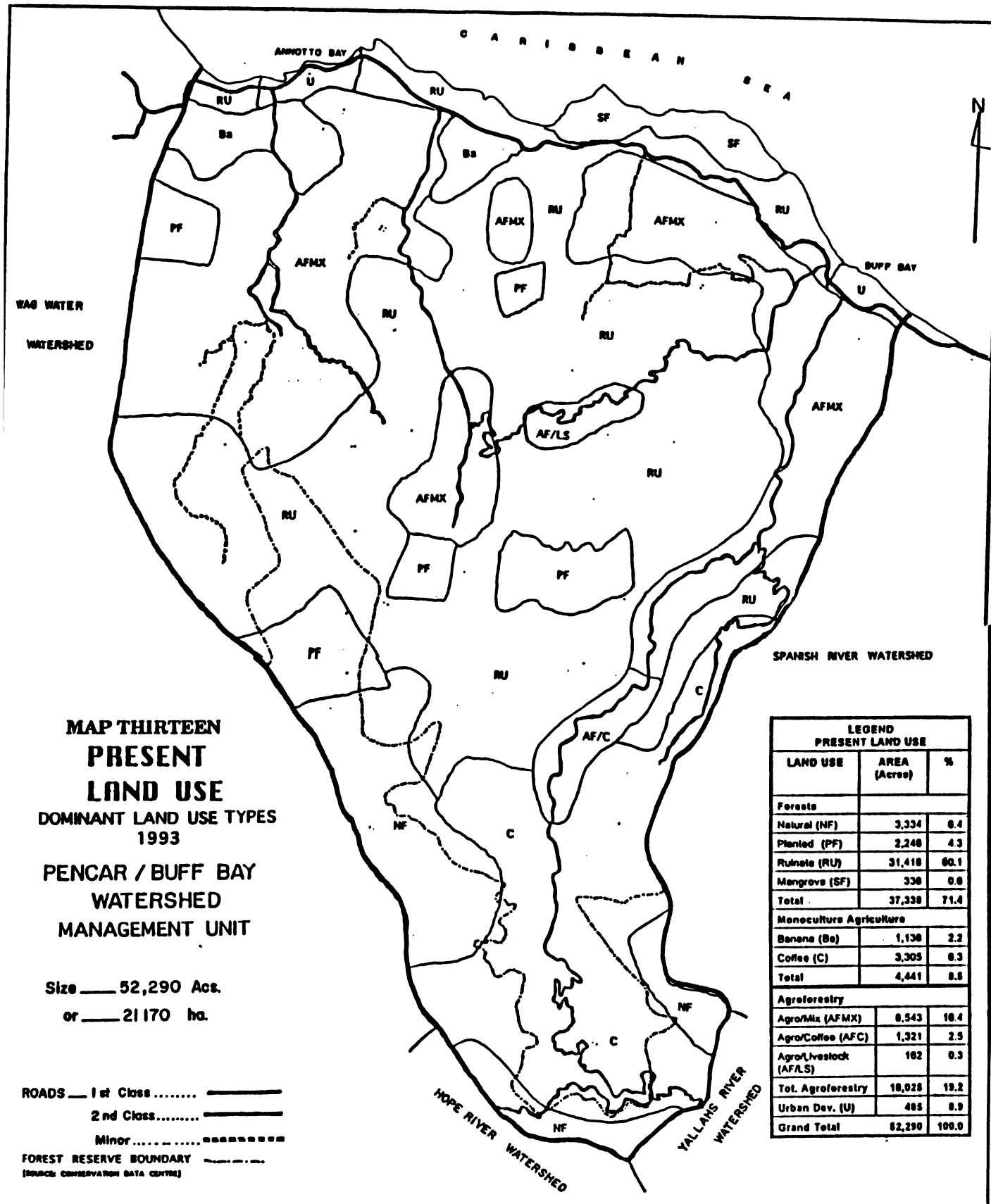
- Re-write the 1937 Forest Act
- Prepare a Forest Land Use Policy
- Prepare a Re-organization Plan for the Forest Department
- Train technical and professional staff
- Land Use Studies in the Pencar/Buff Bay watershed
- Socio-economic studies in the Pencar/Buff Bay watershed

Stage 2

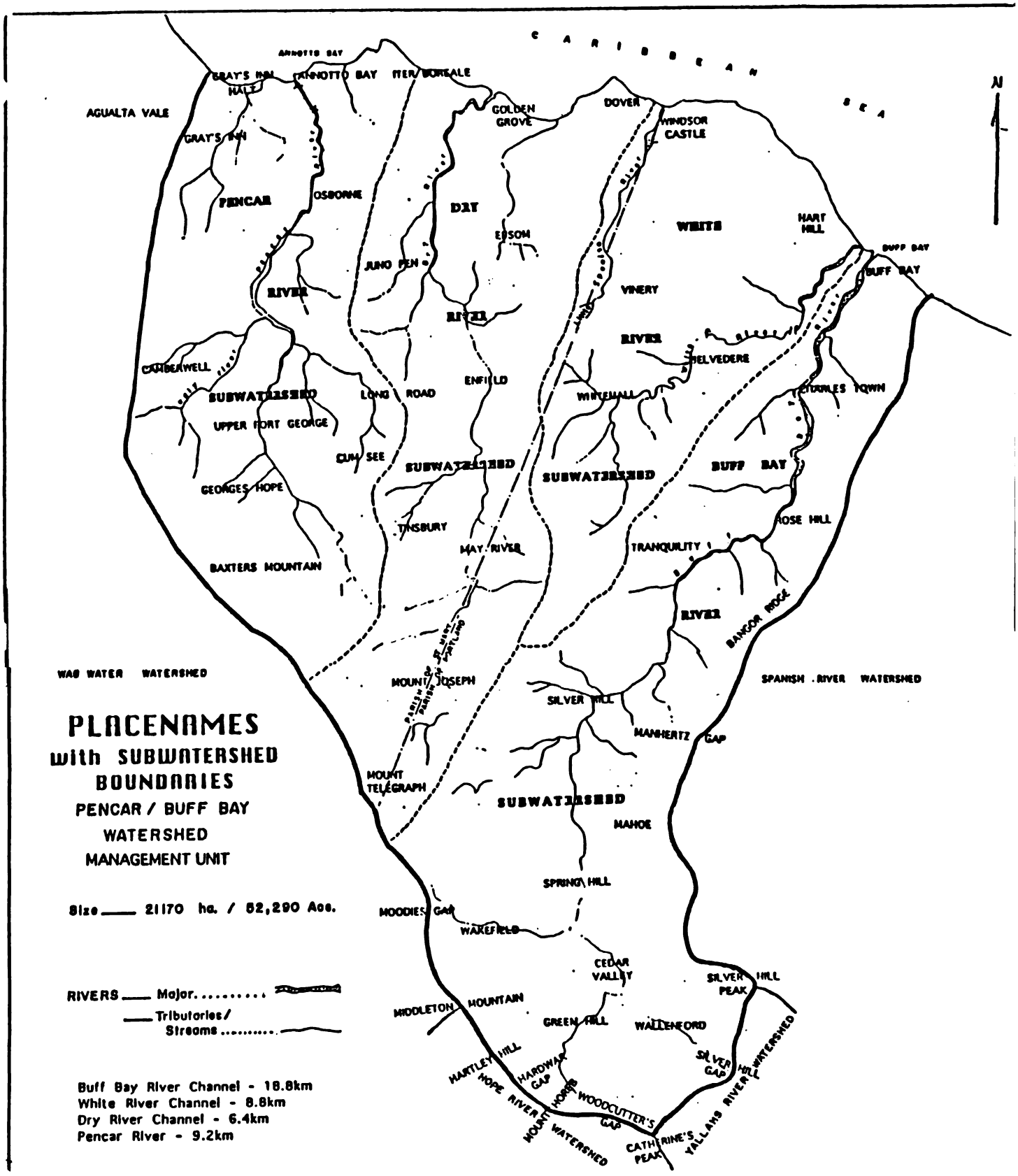
- Develop a Management Plan for the Pencar/Buff Bay watershed
- Environmental education programmes in the media and schools
- Implement Agro-forestry and social forestry programmes
- Do forest inventories and map the forests of Jamaica
- Develop management plans for Jamaica's forests
- Survey and mark the Forest Reserve boundaries
- Improve nursery management and seedling production
- More training

DURATION: 8 YEARS

IMPLEMENTATION: The Forestry and Soil Conservation Division of the Ministry of Agriculture and the Canadian International Development Agency



LEGEND PRESENT LAND USE		
LAND USE	AREA (Acres)	%
Forests		
Natural (NF)	3,334	6.4
Planted (PF)	2,248	4.3
Ruinate (RU)	31,418	60.1
Mangrove (SF)	338	0.6
Total	37,338	71.4
Monoculture Agriculture		
Banana (Ba)	1,136	2.2
Coffee (C)	3,305	6.3
Total	4,441	8.5
Agroforestry		
Agro/Mix (AFMX)	8,543	16.4
Agro/Coffee (AFC)	1,321	2.5
Agro/Livestock (AF/LS)	162	0.3
Tot. Agroforestry	10,026	19.2
Urban Dev. (U)	485	0.9
Grand Total	52,290	100.0



PLACENAMES
with SUBWATERSHED BOUNDARIES
PENCAR / BUFF BAY WATERSHED MANAGEMENT UNIT

Size ____ 21170 ha. / 52,290 Acs.

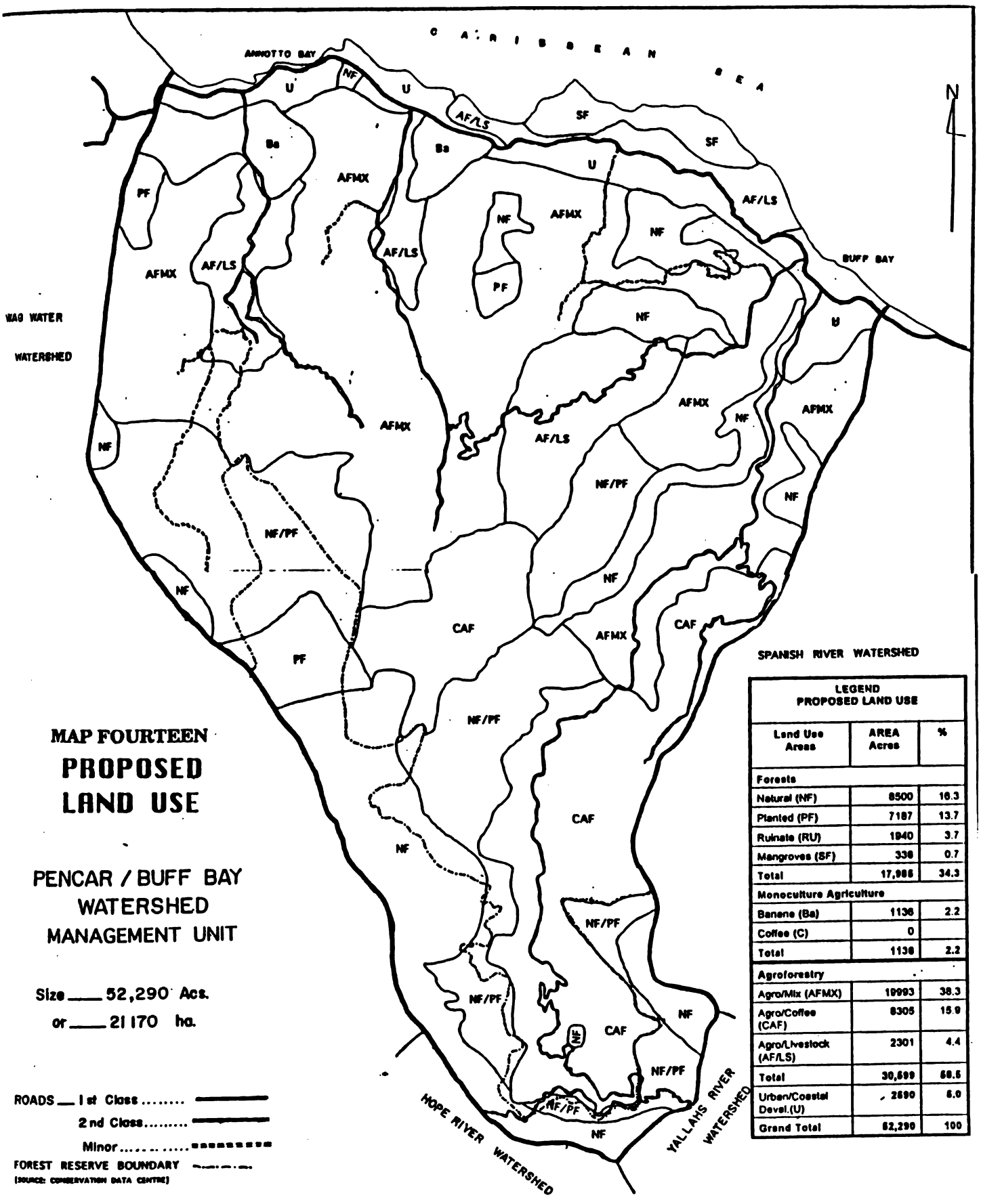
RIVERS ____ Major.....

____ Tributories/ Streams.....

Buff Bay River Channel - 18.8km
White River Channel - 8.8km
Dry River Channel - 6.4km
Pencar River - 9.2km

SCALE 1:50,000

JUNE 1993



MAP FOURTEEN

PROPOSED LAND USE

PENCAR / BUFF BAY WATERSHED MANAGEMENT UNIT

Size ___ 52,290 Acs.

or ___ 21 170 ha.

ROADS ___ 1 st Class .....

2 nd Class .....

Minor .....

FOREST RESERVE BOUNDARY

(SOURCE: CONSERVATION DATA CENTRE)

LEGEND PROPOSED LAND USE		
Land Use Areas	**AREA Acres**	**%**
Forests		
Natural (NF)	8500	16.3
Planted (PF)	7187	13.7
Ruinate (RU)	1940	3.7
Mangroves (SF)	338	0.7
Total	17,965	34.3
Monoculture Agriculture		
Banana (Ba)	1136	2.2
Coffee (C)	0	
Total	1136	2.2
Agroforestry		
Agro/Mix (AFMX)	19993	38.3
Agro/Coffee (CAF)	8305	15.9
Agro/Livestock (AF/LS)	2301	4.4
Total	30,599	58.5
Urban/Coastal Devel.(U)	2690	5.0
Grand Total	52,290	100

SCALE 0 1 2 3 MILES; 0 1 2 3 KMS

DECEMBER 1993

AL/CC/GS

PENCAR/BUFF BAY WATERSHED LAND USE STUDY
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EXECUTIVE SUMMARY

SUSTAINABLE AGRICULTURAL DEVELOPMENT AND THE ENVIRONMENT
THE HILLSIDE AGRICULTURE PROJECT CASE STUDY

J.R.R. SUAH

The Hillside Agriculture Project (HAP) is now regarded among some of the best Agricultural Development initiatives in Jamaica in recent times. It proudly claims the appellation environmentally friendly. The sign boards displayed in the eight eastern parishes of the islands indicate activities on the steeper slopes of hills and mountains inhabited and farmed mainly by small entrepreneurs. They produce most of the tree crops excepting perhaps citrus, mango, papayas, and coconut. Many of these are exported including cocoa, coffee, pimento and kola. Many are soon to be exported in significant quantities namely ackee, avocado, breadfruit, guinep, jack-fruit, naseberry, sour-sop and star-apple.

HAP is a joint undertaking between the United States Agency for International Development (USAID), the Government of Jamaica (GOJ), non-government and private agencies with interest in hillside farming, and the small farmers themselves. It was conceived as another effort to increase the production and productivity of perennial tree crops on hillsides, but with some differences as will be explained later in this paper. Seeing that all the hillsides in Jamaica are now declared watershed, one cannot avoid but include watershed management in the development activities. The Project provides opportunities for an acceptable mix, to ensure improved living standards of the people on the hillsides together with all the known social and economic effects, and simultaneously protecting the immediate environment, as well as other benefits like water catchment and conservation for some major industries, towns and cities.

The design and implementation strategies of HAP have benefitted from several previous experiences at Hillside Agriculture and watershed management. Mention will be made here of only three. Over the past 25 years there was firstly the "Forestry Development and Watershed Management in the Upland Regions Project (1968-75)" funded by the Food and Agricultural Organization (FAO) at a cost of US$2,040,000. It concentrated on demonstration, and included formal and technical training. The demonstration included timber tree planting and engineering works mainly check dams for gully control, paved drains, retaining walls around buildings, river training and erosion control. The cost was exorbitant and could not be afforded by the beneficiaries, and although highly acceptable, could neither be sustained or replicated.

This Project was overlapped with the First Rural and Kenilworth Project, another demonstration type, but involving more research. It was established at nearby Smithfield, with research plots to measure soil loss and water runoff, and to show various types of hillside terraces (bench, orchard, mini) artificial waterways, storm water drains, individual plant basins, barrier strips, gully plugging etc. About 1,080 acres of land were treated between 1974 and 1977 at Kenilworth. An assessment three years after completion showed about 30% of the treated land being cropped but many of the terrace destroyed by animals or bad tillage practices. The farmers complained about lack of grant funding and markets, and also poor yields. Many farmers abandoned the land as it was provided under government lease (Project Land Lease). There was also inadequate extension service, and lack of experience or appreciation of the soil conservation practices. These contributed to the almost total failure of the Project.

In 1978 the second Integrated Rural Development Project was initiated, this time on private lands, and funded by the United States Agency for Internaitonal Development (USAID) at US$15.00 and the Government of Jamaica (GOJ) at $11.2 m. The main focus was on demonstration plots, soil conservation, gully control and reforestation. After a 5 years implementation period, it established all the demonstration plots, 33% of the soil conservation structures, 30% gully control and 44% reforestation. Subsequent evaluations found that the Project suffered for an over-ambitious target, too frequent changes in management and unfavourable political influences. It concentrated too much on getting large areages under mechanical soil conservation treatments, and too litle crop establishment, especially perennial crops. Like at Kenilworth, the farmers were not too familiar with the practices to use them properly or to maintain them. Having become accustomed to generous subsidies and credit, they expected continual payment for any further work. There was no plan for continuity or the potential for sustainability. (See Table 1)

These experiences have served the Hillside Agriculture Project very well, proving correct the chinese adage that 'a wise man learns from his own experience, but a wiser man learns from the experience of others.' The Project Document was prepared as a guideline rather than a blue-print, allowing a Project Coordinating Committee flexibility for planning and implementation. The Committee was selected from the Ministry of Agriculture, USAID, and the Jamaica Agricultural Society. A simple mission statement was adopted "to increase the production and productivity of mainly perennial tree crops on hillside lands, to improve the standard of living of the people in the area and enhance the environment". In other words it set out to increase agricultural production to meet increasing local demands and for export, to earn foreign exchange, while at the same time protecting the natural resource base, mindful of some

Table 1. SUMMARY OF THREE PROJECTS

FDWMUR	FR and K	2nd IRDP
Strong Aspects	**Strong Aspects**	**Strong Aspects**
1. Demonstration	1. Demonstration	1. Demonstration
2. Formal Training	2. Formal Training	2. Formal Training
3. Soil Erosion Control	3. Soil Erosion Control	3. Soil Erosion Control
	4. Research	4. Reafforestation
Weak Aspects	**Weak Aspects**	**Weak Aspects**
1. Engineering Approach to Soil Conservation	1. Mechanical approach to soil conservation	1. Over ambitious; sought to saturate an area
2. Cost Exhorbitant	2. Cost Exhorbitant	2. Frequent management changes
3. Processes not easily replicated	3. Bad tillage practices	3. Too little concentration on perennial crop establishment
4. No provision for sustainability	4. Lack of sufficient funding by farmers	4. Expensive and could not be replicated
	5. Poor yields and markets	5. Shortage of credit
	6. Insecure land tenure	6. Poor yields and market
	7. Inadequate follow-up extension service	7. Lack of appreciation by most farmers
	8. Lack of understanding or appreciation by farmers	8. Use of timber trees instead of perennial fruit trees
		9. Political interferance

of the errors made in past Projects and especially the three I have summarized.

Farmers were trained in simple but effective tree crops production methods. These started from germplasm selection through to reaping and processing where applicable. Some of the practices included mother-plant selection, underplanting with improved varieties, budding, grafting and top-working. Work was done with varieties with which farmers were familiar, occasionally introducing a few new types. The emphasis is on food trees with lessened stress on timber and short term crop. Practices were improved rather than imposed.

The approach to soil conservation has been the agricultural one rather than mechanical eg. terracing, or engineering eg. artificial water ways and paved drains. Crop resuscitation received priority over planting new ones, demonstrating an assurance that one can double or triple production from existing tree stocks. This had brought quick and dramatic increases, and has become the greatest motivational factor among the farmers. To date 2,257,000 plants have been resuscitated. These include 1,646,000 cocoa, 508,000 coffee and topworking of 1,100 mango plants. The production of cocoa and coffee from the treated trees has more than doubled. Other crops embarked on are ackee, breadfruit, avocado, jackfruit, naseberry, otaheiti apple and sour-sop. The process involves simple cutting plants to manageable heights, pruning and shaping, shade management, fertilizing, pest disease and weed control and appropriate soil conservation methods.

During the same period 1,422,000 new stocks were planted including 696,000 cocoa, 395,000 coffee, 150,000 coconut, 22,000 paw paw, 4,500 mango, 64,000 timber and 43,000 miscellaneous fruit trees.

Many practices of these are now coming into production.

Tillage practices are limited to individual holes and plant basins which could be accepted as zero tillage.

Water runoff control is always a problem particularly during excessive rainfall. Instead of creating drains and trenches natural water ways were protected. Many were grassed and plugged with stones, dry wood or live plants (bamboo, Glyricidia, Lucaena, Vetiver, fodder grasses). The live materials often provided fodder for small livestock.

Underlining our methods is the fact that perennial trees can protect the soil through prevention of soil movements, protection of soil cover through litter build up, added organic matter in the soil etc. and that will continue to happen over many years.

Demonstration plots used as a method of technology transfer are very effective. Standardized site signs are used. The plots are placed at visible areas. Only the recommended practices are applied. The sites are used for training sessions, and the farmers are committed to maintain the plots. Only one or two practices are demonstrated at a site. Accurate records are being kept and it is intended to maintain them through other agencies in perpetuity. Other training involves practical demonstration and talk sessions. Long field days are not used, recognizing that the attention span of the farmers is short and it is preferred that they practise what they have learned soon after. The practices are familiar; easy to use by most, and can be taught by them to others.

The inputs used are all easily available, and at reasonable affordable cost. Farmers are encouraged to use many of the locally available planting materials eg. seedlings of timber plants. They are shown how to plant ackee, cocoa and nutmeg at stake and to

topwork mango. Local plant nurseries are being encouraged to provide those plants in great, great demand. The very sight of these plants in the area has increased demand, and many young persons are becoming involved in establishing them.

In some instances where it is recommended to incorporate organic matter (namely chicken manure or bioganic) in planting holes, farmers are getting good results from materials available on their farms or from top soil.

The crops recommended under HAP have guaranteed markets or good potentials. Cocoa, coffee and pimento are sold through Primary Producer Associations. Ackee, avocado, breadfruit, mango, sour-sop etc. are being sold in increasing amounts through higlers or exporters or have a good future markets. The Project is in consultation with several exporters and processors. In one sub-Project a processing plant is being updated to continue canning ackee and making a mixed fruit peel preserve, and new products are being developed from crop produced from the field outreach programme. In another, the farmers from the Rio Cobre watershed are taken to sell their produce in the Portmore area of St. Catherine. In yet another successful marketing is being done through small cooperatives.

In the area of credit and capital HAP, is probably unique in that it does not provide the beneficiaries with cash, but rather with an opportunity to earn their own cash through improved production. All the material inputs including planting materials, fertilizer, pesticide and some small tools (through tool-pools), are provided as a grant, each farmer getting up to one acre of land treated. The farmer is then encouraged to save some of the incremental income through options of his own, to provide capital for future investments on his farm, and to expand his operations.

So far there are almost $2.m vested in three growers cooperatives. Loans are provided to the members at 12 1/2% and these are operating quite successfully.

A major weak aspect of the three Projects previously mentioned was that they were not easily replicated. To overcome this, HAP has used simple familiar easy to apply technology with easily available and affordable inputs. The soil conservation methods were particularly quickly adopted and used by the farmers. Size of holding, topography or age of the farmers were not deterrents to applying the practices, and as stated before the quick and dramatic increases in production served as a great incentive.

The sustainability of HAP is now receiving much active attention. It is hoped that the successes experienced so far will help to sustain interest in its implementation strategies. Some methods for capital generation are working well and should be maintained. The existing markets are absorbing the items produced and future prospects are good. HAP has been receiving increased applications from young farmers. In one such sub-project about a third are between 18 and 25 years, granted their main interest is in growing coffee. Schools and 4H clubs in the sub-project areas are included anoung our clients.

The Project has not suffered from undue outside interference. It is managed at the upper level by a Project Coordinating Committee comprising of the persons from the United States Agency for International Development (USAID), The Ministry of Agriculture and the Jamaica Agricultural Society (JAS). The small Committee approves sub-projects, suggests development strategies, controls the budget, employs senior staff and monitors activities. The

management activities are performed by a small core staff who carry out the directives of the Committee, recommend changes where they seem advisable, manage the budget, control inventories, monitor and evaluate field activities and report to the Committee, the Ministry of Agriculture and USAID. At the field level a small extension staff provides the technology, procures and distributes the inputs, monitors activities and reports to HAP. They are supported by local management Committees (LMC). The LMCs are comprised of farmers, representatives from government agencies like Jamaica's 4H club, JAS, MINAG, Credit Bank etc. That Committee assists in selecting the beneficiaries and dismissing unfit ones, supervises the distribution of benefits, helps to decide on the technology used, assists in monitoring developments, and evaluates final benefits.

People are deliberately mentioned last as the choice place to acknowledge their contribution to the success of HAP. Their commitment and hard work should ensure prolonged future success.

HILLSIDE AGRICULTURE AND THE ENVIRONMENT

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Introduction

There has been great interest in the environment in recent times. This has resulted not only from the threat to the environment but also to mans own survival on the planet. Among the factors causing environment deterioration is that of hillside agriculture. Hillside agriculture is inevitable as it forms an integral portion of the economy not only in Jamaica but throughout the Caribbean and indeed in the vast majority of tropical countries. What is required therefore is a sustainable system which optimize hillside agriculture whilst ensuring harmonization with the environment.

In this paper an attempt is made to review some of the major environmental problems associated with hillside agriculture. Experience and successes in similar agroecological zones are cited and proposals for local/regional hillside management are proposed. Current work at CARDI related to environmental issues are also cited.

Land on steep slopes:

On a global basis, steep slopes occupy more than 50% of the earth's land area. It is hence a critical resource on a global basis. These areas vary from permanently snow capped mountains through tropical forests to dry desert-like conditions. The management varies depending on geology, soils, rainfall and accessibility.

Regionally, sloping lands predominate throughout. In several of the smaller islands there is virtually no flat land. As a result the bulk of the agricultural activity will be based on hillslopes.

At least two thirds of the island of Jamaica consist of steeplands/sloping lands. The Blue Mountains and other mountain ranges run throughout the length of the Island and ensures a high proportion of hill-lands. Agriculturally these lands are very important as the bulk of food crops, coffee, cocoa, and other tree crops are grown in these areas. Forestry and much of the grazing lands also occur on these slopes.

Presented at the NRCA-MINAG-GTZ/IICA Seminar on Sustainable Agricultural Development and the Environment, June 21-23, 1994 Conference Centre, Kingston.

Reasons for cultivating hillside/steeplands:

There are various reasons for the utilization of steeplands for agricultural related activities. Selected reasons are discussed below.

Hillslopes provide unique agro-ecological niches which are ideal for specific crops and livestock. In certain instances given ecological conditions favour the development of superior flavours. A prominent example is Blue Mountain coffee which evolved in the hilly areas of eastern Jamaica. In this case steeplands are the only situations for producing this crop.

Historical events have had a marked influence on land distribution and land use pattern in the country. Resulting from land settlement practices many peasants settled in the hilly areas which had not been under the control of the large estates. Subsistence agriculture has persisted in these areas. The cultivation of steeplands is also predicated on land availability. In the case of many small farmers this is the only land owned. It is therefore inevitable that if the landowner has no other source of livelihood this land will have to be utilised.
The shortage of land in many areas compared to the current population has forced landless people to use the fragile hillsides.

Advantages of hillside farming:

Certain hillside areas provide suitable ecological conditions for the production of particular crops. Coffee, peaches, strawberry, certain cole crops and flowers do well under specific ecological conditions. This will ensure that suitable locations will be sought for production. These are inevitably steeply sloping hillsides.

In several locations the rainfall is higher on the hillsides. This will allow for rainfed production of a range of crops. This is of particular importance as irrigation is often limited in steeplands.

Improved drainage is also one of the features of the sloping land. In certain areas the flatlands with high clay contents are generally of poor drainage. Due to the steep slopes on hillsides, water will drain in response to gravity. Good drainage is critical to the production of crops which are in-tolerant to waterlogged conditions.

Some soils occurring on steep slopes are of high natural soil fertility. A common example is that of the allophanes (Volcanics) in the Windward Islands. These deep fertile soils are widely used for banana production in these Islands. There are also pockets of fertile soils in some sloping areas.

A further advantage of hillside production is the reduced levels of certain pests and diseases as altitude increases. Virus diseases of legumes and solanum potatoes are notorious at low altitudes. These niches are sometimes sought for utilization by the farmer.

The angle of the sloping land makes it more easily cultivated by the small farmer using hand tools than is the case of flat lands.

Finally, the cooler conditions of many hilly areas provide a easier condition for farming.

Limitations of hillside farming:

Notwithstanding the desirable attributes of hillside farming there are several limitations to sustainable agriculture on these slopes.

A predominant problem is that of susceptibility to accelerated soil erosion. The steep slopes, except where covered by vegetation or mulch, do not allow for adequate infiltration. This will cause runoff which is the main cause of erosion on these slopes. Many sloping areas are also susceptible to landslips and other forms of mass movement. This can pose a serious threat to agricultural activities.

Several of these soils are shallow. This can limit rooting depth and water and nutrient storage capacity. This also predisposes the soil to drought stress and susceptibility to lodging. The selective removal of clay by leaching and erosion also results in the soils having more coarse texture. This also contributes to low water and nutrient holding capacities.

An associated problem is the susceptibility to depletion of soil fertility due to leaching and runoff. Selected nutrients are removed in runoff water and eroded soil sediments. With an history of leaching many sloping soils are deficient in nutrients. Hence, except for limestone derived soils many of the soils on sloping lands will tend to be of an acidic status.

Runoff of pesticdes is likely to be more severe from sloping lands. If these chemicals are used improperly and are improperly disposed of they can easily be carried by running water and eroded sediments thereby contaminating the environment.

Except where terraces are provided there is a reduced level of mechanization on hillsides. In view of the steep slopes traditional machinery for tillage or other operations cannot operate on these slopes. Attempts to use terrace systems to overcome this limitation has not met with much success in the region. The potential of all terrain vehicle (ATVs) can provide a certain amount of flexibility thereby minimizing the limitation of

accessibility to the farmstead. The use of conventional tillage practices is not recommended for steep hillslopes.

In view of the steep slopes occurring on most hillsides certain forms of irrigation are difficult or unlikely to be used on these steep slopes. Hence flooding and furrow irrigation cannot be easily practised. This is not an insurmountable problem however, as the development of drip irrigation system makes it possible to efficiently apply water irrespective of soil type, slope, and crop type.

Potential of sloping land for agriculture in Jamaica.

In the previous chapters both advantages and limitations of hillside agriculture have been presented. These lands still have tremendous potential in the unfolding scenario of the nineties. A cursory glance at these land in Jamaica will show that whereas there are mini pockets of intensive agriculture on sloping lands in Jamaica invariably the majority of lands are either abandoned, in ruinate or in bush.

However, as shown by the various highly productive pockets and a knowledge of the influence of management on these sloping soils, significant increases in production from these areas can be achieved. This is also illustrated by the successes of the Hillside Agriculture Project (HAP) and expansion of various tree crops in selected hilly locations.

There are available basic soil and crop management information to facilitate the development of many of these areas. However, these are not the only requirements for successful development of these zones. Among the other requirements are the following:

i) Financial resources at competitive rates to facilitate development

ii) Sources of suitable germplasm of plants and animals of adequate quality and quantity.

iii) Management personnel to ensure the establishment and maintenance of development activities

iv) Availability of suitably skilled labour force

v) Availability of agrichemicals close to source

vi) Infrastructure to facilitate the movement of personnel, inputs and outputs.

vi) Markets for fresh and processed products

vi) Suitable land tenure

The factors listed above all influence the lack of development of the vast areas of underutilised sloping lands in the country. The advent of liberalisation of foreign exchange and the economy, and the renewed interest in export agriculture has rekindled much interest in agriculture production. The opening of avenues for non-traditional agriculture has resulted in this area becoming the fastest growth area within the Jamaican economy. The change in this scenario now provides a major opportunity to develop sloping lands using crop species which have export and processing potential. Tree crops and grasses, if properly managed, provide suitable cover and protection for fragile sloping lands.

Business opportunities in support of the development of hillside agriculture:

The accelerated development of hillsides in Jamaica has the potential of increasing domestic and export agriculture. In realising these increased production business opportunities are likely to develop as a result. Among the potential areas are the following:

Soil management/soil conservation

Agroforestry/Horticulture

Nursery management

Extension/rural sociology/gender issues

Marketing

Agricultural inputs retailing

Export

Processing

Transport operation

Measures one can adopt to ensure sustainability of hillside farming:

Traditionally, hillside agriculture has depended to a large extent on the ability to rotate and rest the land for extended periods to facilitate soil renewal. The land scarcity and desire for continuous production from these areas will necessitate the development of sustainable systems of production. Below are discussed several components which can contribute to sustainable development in these areas.

Agroforestry:

The term agroforestry refers to land-use systems in which trees and shrubs are grown in association with crops in a spatial arrangement or rotation (Fig. 1). There are both ecological and economic interactions between the trees and other components of the system.

The place of agroforestry in hillside management is assured as it meets several ecological, social and economical criteria which are essential for sustainable land use systems. As a soil conservation measure, agroforestry is likely to be successful in protecting the environment on sloping lands. This is so as the particular form can be chosen on the basis of the farmers choice and can be integrated into the farming practice for integrated hillside development.

As a soil conservation measure agroforestry serves two functions. It acts as a barrier to the movement of soil and water especially when planted in parallel strips or as contour hedgerows across sloping land. It also serves as a cover as the leaves assist in breaking raindrop impact whether attached to the plant or as leaf litter. The leaf litter also provides an avenue for detention storage. Further, depending on the stage of decomposition, the litter can absorb several times its own weight in water.
According to Wijewardene (in Mercer, 1985) soil loss was significantly reduced from 232.6 t/ha/yr on tilled non-mulched annual cropping systems to 0.2 t/ha/yr on no-tilled intercropping systems with leuceana, using the lopped foliage as mulch.

Young (1989) suggests that the function of trees on erosion control may include the following:

Reduction of water erosion by a surface litter cover;

Act as a runoff barrier by closely planted hedgerows coupled with the litter that accumulates against them;

Prevention of decline in soil-erosion resistance, through maintenance of organic matter;

Strengthen and stabilize earth-conservation structures where present;

Reduction in wind erosion by windbreaks and shelterbelts;

Ensure more productive use of land taken up by conservation structures; and

Agroforestry also plays a role in soil fertility maintenance through the following mechanisms: Increase the additions of organic matter and nutrients to the soil and, reduce nutrient losses from the soil thereby leading to more closed nutrient cycling.

Hedgerow cropping/alley cropping:

Hedgerow cropping, an agroforestry form, involves the establishment of live vegetation in contour or parallel rows across sloping lands. The hedgerows should be continuous and be closely spaced in order to minimise water runoff and act as a filter to trap eroded sediments.

Hedgerows have been used for a long time in the Caribbean and in many other countries. There have been mixed successes, however, as various limitations have been recorded. In many instances these hedgerows have been established as a result of subsidies and special projects. Some have been used for purposes other than soil conservation and may have exacerbated the erosion problem in the long run. An example is the use of the roots of vetiver grass for the production of cosmetic oils/fragrances leading to the destruction of hedgerow barriers. Others have been destroyed by roaming livestock while many have been abandoned once the project ends.

The current thought is the combination of multi-purpose materials for hedgerows. This means that the hedgerow will provide several functions e.g provision of food or forage for livestock, provision of supplementary soil nutrients, provision of a source of vegetative mulch, use as craft and provision of firewood and fence posts. Commonly used hedgerow materials include:

Perennial legumes: Leucaena, quick stick, calliandra, pigeon pea Grasses: khus khus (vetiver), napier, king, guinea, sugar cane -for chewing; and Miscellaneous materials such as : Sorrel and pineapple.

Proposal for a modified hedgerow system for hillside farmers with limited resources.

A proposed modified hedgerow system for hillsides is shown Figure 2. It is a strip cropping system in which permanent tree crops are established as a strip analogous to the hedgerow. However, depending on farmers preference, two or three rows of the trees (pure or mixed) would be established. The intervening alleys which would vary in width according to farmers choice would be planted to cash crops. Supplementary soil and water conservation structures such as hillside ditches and multi-use barriers would also support the trees and cash crop sections.

This system modification is proposed in light of the often recurring system in home gardens where a range of trees and cash crops are planted in an ad hoc mixture. Though adequate in the initial stages, as the tree develops the excess shade limits the production of most crops within the system.

During the establishment and development phases cash crops/annuals are planted with the trees. As the canopy develops the volume of crop produced is reduced and so are the returns from the non tree component.

It is essential, that for the average farmer there should be the availability of land to produce staples and cash crops to maintain his family. Furthermore, most fruit crops have seasonal production and the cash crop will serve to supplement the farmers income during the low production periods.

Many fruit crops, which are needed for local consumption, processing and for export as non-traditionals are seasonal and are unavailable in adequate quantities. The system proposed here can facilitate the increased production of a range of these species. Mixed plantings of fruit/tree species are suggested to retain biodiversity, to reduce potential pest problems from mono species cropping and to allow for a spread of the risks associated with the production of a single crop species.

This system should also be suitable for coffee and cocoa production on small farmers holdings on hillsides. The seasonality of these crops and fluctuating price regimes, increase the risk of the farmer. As he diversifies his farm portfolio, chances are that all commodity prices will not decrease simultaneously.

Livestock production is also suitable for this modified system. The hedgerows may be utilised for forage. Furthermore, on occasions when there are no cash crops in the field the animals may be tethered and allowed to graze in the alleys. The manure produced by the animals will help to enrich the system. Materials not used for export or local sales or farm consumption may be used for livestock feed.

This concept requires refinement and field testing and continual upgrading. It is considered to be more appropriate for small farming systems than the home garden system which now exist. It will accommodate the appropriate spacing for various trees taking cognisance of their space requirement at maturity. It allows for a formal mixing of various fruit tree/crop species so as to prolong and diversify income generation.

Conservation tillage:

Tillage involves the mechanical manipulations of the soil to promote a desired tilth and thereby to optimise plant growth other factors remaining non-limiting. There are other reasons for tillage including the incorporation of debris, weed control, pest and disease control and for the creation of soil boundaries for irrigation and drainage. The conventional tillage methods which are common on flat lands are unsuitable for hillsides except where special measures such as terraces have been established.

Conservation tillage methods are aimed at reducing the potential of soil erosion and increasing the storage of water on sloping lands. There are various modifications of this system and includes reduced tillage methods such as plough plant and no-tillage. No-tillage is the form of tillage in which soil disturbance is kept to the minimum. The main disturbance is that done for the planting of the seed/propagule and the placement of fertilizer application. In all no-till systems a mulch cover is present. This mulch protects the soil from the direct impact of raindrops and enhances soil moisture storage as runoff is minimised. Other advantages of no-till/conservation tillage include :- moisture conservation, soil conservation, optimization of soil temperature and increase in soil organic matter content (Phillip and Philip 1984).

Reduced tillage has been successfully demonstrated on a range of soils (clay, loam and sand) and crops including cereals, legumes, cassava, peppers etc. Table 2 illustrate the suitability of no-till for several crops grown in Nigeria, Trinidad and Tobago and elsewhere.

Tree crops which are particularly suited to sloping lands where drainage is generally better, do not require conventional tillage. It is adequate to make an opening for the planting of the tree and the placement of fertilizer without additional soil disturbance. Where intercropping is practised however, there may be some need for tillage depending on the crop species to be grown. Crops such as legumes and corn can do well without tillage provided mechanisms can be developed for adequate weed control.

Integration of livestock into hillside farming systems:

In many locations a major use of sloping land is that of livestock grazing. This is a universal approach as was previously shown due to the soil characteristics shallow depth,
low fertility, and unsuitability for tillage. Grass production is however ideal for the situation. This will also lead to the grazing of livestock as a natural progression. Many of these fragile areas are very susceptible to soil erosion. Overgrazing and compaction due to the trampling by animals especially when the soil is wet can exacerbate the problem. Due care must therefore be taken in managing the ecosystems.

In certain areas, silvopastoral systems have been developed. These involve the production of livestock with forest species or fruit/food trees. In this system the animal obtains forage from the tree and grass species. The tree also provides shade and shelter from wind and rain. The animal in turn provides manure and control weeds which compete with the tree species. There is also the provision of animal proteins and other by-products from the system.

There are also disadvantages within the silvopastoral system (Fig 1). As noted earlier, though varying for specific situations, animals can lead to soil compaction and overgrazing thereby contributing to soil erosion. There is also the possible ringbarking of tree trunks and trampling damage to saplings.

There is much potential, however, for increasing livestock production from this system. In addition, the species which seem to have the greatest potential are goats, sheep, cattle, pigs and poultry. A major deterrent to goat production is attacks from dogs and thieves. Close supervison, appropriate security fencing , keeping animals close to home or in an area with close supervision and the use of guard dogs should be integrated into the system. As far as possible and to be sustainable the bulk of the feed for animals should come from the farm. Emphasis on cut and carry, provided there is adequate labour, should be the norm for ruminants.

Support services:

To ensure proper management of hillsides the following support services are urgently required:

Information on soils, climate, suitable crops/livestock enterprises

Market information:

Extension service

Farmers groups/coops

Agro-processing facilities

An assessment of the impact of soil conservation efforts in the Caribbean by Gumbs (1992) have revealed the following:

A high proportion of farms are small, resources poor, and on hillsides or non-contiguous parcels of land at various locations in the watershed. This limits farm management and the implementation of soil conservation on all the land.

Engineering methods have not been readily adopted by farmers due to high cost of implementation, maintenance and the lack of sufficient technical assistance.

Agronomic measures are have been more readily accepted by the average hillside farmer

Related environment issues

There has been little focus on specific aspects of environment issues associated with hillside farming. Mention has been made of soil erosion and land slippage which are associated with runoff of excess water. Several non-point pollution problems result from the movement of agrichemicals and soil sediments. Flooding of low-lying areas is also a major problem which worsens as deforestation increases. Infrastructure for housing and roads also exacerbate runoff problems on hillsides.

Whereas these problems are severe, special measures can be incorporated in hillside agricultural management to mitigate them. Fertilizer and manure include usage need to improved to ensure that these materials are incorporated/buried in the soil. This will reduce the volume that leaves the farm in runoff, soil sediments and organic matter.

With regard to the use of pesticides several organizations including CARDI, have been increasing the provision of information and training on improved pest and pesticide management. Integrated pest management (IPM) is being widely promoted as a means of ensuring the use of alternative pest/disease control strategies. Strategies include use of resistant varieties, cultural measures, use of natural enemies/parasites, trapping - pheromones as well as the judicious use of certified pesticides as a last resort. This integrated approach it is hoped will assist with reduction of abuse of pesticides.

It has also been noted in many instances that the optimum management of crop can also minimize environmental problems. Proposals proferred above for agroforestry, alley cropping, conservation tillage and mulch farming will also minimise runoff and erosion problems. The most potent measure against erosion is to keep the soil covered. This can be achieved either by standing vegetation and or leaflitter/mulch on the soil surface. Hence the approach is to minimize the area of the land which is left bare or exposed.

Despite previous statements about the impact of agroforestry and related practices on erosion control, excess runoff occur from time to time and the ability to manage the water is a key issue in erosion control. Experience in Trinidad, locally and from the literature indicate that the bulk of annual erosion and runoff occur in less than 10% of the total number of rainfall events. This is exacerbated when the soil is already saturated due to prolonged rainfall. Contrary to popular belief local deforestation does not significantly affect the annual rainfall as the major events have always been associated with extra-regional disturbances. These events are the ones which cause the major problems. Runoff will be inevitable in such situations and normal farming practices will not readily control it. Deforestation however contributes significantly to increases in runoff and soil erosion.

Uncontrolled runoff leads to destruction of hillside farms mainly in the form of gully erosion and landslides. To minimize this problem additional structures for conveying water across and down slope must be provided. Hillside ditches and storm drains can convey water across the slope at non-erosive velocities. Collected water should be emptied into protected gullies and constructed waterways.

Wherever feasible it is suggested that runoff water be stored in dams to facilitate irrigation and watering of livestock. This water can generally be gravity fed to lower reaches of the farm.

Hence a combination of management efforts and the implementation of appropriate bio-engineering techniques are recommended for environment friendly management in hillside agriculture.

Related work at CARDI

Several projects which can impact on hillside agriculture are on-going in CARDI. A study of the use of hedgerows for erosion control and for enhancing hillside farming system has been in progress for the past three years . The two main leguminous hedgerows evaluated are leucaena and gliricidia. The grasses napier and khus khus have also been employed. Parameters being monitored are soil and runoff losses as well as nutrient content of the soil sediments. The growth of the hedgerow is also being measured and

its impact on runoff and soil loss monitored. The choice of the above hedgerow is related to their utility as animal feed, mulch, soil nutrient and use in craft making enterprises.

Research over the last three years has also involved the monitoring of various agrochemicals in several river systems in the southern regions of the Island. In order to reduce the use of pesticides, biological control measures are also being evaluated for a range of crops in varying ecosystems. Several of these projects are on-going.

Conclusion:

Hillside agriculture whilst providing niches for certain agricultural production systems can lead to environmental problems. These problems including soil erosion and pollution with agochemicals need to be mitigated. Several suggestions for improving the management of hillsides have been suggested. Potential business opportunities and research developmnent needs have also been put forward. It is hoped that the pooling of available technical and human resources will help to ensure on a sustainable basis the successful utilization of hillsides without damaging the environment.

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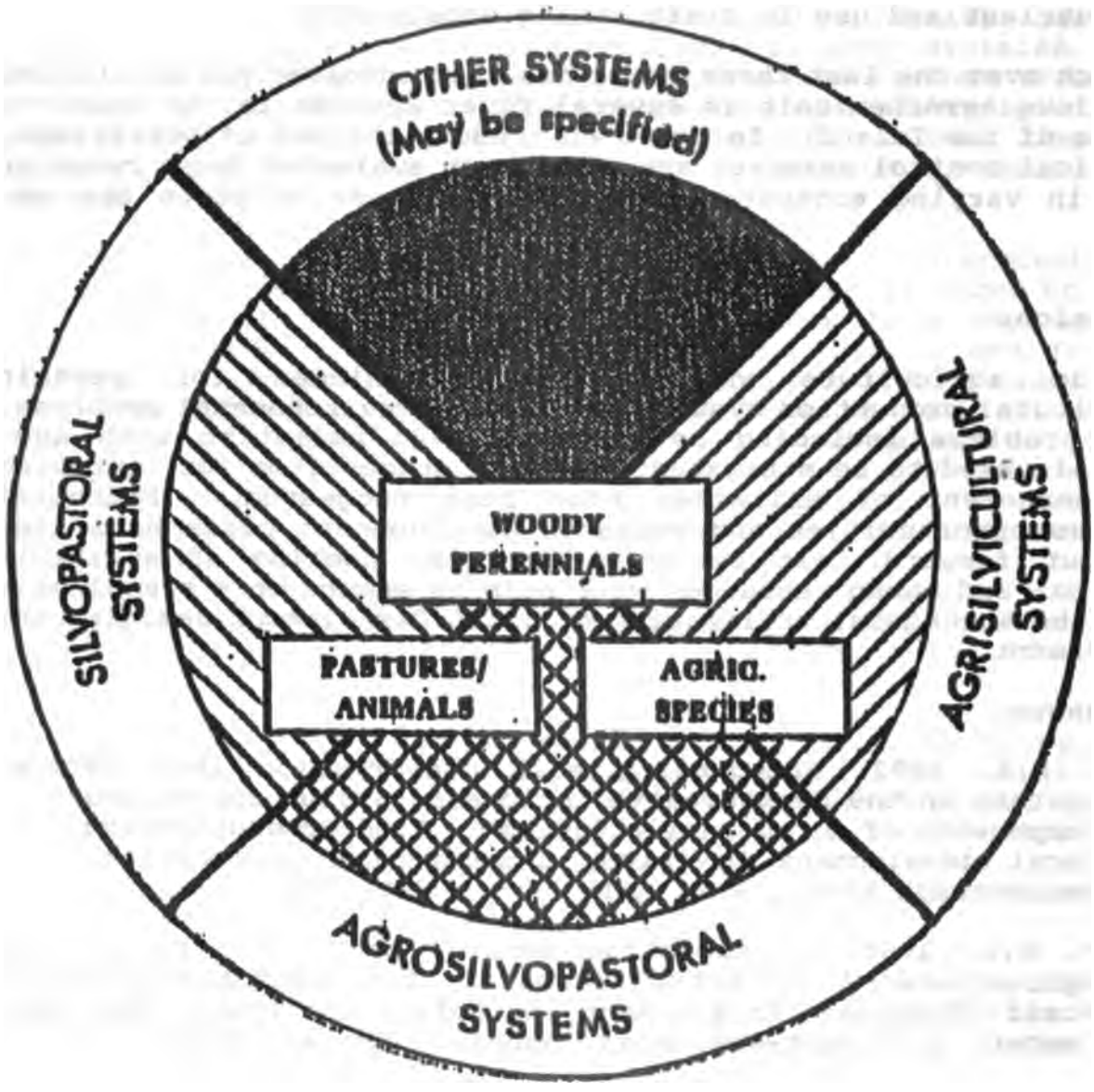
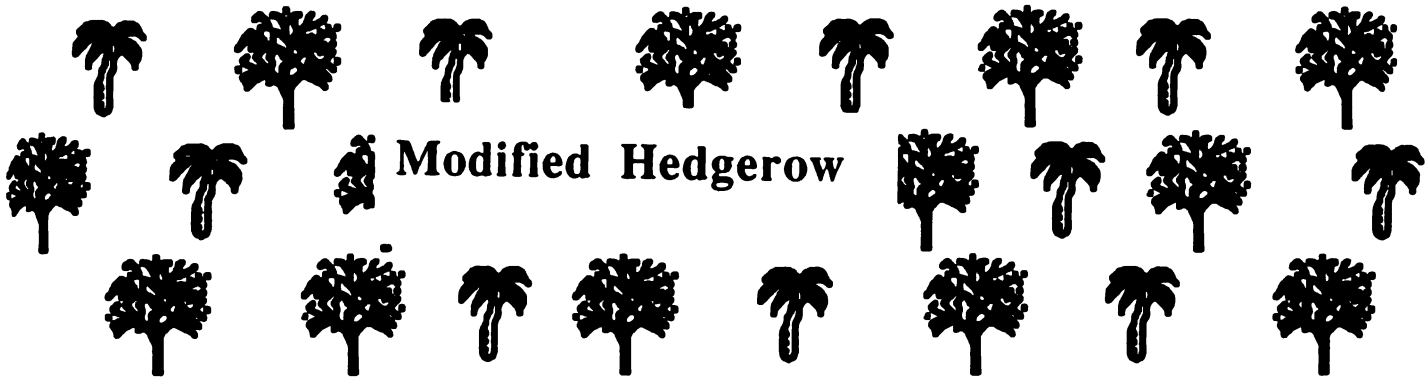


Fig. 1 : Categorization of agroforestry systems based on the nature of components



Cropping Area

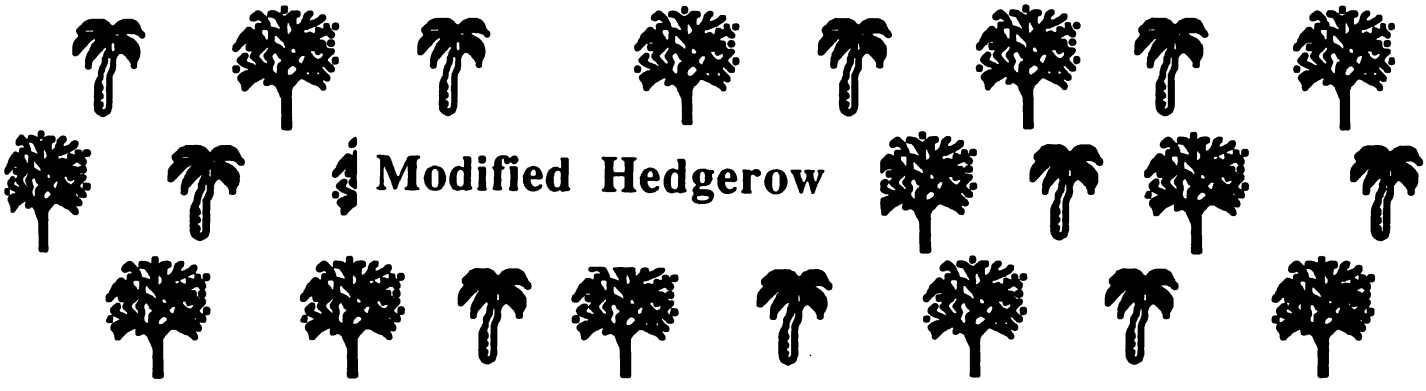


Fig.2 : Modified hedgerow/strip cropping system for hillside management

ENVIRONMENTAL IMPACT

OF

PRESENT LAND USE

The Rio Cobre

Case Study

Presented by
Tomás Mulleady

Seminar on Sustainable

Agricultural Development and the Environment:

Focus on Watersheds

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Impact of Actual Land Use in the Rio Cobre Watershed

1. Introduction

The definitions of **sustainable agricultural development** include references to the relationship between the availability of natural resources[1] / and the increasing use, or misuse, of such resources. All emphasize the need to give greater consideration to natural resource management. Sustainable land use planning is therefore becoming a necessity that demands attention.

Better knowledge of the interrelation among the components of the environment, including humans, has not been focused on sufficiently up to now. This information will help policy makers to enact policies and formulate programs and projects to manage the natural resources more efficiently. Efficient management of resources is sustainable over time, and maintains the structure and function of the natural environment.

De Camino and Muller (1992) define sustainability of agriculture in terms of the use of resources (biophysical and socioeconomic) according to their capacity to generate, using appropriate technologies, goods and services for present and future generations. Accomplishment of this assumes that there is ecological and socioeconomic sustainability.

De Camino and Muller refer as an inconsistency with sustainable land use when the **actual land use differs from the potential land use of the region.** Development opportunities are lost because of underutilization and over utilization of the land.

Given the role of agriculture in providing goods to satisfy the basic needs and its role in the economy in particular, the relationship between the economy and the environment must be reconsidered so that this vital activity can be maintained on a sustainable basis.

It has therefore become necessary to view sustainable land use in terms of the economic gains and the social and environmental impact that such uses cause. Sustainable land use therefore involves the rational management of the different components in the system trying to achieve optimum returns and a derived quality of life without appreciable degradation of the environment and social disruptions.

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[1] Soils, water, minerals, air.

2. The Study

The purpose of this study is the application of a methodology to analyze the impact of land use and evaluate the consequences that such land uses may have on production, environment and local communities in a region. The methodology includes an analysis of proposed land use production alternatives concerning soil conservation, social and environmental impacts.

The study is done at the farm and at the regional level in a selected area in the north eastern section of the Rio Cobre watershed. It is recognized that many activities that lead to accelerated soil erosion and contamination problems originate on the farm.

2.1 Methodological Approach

The methodology is a comparative one between actual and potential land use. The present land use of the study area was determined based on aerial photographs in black and white for 1982[2]/ and 1991-1992.[3]/ Present land use of the project area was compared with the land use map compiled in 1982. Major changes in land use and trends during the ten-year period were analyzed.

The biological potential of the different areas is determined based on life zone ecological principles (Holdridge, 1967, Tosi, 1981). The Life Zones method uses temperature, precipitation, evapotranspiration and geographical location of the study area to determine the biological potential of the area. Climate data, slope maps and soil classification information were used for this purpose and an assessment of the potential land use for agricultural purposes (McKenzie, October 1993)was completed. By overlaying the actual land use map with the potential use map, areas of sustainable land use, underutilized or with excessive utilization were estimated.

The identification and evaluation of alternative uses for underutilized and over utilized land and the effects these will have economically, socially and environmentally are analyzed. The future situation is derived from representative farm production models for sustainable agroforestry situations. The design of the

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[2] V. Campbell, 1993. Map prepared from the revised computerized map of the 1983/84 Jamaica Resource Assessment.

[3] The aerial photographs were generated by the "Trees for Tomorrow Project", Forestry Department, MINAG/CIDA.

production models means that sustainable and more productive agroforestry will be possible. The farm models show alternative sustainable land use for the different land classification groups. The Universal Soil Loss Equation (USLE)is used to predict soil erosion in each situation (Wischmeir & Smith, 1965).

The quantitative differences between the present situation and the future situation represent the opportunity lost due to current agricultural land uses. It is generally considered here that the adverse environmental and social impacts will not be present in the future sustainable scenario.

Major environmental and social impacts resulting from actual land uses are identified and whenever possible quantified in monetary terms. The main environmental issues that this appraisal tries to capture are: a) at the farm level, erosion and site degradation through nutrient loss (biomass depletion); and b) at the watershed level, water quantity/quality problems, infrastructure losses and contamination.

The major environmental impacts that have been affected by land use and agricultural practices, other than on-farm soil erosion, are related to roadways and stream channel erosion, water supplies, loss of biodiversity, and concentrated wastes that contaminate. Since most of the watershed is tree covered at present, the carbon sequestering capacity is not considered in this appraisal as having suffered a major loss. Therefore there is hardly anymore carbon (CO_2) which could be removed by this watershed.

Specific questions regarding tangible evidence of environmental degradation are formulated. A total of eight typical points of observation is used in this appraisal of the Rio Cobre. An effort to put in monetary terms the impacts is implied by each suggested question. For example, improvements needed in drinking water supplies (in quantity or in quality) are installation costs or treatment costs that have reportable (or expected) expenses. Current investment levels needed, or increased operational costs needed, are good estimates for relating to today's level of watershed degradation and today's population levels.

The appraisal framework also contains nine suggested questions for identifying and quantifying the social aspects in the Rio Cobre watershed. These questions are grouped in relation to housing, needed supplementary work, health and government responsibilities. Although cultural degradation may be present in the watershed, this aspect of social impact has not been included due to the practical difficulty to quantify indicators in the field.

An effort to put in monetary terms the social impacts is implied by each suggested question. For example, the need for

residents of the watershed to travel for employment opportunities (or health services) outside the Rio Cobre shows a negative social situation and quantifying the number of persons and their incurred transportation costs is a good measure of this. If food and supplies infrastructure within the communities is also lacking, then another possible social impact measure could be included in the appraisal framework.

Since the combined improvements in agriculture production will likely give most of the environmental improvements identified, it is best to plan when the combined costs and lost opportunities are known from this appraisal so that an appropriate watershed program can be adequately sized, budgeted and planned.

2.2 Outputs

Major outputs of this study useful to planners and policy makers are: a) a methodological approach; b) socioeconomic and environmental analysis of present land use; and c) the identification and evaluation of socioeconomic and environmentally feasible alternatives for sustainable land use.

With these outputs it is possible to evaluate regional economic, social and environmental consequences of the present situation. Also possible at the farm level will be the formulation of alternative farming methods and production systems, and the evaluation of the particular consequences of such proposals from a technical, economical and a social standpoint.

The case of the Rio Cobre is useful to show the impact of land use and simultaneously to show the practicality of the methodology proposed in view of limited sources of data (McKenzie, October, 1993). To date no such complete land use appraisal methodology has been found applied in Jamaica.

3. Project Area

The Hillside Agricultural Sub-Project (HASP) area in the Rio Cobre watershed has been selected for this study.[8]/ The Rio Cobre watershed, with an area of 63,968 ha, occupies more than 50% of the parish of St. Catherine and a small area of the south western sections of St. Mary. Elevations increase in a northerly direction, reaching altitudes of about 700 meters. The Hillside

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[8] HASP is a sub-project of the Hillside Agricultural Project (HAP) financed by MINAG/AID. HAP is promoting the expansion of food tree crops to alleviate the degradation of the hillsides.

Agriculture Sub-Project (HASP) with an area of 7,260 ha is located in the north eastern section of the Rio Cobre Watershed in St. Catherine.

The project area can be considered as one of the most watered areas in the parish of St. Catherine. It has a dense network of streams and rivers, most of which are seasonal. Slopes range from 0% to over 50%. Most of the area falls in the undulating to very steep categories with more than 50% prone to moderate to very severe erosion. Hills and foothills account for more than 90% of the area.

Total population in the project area is 14,248 persons (STATIN, 1982 Census). An estimated 50% of the population forms the potential and actual working population (15-64 year old).

The total number of farmers is 6,017 (MINAG, Farmer's Register, 1988). Farms in the project area consist of one or more parcels, sometimes one or more kilometers apart. The median farm size is 1.7 ha with a range from 0.09 to 27.3 ha (Bockarie, Baseline, 1993). Most parcels are owned by farmers or their families. About 50% of the farmers have only one parcel and 34% own two or three parcels.

Agricultural production consists of a mix of food tree crops, cacao, coffee, root crops, vegetables and livestock (mainly goats, pigs and chickens). Women tend to farm smaller areas than men, and grow fewer labour intensive crops than men. A third of the farmers had access to off-farm income most of which came from wages or salaries for work performed outside the farm.

The effects of improper land use in the Rio Cobre watershed are manifested not so much in the upper regions of the watershed, but in the lower reaches when flood occur at destructive level. This was amply shown during the May rains of 1991 when the dam at Dam Head on the Rio Cobre was washed away. Many homes were flooded in Spanish Town and its environs, 13 lives were lost and total damages to crops, livestock, infrastructure and homes amounted to about US$6.2M.

Studies and projects of different sections of the watershed have been and are being done for specific purposes over the years.[*] / So far, none has comprehensively addressed the effect of improper land use and the appropriate and practical measures to be employed to prevent further degradation while maintaining sustainable occupation of the land. Efforts to develop some analysis of the Rio Cobre began in 1986, but during 1993, in-

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[*] Rural Physical Planning Division (RPPD), MINAG, 1988. Japan International Cooperation Agency (JICA), 1987. GOJ/USAID, HAP, 1990.

creased attention has been focused on sustainable land use alternatives and possible social and environmental impacts (Campbell, June 1993, McKenzie, July 1993).

3.1 History of Land Use

In the project area land was owned mainly by large land owners before and during the period 1930-1970. Production was mainly sugarcane, banana, cattle, cocoa, coconut and to a lesser extent coffee. This pattern began to change after 1944, and intensified in the early 1970's when the Government bought many of the large properties and had them subdivided as land settlements, in communities such as Riversdale, Williamsfield, Harewood, Troja, Kendal and Crawle.

The birth of land settlements coincided with the introduction and expansion of mixed cropping involving use of food crops (yams, sweet potato, squash and other root crops), vegetables, fruit trees (breadfruit, mango, avocado, ackee, sweet and sour sop, jackfruit, guava, naseberry) and the traditional plantation crops mentioned above. "Food forest", a type of multi-storied farming system in which vegetables and other annual crops are grown mixed with plant trees (lumber species, breadfruit, mango, ackee) as an overstorey and with a middle layer of coffee, cocoa and bananas, has become very popular over the years.

The old plantation system has therefore evolved into a mix of plantation and ethnic crops (food crops, vegetables and fruits) along with forests. This crop mix provides food to the household and the surplus is sold in the market. Fruit trees are found as individual trees and not as part of a planned orchard cultivation. They are part of the natural vegetation of the small farms.

3.2 Actual Land Use

The general patterns of land use are the results of a complex set of factors, including topographic, edaphic, ecological and socioeconomic, as well as agronomic technology. From a previous mapping of actual land use dating to 1982 (V. Campbell, 1993) an overview was possible. However, field inspection revealed that changes in land use had occurred during the last ten years, therefore an interpretation of 1991-1992 aerial photographs was made and an updated land use map was prepared for this study.[7]/ The main farming systems practiced by farmers in the area and changes in land use during the ten year period can be seen in Table 1.1 below..

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[7] T.A. McKenzie, July 1993, Annexes 9 an 10.

Table 1.1 Land Use/Cover, 1982-1992 period

Land Use Class	1983[a] ha	%	1992[b] ha	%	
Urban	171	2	n.p.		
Crops:	41%		69.8%		
Clear Cropping	274	4	264	4	
Sugarcane	48	1	n.p.		
Banana plantation	75	1	7	.1	
Mixed Cropping	1160	16	4706	65	
Food Forest & Orchard	1355	19	51	.7	
Pasture	488	7	347	5	
Bush, (ruinate)	656	7	1017	14	
Forest	3036	42	174	2	[c]
			697	10	[d]
TOTAL	7263	100	7263	100	

[a] V. CAMPBELL, March 1993 (Table 4.1) [c] mature forest
[b] T. A. McKENZIE, October 1993 [d] succession forest
n.p. not present in photos

There are many similarities between the 1983 and the 1992 data, but a separate study should be made to carefully assess if the aerial photographic interpretation methods used give fully comparable information. It has been suggested that in the definition of food forests, the question of the mixed cropping pattern could mean that up to 35% was in this system in 1983, thus the apparent growth to 65% in 1992 is reasonable. Similarly a possible interpretation for the apparent decline of forests, from 49% (including bush) to 26% in 1992, is also felt as reasonable.[7]

The limited overall extension of clear cropping as well as the intensive agriculture associated with sugarcane and plantations (bananas or citrus) should be noticed. Cash crops seem to be growing most (total increase in the area under mixed cropping--food crops and vegetables--) at the expense of the forest area. It is felt that the total hectare estimate for clear cropped lands, food forests and plantations is low due to the small and scattered nature of these farming patterns.

Field observations in the watershed show clearly that the food forests are most often located on the deeper soils, and at mid-slope or next to stream banks (McKenzie, June 1993). Higher up the slopes, generally there are areas of ruinate, invading bamboo and degraded pastures. The erosion from these unproductive areas is partially captured by the down-slope, conservation friendly food forests. Furthermore, on the flat hilltops and in

[7] T.A. McKenzie report July 1993, p.7.

some areas where deeper, fertile soils are found, the present farming patterns generally use fallow instead of a more productive food forest management component.

Farm models were developed for each land use (clear cropping, mixed cropping, secondary forest and forest). The models represent the farm crop mix and gross income generated by the crop combination. Soil erosion estimates under actual land use, using the Universal Soil Loss Equation, were calculated in each case. This information will be used later on to estimate the production impact due to actual land use.

3.3 Land Utilization Patterns at the Farm Level

Complementing the aerial photo interpretation, cropping patterns were analyzed for this study using farm data from the project area.* / Survey data shows that the greatest tendency is toward food forest, extensive and intensive mixed agriculture and pasture. It is estimated that over 97% of all farmers use the food forest system; and over 65% of the land is in some kind of tree cropping or food forest production system. Most of the area is used for extensive mixed agriculture (food crops and vegetables) but less than 60% of the areas involved is under production at any given time.

The crops grown by the largest percentage of farmers were cocoa, banana, coffee, citrus and other tree crops. **Sixty-one percent of farmers had ruinate land (unused land) which was the third most frequently listed component on a given parcel.**

The proportion of the farm cultivated with those crops did not differ significantly by farm size. Smallest farms (less than 0.8 ha) when compared to the other sizes had a significantly greater proportion with banana, cocoa and yam.

Cropping patterns when analyzed by tenure, gender and age show that in general the cropping pattern is quite uniform. The main parcel is more fully used than other parcels. Ruinate occupies up to 50% of some farmers' land and over 60% of farmers had some land in this condition.

3.4 Factors Affecting Land Use

Survey results show that constant cash flow (34%), financing (22%) and unavailable labour (12%) were the main factors that determined land use decisions. Knowledge of the crop and market price were the primary factors in land-use decisions for 10% of

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* Land use information from 1,000 farms included in the HASP Farms' Registry Survey was used in this analysis.

the farmers respectively. There was no significant difference in response by farm size, age or gender.

Also, survey results show low use of credit. Farmers' risk considerations, land tenure, the actual production mix and the levels of technology used may explain the low demand for credit by small farmers.

Cash flow (for household and production expenditures), financing and availability of labour interacts and influence farmers' decisions and strategies. They play a crucial role in deciding land use and economic performance. These survey results seem to be supported by simulation results from a multiperiod four year farm model (Mulleady, 1991).

The model represents a typical farm (1.6 ha) in the region. The model shows that farmers allocate resources efficiently. Given the actual crop mix and low input use technology practiced by the farmers, working capital is not a limiting factor. The farm generates enough cash to satisfy basic household and farm operational needs without external financing.

Land is not a severe constraint either. The results of the simulation process show that approximately 25% of the land is not used.[10] Labour supply was a limiting factor during land preparation for annual crops in April and during the period August-November. There is a surplus of labour in the other periods. Survey results show that 74% of the farmers found labour was available, but it was either expensive or periodic. Twenty three percent found that it was difficult to obtain (Bockarie, 1993, pg.24).

The model solution (50% of the land with a combination of cocoa and coffee interplanted with bananas, 25% with annual crops and 25% unused land) portrays the evolution of land use in the region. Large farms with cocoa, coffee, coconut and other production activities were subdivided. Some of these tree crops fields have been gradually transformed into mixed cropping involving use of food crops and vegetables. This is supported by the comparative analysis presented in Table 1.1 above, showing a trend toward the increase in mixed cropping between 1982 and 1992 and a decrease in the forest area during the same period.

Annual crops demand the largest amount of labour at very specific short periods of time because of the two main rainy seasons in the region. Timely planting of annual crops competes

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[10] Some farmers use part of this land in livestock activities.

for labour with land preparation.[11] This may help to explain the large areas under fallow or ruinate. Labour is the limiting factor and not land. This labour constraint seems to be an important explanatory variable in the present land use. This constraint determines a rotation system that includes land under ruinate (fallow).

On the other hand annuals are more profitable and generate the largest amounts of cash. Increases in the supply of working capital and labour, under the conditions specified in the model, will be allocated to annual crops.

Under the present available technology expansion of the area with annual crops in the hillsides is not the most sustainable social and environmentally feasible alternative. The continuation of this trend will have severe economic, social and environmental consequences.

Unused land presents economic opportunities for developing sustainable land use alternatives but the apparent high opportunity cost of labour needs to be taken into consideration in the alternative land uses proposed. Farmers will expect higher returns for their labour before they decide to allocate their time to the new production activities. The impact of actual land use and alternative land uses are presented in later sections of this study.

3.5 Potential Land Use Patterns

The biological potential of the different areas was determined based on Life Zone ecological principles (Holdridge, 1967, Tosi, 1981). The Life Zones method uses temperature, precipitation, evapotranspiration and geographical location to determine the biological potential of the area. Climate data, slope maps and soil classification information were used to determine the potential land use for agricultural purposes (McKenzie, October 1993).

Using this systematic relationship of ecological possibilities, it was decided that by combining available slope classes with observations made in the field covering farmer's practices, and the consequences one can forecast of erosion related to the slope percent/length factors, a workable approximation could be found for defining slope classes. The slope map at 1:25,000 scale (RPPD, MINAG) was interpreted to form the basis for the potential land use map of this study. Slopes were grouped into 0-8%, 8-16%,

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[11] Land preparation (forking) of one half a hectare may require no less than 18 man-days of labour.

16-50% and over 50%. This results in the following sustainable agroforestry cropping patterns:

Table 1.2 Potential land use in rio cobre

Land Use Class	Slope %	Slope Distance [a/] meters	Areas Available has	Areas Available %
Clear Cropping, contours	0 - 8	50	2750	38
Tree Cropping with annuals	8 - 16	100	384	5
Permanent Tree Cropping	16 - 50	25	3287	45
Forestry and Protection	> 50	20	842	12
TOTAL			7263	100

Source: McKenzie, October 1993, pg. 15.

[a] / This is an indicator of plot size possible which under good management is not likely to cause excessive erosion.

It should be understood that all lands have been assigned their "best use," or generally, the higher sustainable biomass production rate. However, as the actual land use shows (Table 1.1, pg.-7-) there are over 20% of the lands now practically unused (pasture and bush) and these use categories do not appear in the future land use pattern (the land is totally used under a sustainable rotation pattern). It should be noted that there is reported no areas where natural pasture would be likely to be found as the sustainable, long-run predominant land use.

At the farm level activities are modeled to reflect sound land use practices and proposed alternative land use systems. A production model for each of the four land use categories is developed.

Calculations were made of the soil losses that these slope categories would have under un-degraded natural vegetation. The range in potential natural soil losses under good levels of management was from 21 tons/hectare/year to 35 tons/hectare /year. These calculated losses compare well to direct field observations of conservation practices showing 17 to 37 tons/ha./year in yams, and 16 to 69 tons/ha./year in Bananas (Smithfield plots).[11/]

[11] UNDP/FAO (1977) p. 104.

3.6 Delineating Use and Misuse Classes

By overlaying the actual land use map with the potential land use map, those areas in optimum use (where potential is equal to actual) were determined. Some interpretation, however, was necessary to decide those situations where under-utilization or excessive utilization was being observed.

Under-utilization was considered wherever pastures or fallow occurred because, as noted above, no naturally occurring pastures are known to occur in the watershed. Under-utilization is also the case when potential clear cropping lands (0-8%) are used in something that is not clear cropping; and this would include forest cover, mixed cropping, food forests, etc. on these potential agricultural lands. Similarly, wherever a lower potential use was practiced than the potential would dictate, then this case was considered under utilizing the site. In general, this was the most common situation, as previous surveys and field observations have shown.

All fallow lands (including pastures, ruinate and bamboo) are considered as not utilizing the potentials of any of the sites they may be found on. Pastures in land suitable for clear cropping is an example of underutilization of land. Other examples are: mixed tree cropping on flat lands (the most frequent), and natural forest on moderate slopes. Although this second category is part of the natural succession which occurs after fallow, in the present unmanaged system there is no productivity, as potentially there could be.

Over utilization is where the actual use in excess of the potential land use. Excessive use occurs on moderate slopes (clear cropping, usually) and on steep slopes (mixed cropping, usually). Excess use was not noticed generally in the field, from the roads which transit the area.

The summary statistics from this general comparison are as follows:

Use Category	Hectares	Percent
Lands under utilized	4075	56
Lands in optimum use [12]/	2658	37
Lands with excess use	530	7

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[12] Optimum use today is probably not sustainable in the clear cropping areas (slopes from 0% to 8%); and therefore, there are fallows, crop rotations, ruinate and much unused farmlands which exist in the watershed. Sustainability in clear cropping patterns would require contour planting.

As has been observed in a neighboring, similar area, the Pindars River watershed, the preponderance of uses are in the under utilization category. This appraisal has used this fact as the general focus of how to improve the local situation as to production, environmental stability and social welfare.

The possible transition from present actual underutilization of lands in the Rio Cobre watershed is a many faceted question. Although traditional extension service methods have had little impact, the HAP project with the promotion of tree crops and the HASP project with the farming system approach, have been gaining acceptance and have made headway on certain crop lines.

3.7 Possible Changes in Land Use Over Time [13]

The identification and evaluation of alternative uses for underutilized and over utilized land and the effects these will have economically, socially and environmentally is analyzed in the following sections. The future situation is illustrated by means of representative farm production models (Sustainable Clear Cropping, slopes < 8%, contour cultivation; Tree Cropping in rotation with annuals, slopes 8% to 16%, contour cultivation; Sustainable Permanent Tree cropping, contour mounds on slopes 16% to 50% and Sustainable Secondary Forest, continuous growth and 10 year periodic harvests).

The production models show sustainable and more productive agroforestry alternatives to present land use in the watershed. Optimistically one might expect that the fallows are phased out and higher productivity and more careful use of hedges and trees will become more common. **This is the proposed sustainable production system concept** The quantitative differences between the present situation and the future situation for the different land classification groups represent the opportunity lost due to current agricultural land uses.

4. Production Impact of Actual Land Use in the Rio Cobre

The appraisal of the production aspects of agricultural land use, uses the actual and potential land use classification based on area presented earlier. [14] The summary of the present situation versus potentially sustainable agricultural production is shown in table 1.3 below.

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[13] See T. McKenzie, July 1993, pages 9-10 and Annex 8 for additional details.

[14] Table 1.1, page 7 and Table 1.2, page 11, and the agricultural production farm models.

Table 1.3 Area and gross income increases due to changes in land use

ACTUAL LAND USE 1992			POTENTIAL LAND USE		
Land Use	Area[a] ha	Gross Income[b] ---JA$000-	Land Use	Area[a] ha	Gross Income[b] ---JA$000-
Clear Cropping	271	2954	Clear Cropping	2750	94325
Mixed Crops	4757	59938	Tree/Crops	384	9485
Pasture[c]	347	868	Permanent Trees	3287	45689
Bush[c]	1017	fallow	Forests	842	5473
Forests	871	794			
TOTAL	**7263ha**	**$64554**		**7263ha**	**$154972**

[a]/ From table 1.1, column 1992 on areas available.
[b]/ From farm models average income /ha. The higher levels of gross income are the result of new technology and species selection which try to maximize biotic and economic potentials.
[c]/ No overgrazing and no excess soil losses from production are considered for these uses.

The difference in gross income between the present and potential land use in the project area (7,263 ha) is the production impact of actual land use. It has been estimated in a loss of production opportunity of JA$ 90.4M.

154,972 - 64,554 = (J$000) 90,418.00

Production impact

per farm 90,418 ÷ 6,017 farms = $15.3 thousands
per hectare 90,418 ÷ 7,263 ha = $12.45 thousands

The summary comparison shows the great economic advantage of promoting sustainable, full use of the Rio Cobre watershed resources, a more than two fold increase of gross income. Returns to the labour actually dedicated to agriculture would increase from the present average gross of JA$144/man-day to JA$179/man-day.[16]/ Total numbers of people employed in the

[16] Calculated as the sum of each gross income/m-d for each class of production weighted by the number of hectares in production in that class, divided by the total number of hectares in production in the watershed. Today there is an estimated 14% in bush fallow that would be in production.

project area would also increase from the present estimated labour needed of 2,000 each year to a full resource employment level needing and estimated 2,600 people.

5. Environmental Impacts

The main environmental issues that this appraisal tries to capture are: i) at the farm level, erosion and site degradation through nutrient loss (biomass depletion); and ii) at the watershed level, water quantity/quality problems, infrastructure losses and contamination.

i) Farm level

One of the impacts of present land use is soil erosion. The area enjoys quite heavy and prolonged showers particularly during the two rainy seasons. Cutting of trees for the purpose of providing lumber, fuel, yam sticks and other uses takes place regularly in the area. At present, most of the primary forest has been removed.

Survey data shows (Bockarie, 1993) that 65% of farmers had observed soil erosion on their farms. Soil erosion problems were noted regardless of farm size. Gully erosion was the frequently cited type of erosion. Twenty-three percent of farmers used trenching to control erosion. Farmers with farm sizes below 2 ha used no control.

Soils types and steep slopes, contribute to soil erosion in the project area. Although some of the soils have clayey textures they occur in steep slopes. They are eroded especially when disturbed by tillage and other operations. Measures such as clean tillage, ploughing and planting down rather than across the slope, lack of contour barriers, burning to clear the land set the stage for soil erosion.

Also, construction of roads, bridges and other structures expose the soil to erosion. In some areas this has led to landslides. Mobility in the area is constantly curtailed due mainly to poor road conditions caused by runoff from farmers' lands and poor drainage.

These soil losses remove the most fertile and productive part of the land with severe environmental and social impacts. Excessive use of agricultural chemicals applied to improve soil fertility (commercial fertilizers) and crop protection (weedicides, fungicides and pesticides) pollute water sources for domestic and agricultural purposes. Lower productivity results in higher production cost per unit produced or in higher operating costs (use of fertilizer) to maintain productivity affecting farmers' well-being. Severe erosion problems may result in

abandonment of the areas or a switch to other use which could be less productive, the need for often establishing new plots and abandoning older ones, gullying in fields, as well as causing sedimentation downstream and streambank erosion.

A summary of the farm level environmental losses is presented in Table 1.4.

Table 1.4 Soil and biomass losses

Land Use	Area[a]	Excess Soil Losses[b]	Excess Biomass Depletion[c]	
	has.	tons	tons	(duration[d])
Clear Cropping	271	4387	5284.5	(3 yrs.)
Mixed Crops	4757	168683	92761.5	(2 yrs.)
Pasture [e]	347	-	2707	(4 yrs.)
Bush [e]	1017	-	3966	(6 yrs.)
Forests [e]	871	15251	1698	(8 yrs.)
TOTAL	7263ha	188321t/yr	106417t/yr	

[a] From Table 1.1, column 1992 Pg. -7-
[b] From farm production models(excess erosion x area = excess soil losses
[c] Excess biomass depletion:(area x potential biomass production) x (average yearly model biomass extraction / potential biomass).
[d] Period estimated needed for return to normal biomass production.
[e] No overgrazing and no excess soil losses.

The improvements in management suggested include contour planting and cultivation, provision of overstorey crops which shield against rainfall impacts and whose roots also improve the soil's permeability, and the establishment of one hedgerow barrier (Quickstick or Pigeon Pea on the contour) no less than every 100 meters of slope distance.

The estimates above used to indicate the period needed to regain biomass productivity is based on the period using a cropping pattern which harvests more than a fully stocked hectare could produce naturally. Clear cropping seldom fully occupies the cultivated plot and the natural succession of vegetation which follows abandonment is slow on these eroded fields. In the case of pastures, bush and unmanaged secondary forests, these have little or no soil losses; their biomass production, however, is lower than it could be (estimated as only 80% of the potential

for pasture, 90% for bush, and perhaps 95% for unmanaged secondary forests).

These present day on-farm losses for the project area (7,263 ha.) have been valued in the following manner:

Soil erosion and reduced farm production have their opportunity costs appraised by direct comparison with their sustainable alternative. This means that for each hectare in -

- clear crops
  . loss of JA$ 23,400/ year ($34,300 - $10,900)
- mixed crops
  . loss of JA$ 12,100/ year ($24,700 - $12,600)
- pasture
  . . loss of JA$ 11,400/ year ($13.900 - $ 2,500)
  compared to permanent tree crops
- forests
  . . loss of JA$ 5,588/ year ($6,500 - $ 912)

With no changes in land use patterns, (actual land use area, Table 1.3) then, today's value of accumulated production opportunities lost is estimated to total JA$ 78,407,044 (the losses above multiplied by today's area in each use category.[14]/ It is possible to estimate on the basis of this, that for each ton of soil lost has an estimated negative impact of JA$416.3 ($78,407,044/ 188321t, from table 1.4 above) on crop production.

Biomass that is not produced in one form could possibly be available in some other form: but the absolute absence of potential biomass for some period is a real loss. This means that potentially biomass not produced in -

-clear crops is a loss of JA$ 1,943/ton for no less than 3 years
-mixed crops . . loss of JA$ 2,000/ton for no less than 2 years
-pasture . . loss of JA$ 1,563/ton for no less than 4 years
-forests & bush . loss of JA$ 464/ton for no less than 8 years

The total estimated loss due to biomass depletion after cropping is abandoned is calculated at 1,943 x 5284t + 2000 x 92762t + 1563 x 2707t + 464 x 1017t + 464 x 871t= JA$200,896,882 during the first year (the above losses multiplied by today's biomass losses, incise a). Later, and according to the particular rehabilitation program which allows the regaining of natural productivity levels, this figure would be less in following years.

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[14] (J$23,400 x 271 ha) + (12,100 x 4,757) + (11,400 x 347) + (5,588 x 1,017) + (5,588 x 871)= 78,407,044.

Since the problems of land and environmental degradation have linkages, crop mixes and cultural practices implemented by farmers in the upper watershed areas directly affect those in the middle and lower sections and other areas inside and outside the watershed. The damage to the Rio Cobre Dam during the flood rain of May, 1991, has had a multiplier effect in that it stopped the supply of water to farmers on the plain. This results in appreciable economic loss.

ii) Watershed level

Tangible evidence of environmental degradation are the costs incurred in maintaining the present conditions of the watershed. Current investment levels needed, or increased operational costs needed, are good estimates for relating to today's level of watershed degradation.

Because water is one of the main natural resources of this ecosystem, it is natural to consider its impact. Water problems are important to evaluate because they affect health, infrastructure and security, as well as agriculture production.

a) Drinking water is necessary for all households in Rio Cobre. The HASP baseline survey[18]/ gives information about drinking water, including that typically most get their water from over 1 kilometer from the house, presenting a social problem, and that it is of uncertain quality. Installed piping for drinking water supply has been abandoned in over 30% of the watershed. The estimated costs of this aspect is estimated and prorated so that a first year's cost of JA$ 1M[19]/ is identified and accumulated with the other environmental impacts in Table 1.5 below.

b) Irrigation water shortages have been reported (World Bank, 1993), and with particular reference to downstream areas supplied by Rio Cobre and its tributaries. The map "Location of Irrigation Plains and Swamps in Relation to Rainfall Distribution" identifies Clarendon Plains and St. Catherine Plains as important. Water shortages have resulted in 1992 in a reduction in area planted to sugarcane, and lower yields in planted areas. The impact of these problems during 1992 are estimated in about JA$ 6M.

c) Damages in the watershed caused by watershed erosion, flooding and sedimentation are likely to be self-correcting under

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[18] Question 41, processed for this study.

[19] An estimated cost of about US$ 45,500 in US$ exchange rates of 1992.

good conservation management. The damages and maintenance encountered in Rio Cobre during 1992 relate to the repairs to the dam on Rio Cobre, the cleaning of landslides and the construction of roads of feeder roads. The impact of these problems during 1992 were estimated in about JA$ 280M and accumulated with the other environmental impacts.

d) Conservation actions to stabilize streambanks, and roadsides are useful to avoid the continued high maintenance costs (as noted above in c.). Actions carried out in the Rio Cobre watershed for conservation include cost of reforestation and the construction of retaining walls. These cost were estimated at about JA$ 24.5M and accumulated with the other environmental impacts.

e) Localized contamination by garbage and other non-recycled refuses can be eyesores, as well as foci for infectious diseases. This social-environmental problem when present should be estimated and accumulated with the other environmental impacts. At the time of conducting this study, plans to develop such infrastructure were not known and cost information estimates were difficult to obtain. No cost has been included for this environmental impact.

f) Fertilizers, insecticides and pesticides are indicators of ecological imbalances, which in the future would be reduced through technologies such as minimum tillage, crop rotations and use of insect repelling species. The HASP baseline survey gives information about farmers usage of chemicals and farmer's observations of agro-chemicals.[20] The estimate of current overuse is significant and is accumulated with the other environmental impacts.

In summary, the estimate of basic environmental impacts of the present agroforestry land use pattern presented in Table 1.5 could be considered a conservative estimate given that no estimate has been included for the environmental impact of non-biodegradable garbage. Furthermore, it is clear that future negative environmental impacts will be even greater if there are no changes to more sustainable and conservation kind land use patterns within the watershed.

6. Social Impacts in the Rio Cobre

Social impacts related to the agroforestry nature of land use are grouped into two general types: first, purchases of certain goods or services which are felt necessary and are not provided for in the community, and second, additions which the

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[20] Questions 20, 21, 24 and 41.

people find necessary so as to continue in the community, or watershed.

a) Outside purchases which seem basic for people who are maintaining their residence within the watershed could be calculated for 1992 for items like cooking fuels. This expense is an important social cost to consider since the farm system could easily supply sufficient firewood.

b) Additions in time or money which help support the living conditions in the communities, or on the farms, are another kind of social cost. Considerations of extra time spent gathering firewood, or additional support in cash or products from outside donors may be significant to the communities.

In summary, the estimate of basic social impacts of the present agroforestry land use pattern are accumulated for the year 1992. This should be considered a conservative estimate given that no quantification has been included for social costs of reduction of land values in real terms and loss of tax revenues, or the additional cost of health care due to contamination and pollution. As was true for environmental impacts, it is also clear that future negative social impacts will be even greater if there are no changes toward a healthier, economically satisfying community, which itself is more sustainable and conservation kind. The inevitable increase of population pressures must be taken into account.

Finally these accumulated direct, indirect and opportunity costs could be summed. The total impact is presented in Table 1.5.

Table 1.5 Total impact of present land use in the project area
(Values in J$000, Year 1992)

A. PRODUCTION ASPECTS	
Production impact of actual land use[a] /	$ 90,418.00
Subtotal	$ 90,418.00
B. ENVIRONMENTAL ASPECTS	
1. Erosion[b]/	$ 78,407.00
2. Biomass Depletion[b]/	200,897.00
3. Drinking water improvements within watershed annual[c] /	1,000.00
4. Irrigation water shortages outside watershed	6,000.00
5. Damages to infrastructure (dams, roads)	
Repair and maintenance of Rio Cobre dam	126,130.00
Road maintenance and repairs	154,252.00
6. Landslides and stream bank erosion (protection)	
Dredging of river beds	2,248.00
Repair of retaining walls	180.00
Flood warning system maintenance	24.00
Reforestation and protection	22,117.00
7. Fertilizer and Pesticides used	5,600.00
Subtotal	$ 596,855.00
C. SOCIAL ASPECTS[d] /	
1. Purchase of outside lumber	4,000.00
2. Purchase of cooking fuels	810.00
3. Added time for firewood and water collection	7,500.00
Subtotal	$ 12,310.00
OVERALL IMPACT	
ESTIMATED TOTAL OF AVOIDABLE LOSSES (J$000) . . .	699,583.00

[a] From item 4, page 13 and table 1.3
[b] From 5., item i)page 16
[c] Values for items 3 to 6 correspond to approximately the total area of the Rio Cobre watershed. Therefore, the contribution of the project area to those values is lower than reported in the table.
[d] Values for items 1 to 3 correspond to the project area and are based on 6,000 farms.

This grand total of production opportunities lost and the environmental and social costs incurred, then, are the appraised value of the impact that the present land use pattern has for the project area. The costs and investments needed represent the costs to maintain the present poor state of the project area.

Environmental losses (just taking into consideration erosion and biomass only) are first in monetary terms followed by the production impact. The social impacts are also notable. The changes in present land use suggested in the farm models would significantly reduce these losses and erosion could be controlled to reasonable levels. The production impact shows that through changes in land use over time gross income for the project area would more than double. This change in land use will result in increases in employment and higher returns to farmers labour and capital.

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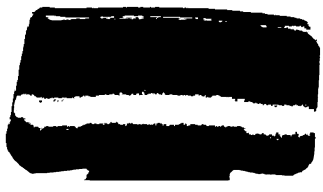

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