A2/JM - 94/002
ISSN - 0534 - 5391

IICA

IICA'S ADAPTIVE RESEARCH PROJECTS ON HILLSIDE AGRICULTURE IN JAMAICA

Prepared by: Irving E. Johnson

December, 1993

PRESENTATION

Over more than a decade the IICA Office in Jamaica, with the collaboration of the Ministry of Agriculture (MINAG) and different national and international organizations, has jointly conducted adaptive research projects. This report is a synthesis of this institutional experience specifically on hillside agriculture.

The document partially describes lessons learned and strategies and methodologies used. It also suggests some critical components for on-farm adaptive research to address small hillside farmers needs. It is especially important for developing appropriate technologies for small limited resource farmers in fragile natural resource environments.

IICA/Jamaica acknowledges and greatly appreciates the dedication of the technical and support staff involved in this endeavour. Special recognition to MINAG; specifically the Research and Development Division, national, regional, international organizations, bilateral agencies, and the hillside farmers of Jamaica for allowing IICA to contribute to the understanding and development of strategies for a more sustainable and new hillside agriculture, thus strengthening the institutional systems engaged in the hillside agricultural development effort in Jamaica.

Armando Reyes-Pacheco
Representative
IICA Office in Jamaica

TABLE OF CONTENTS

IICA'S ADAPTIVE RESEARCH PROJECTS ON HILLSIDE AGRICULTURE IN JAMAICA

Prepared by: Irving E. Johnson

I. OBJECTIVES

The broad objective of this document is to provide a synthesis of the Inter-American Institute for Cooperation on Agriculture's (IICA) Projects on adaptive agricultural research in terms of lessons learned and methodologies developed. Brief attention is also given to the applicability of the lessons and methodologies for enhancing agricultural development elsewhere in the Caribbean.

The specific objectives are to prepare:

(i) a synthesis of the research projects with particular reference to sustainable agriculture and natural resource management;

(ii) a description of the methodologies used in adaptive agricultural research activities for hillside agriculture in Jamaica; and

(iii) based on lessons learned, a generalizable methodology on adaptive agricultural research.

II. BACKGROUND

There has been more than a decade of on-farm adaptive research (OFAR) in Jamaica that results from MINAG/IICA implementation of donor-funded projects. The Government of Jamaica's (GOJ's) recognition of the importance of hillside agriculture resulted in a joint effort in March, 1978, to prepare and deliver an intensive short-course titled "HILLSIDE FARMING TECHNOLOGY" to technicians from MINAG, other Ministries, as well as non-Ministry representatives.

This technical course was given concurrently with MINAG/IICA's initiation of the ALLSIDES PILOT PROJECT (APP) which dealt with lands in the parish of Trelawny, recently bench-terraced, and focused on strategies designed to enhance development of hillside agriculture. The APP provided opportunities for adaptive research on hillsides with implications not only for agricultural production but also for natural resource management. This project was followed by two other major projects implemented by MINAG/IICA namely - The Cropping Systems and the Hillside Agriculture Sub-Project (HASP), which had hillside adaptive research components.

III. OVERVIEW OF JAMAICAN AGRICULTURE

A prerequisite for discussion of adaptive research for hillside agriculture in Jamaica is an examination of the agricultural sector and the various elements of the national economy and infrastructure that affect its performance.

Jamaica is characterized by a hilly, rugged topography occupying an area of approximately 4,400 square miles (11,396 sq. kilometers). Of the land surveyed (1970), 16% was assessed to be the flat or gently rolling; 34.7% having slopes up to 20°; 20% having slopes from 20° to 30°; and 29% slopes steeper than 30°. (See Annex II - Table 2.)

Land used for agricultural production and for pasture accounted for 46.5% of the total area, while forest and other woodland accounted for 43.9%. (Annex II - Table 1.)

The 1978/79 Agricultural Census recorded a total farm area of 1,327,000 acres (537,250 hectares), farms under 25 acres accounting for 75% of the number of farms and 15% of the acreage in farms.

The distribution of farms by number, acreage, and by major agricultural income activity, and the derived average farm sizes, are shown in Annex II - Table 4. The data highlight the skewed distribution of land with respect to farm sizes, size groups and number of farms.

The agricultural sector is divided into five sub-sectors, namely:

- Export Agriculture (traditional).
- Domestic Agriculture (including non-traditional exports).
- Livestock and Hunting.
- Fishing.
- Forestry and Logging.

The major land use next to forestry (largely natural and un-improved) are export agricultural crops, livestock (plus improved pasture) and domestic food crops.

Export Agriculture

Traditional export crops, so designated due to a long-standing ability to generate foreign exchange through assured markets, include commodities such as sugar, banana, coffee, citrus, pimento (Allspice) and cocoa.

Domestic Agriculture

During the era of British colonization and the associated slavery-based plantation system, slaves, freed-men and their descendants migrated to the hills for safety reasons and in due course developed a pattern of hillside agriculture. This involved the development of mixed cropping systems and the largely subsistence agriculture which ensued.

The Hillside Farmers employed intensive means of cropping lands which, ordinarily are not recommended for

agricultural purposes, except when appropriately soil-conserved. The multi-cropping systems, however, had certain advantages, specifically those relating to increasing the statute acreage as determined by the Land Equivalent Ratio, and also increasing total use of soil nutrients and other amenities. In view of the erosion associated with hillside farming as identified in Jamaica, any structured system for its expansion implies the necessity to under-pin the agronomics pursued with built-in or integrated appropriate soil conservation measures.

Currently, these hillside lands produce over 35 food crops of economic significance as recorded by the Data Bank and Evaluation Division (DB&ED) of MINAG. The cropping systems that have evolved are diversified to hedge against risks. A major limitation apart from inaccessibility is the shallow and rocky soils which prevail over most of the hilly areas. The predominant soils (Classes III and IV) are suitable for intensive cultivation only with major erosion control measures. On the basis of land classification, the hillsides should be used for tree crops, pasture and forestry not annual food crop production. Unfortunately, the competitiveness of tree crops with short-term cash crops that better meet farmers' cash flow needs is an issue.

Non-traditional exports (NTE), which include a small number of tubers, vegetables, fruits, largely for ethnic population in the North American and European markets, constitute approximately 5% of the domestic food crops produced.

Forestry

Forestry, which occupies the largest percentage of the land area is primarily a public sector activity. However, in recent decades there has been development of forest industries (i.e., Forest Industries Development Company, FIDCO) on a commercial scale. Continuing mis-use of forest lands has resulted in noticeable weather changes, drying up of many streams and accelerated soil loss due to deforestation, resulting in problems such as decreased fertility, siltation, increased gully formation and flooding.

Livestock

Jamaica produces a wide range of livestock for food, namely dairy and beef cattle, pigs, poultry, goats and a small number of sheep. Beef and dairy cattle occupy the improved pastures as well as most of the un-improved pasture land.

Performance of the Agricultural Sector

This section deals mainly with the domestic agriculture sub-sector since it encompasses much of the country's hillside agriculture.

The importance of the domestic agriculture (Domestic Food

Crops - DFC) sub-sector accounts for over 80% of the food crops produced for domestic consumption, its contribution to import substitution, generation of employment opportunities and farm income, and ultimately its accounting for nearly one-half of the Agricultural Sector's GDP, constant prices, 1974. (See Annex II - Table 5.)

Over the decade 1981 to 1990, comparative GDP values for the Agricultural Sector's five (5) sub-sectors were as follows:

Table 1. Agricultural Sector Gross Domestic Product (GDP*), by Sub-Sectors, Jamaica 1981-1990

Sub-Sectors	Avg. Annual GDP 1981/90 (%)	GDP Range (%) 1981/90 High	Low
Domestic Agriculture	49.2	52.6	44.0
Livestock & Hunting	29.7	36.5	26.6
Export Agriculture	15.1	17.0	13.5
Fishing	5.1	5.9	4.2
Forestry & Logging	0.9	1.4	0.2
Total	100.0		

* GDP in constant prices, 1974
Source: Annex II (Ibid) Table 5

Thus, domestic agriculture production factors and inputs demand much consideration, particularly in maintaining and managing natural resources, but also developing human resources to pursue activities designed to exploit food crop production on hillside lands on a sustainable basis.

The better grades of agricultural land are used for the production of export crops, orchard crops and livestock, relegating the production of domestic food crops to the hillside lands which are less fertile and prone to accelerated soil erosion.

There are many agro-socio-economic factors determining the agricultural performance on these hilly lands. For example, the high average age of farmers near to 60 years, affects output when labour is largely if not entirely manual. Many small farmers in the hillside areas rely on off-farm income sources. On small farms, available family labour is restricted and the cost of hired labour, if available, is high relative to the return to small-farm enterprises.

Ownership of land is largely of a freehold nature, but is supported by varying degrees and types of leasehold tenure.

An associated factor is the extent to which legal entitlement to land is lacking. This inhibits the participation by many farmers in development programmes.

Agro-socio-economic surveys conducted jointly by MINAG and IICA have shown that productivity is low, yields per acre being usually lower than many of those in regional countries producing under similar conditions. Increased production is often due largely to increased acreage.

Significant improvement in technology is necessary and this requires on-farm adaptive research to produce technically and socially appropriate technologies. While the farming systems throughout the hillside areas vary, one factor characterizes them all -- the lack of improved technology. While the existing systems work for subsistence purposes, they do not suffice for improved production, increased incomes and expanded employment. In the absence of soil erosion control, the basic resource of agricultural production is being depleted.

IV. IICA'S INVOLVEMENT IN HILLSIDE AGRICULTURE

IICA's involvement in hillside agriculture in Jamaica began with the identification of areas in which it could provide support for the national effort to address problems associated with agricultural development. The important roles played by the domestic agriculture sub-sector, which is largely associated with hillside agriculture, determined IICA's emphasis on this area.

The areas of collaboration identified were those related to the development of hillside agricultural technology for achieving more intensive use of hillside lands for food crop production, while protecting the natural resource base and the environment through appropriate farming systems.

A characterization of the hillsides was initiated by the establishment of an information base. The major subjects identified and on which information was collected were:

(i) Hillside Agriculture and Technology

- Land, soils, land use & tenure classification, land settlement; farming area and farm sizes, farmers;
- Watersheds;
- Conservation of land and soils;
- Hillside agricultural practices;
- Crops and cropping systems;
- Problems and limitations;
- Performance.

Land characteristics dictated that soil conservation measures be accorded as an integral part of any agricultural activities carried out on hillside lands,

especially in hillside agriculture; virtually synonymous with small-farm agriculture. Suitable incentives and/or assistance were to be provided to encourage implementation and maintenance of soil conservation measures.

(ii) Agricultural Research

- Agricultural Research relating to hillside agriculture;
- Fertility assessment of soils, adaptive research on crops and soil relations;
- Varietal trials and experimental designs for main hillside agri- cultural crops;
- Cropping and farming systems and their potential for increasing farm output and income;
- Introducing livestock enterprises into farming systems;
- Planning, undertaking and evaluating experiments on station and on farms;
- Soil conservation, comparative response to various cropping systems;
- Comparative soil loss using different soil conservation measures;
- Using tree crops to re-enforce soil conservation methods and to preserve the environment.

(iii) Support Services

- Extension services; supervised farming practices;
- Broadening information base, including activities in training research, surveys (agro-socio-economic);
- Production and marketing studies for major hillside crops;
- Plant protection;
- Credit facilities/ systems, arrangements;
- Co-operative activities;
- Case studies, Seminars, Field trips, Workshops, Demonstrations;

This was required to determine areas for adaptive research for hillside agriculture (ARHA) in Jamaica.

1. Identifying areas for participation

Initially IICA and MINAG could best participate in joint activities related to hillside agriculture in the following areas:

. Intensive Short Course on Hillside Farming Technology, March 1979.

. Designing, implementing, monitoring and evaluating cropping systems developed in the Allsides Pilot Project (APP) on bench-terraced land. This was later extended to include non-bench terraced land at the Olive River site, (May 1979 onwards) to find a lower-costing alternative to bench-terracing.

. Case studies on Hillside Agriculture for:

(i) The Allsides Pilot Project (APP) in Jamaica - Development Potential of Hillside Agriculture, Case Study presented at Seminar

in Rural Development, Iowa University, Ames, Iowa, USA, September, 1980.

(ii) Experience of Jamaica in the Management of Agricultural Production on Hillsides, Seminar, Juarez, Peru, June, 1981.

(iii) Agricultural Production, Allsides Pilot Project (APP), Case Study presented at the Inter-American Congress of Food and Production, September 1981.

The APP, initiated in March 1976 and implemented in 1977, covering the period until 1982, was used as the basis for the preparation of the Pilot Hillside Agriculture Project for Southern Trelawny (financed by the IDB). IICA designed and engaged in joint-venture Adaptive Research in Hillside Agriculture (ARHA) for enhancing production performance in agriculture.

. Collaborated with national technical personnel in joint-venture organization and conducting of seminars workshops, training courses, (including the provision of resource personnel).

. Determined production potential of soils in project areas (using a micro-plot technique).

. Participated in joint action (MINAG/IICA) in Cropping Systems Project, responsible for:

(i) varietal testing of selected food crops - roots, vegetables, grain legumes;

(ii) facilitating the conduct of production and marketing studies for major crops grown on hillsides;

(iii) project evaluation;

(iv) conducting relevant agro-socio-economic surveys.

2. Research Strategy

Overall the research strategy was to pursue short-term adaptive research in areas designed to provide answers where information was limited or non-existent.

IICA/Jamaica participated with MINAG in several activities as part of a holistic approach towards adaptive research, through project formulation and implementation.

The main activities covered were associated with the following projects:

- Allsides Pilot Project (APP).
- Pilot Hillside Agricultural Project (PHILAGRIP).
- Cropping Systems Project
- Hillsides Agriculture Sub-Project (HASP).

V. ALLSIDES PILOT PROJECT (APP)

1. Background

South Trelawny is one of the major yam producing areas of Jamaica. Traditionally yams were produced on lands often steeper than 17° under conditions of heavy annual rainfall. Consequently there was an escalation of soil loss through erosion and the concomitant reduction in soil fertility and productivity.

FAO/MINAG's Soil Studies Project at Cascade in the Parish of Hanover estimated annual soil loss from 17° slope lands without soil conservation, measures to be 54 tons per acre (136 tones per hectare). There was a comparable soil loss of 7.3 tons/acre/year equivalent to 18.3 tones/hectare/year from bench-terraced land, with an accompanying increase in soil fertility and productivity.

As a consequence GOJ embarked upon a programme of bench-terracing as the favoured soil conservation measure.

2. The Project

MINAG selected the bench-terraced GOJ owned land located at Allsides in the Parish of Trelawny for the project site. The adaptive research was largely to develop and utilize measures for extending improved soil conservation measures and cropping systems, while providing a number of agro-socio-economic benefits. The Project was initiated in 1976, implemented in 1977 through 1983.

3. Objectives

The overall objective was to enhance the knowledge on hillside farming and cropping systems conducive to changing the traditional pattern of hilly land farming.

The Specific Objectives were to:

- increase levels of production and productivity;
- increase farm incomes;
- enhance nutritional profiles of farm families;
- increase opportunities for rural employment; and
- identify an alternative and less costly soil conservation measure than bench-terracing.

From the outset IICA-Jamaica collaborated with MINAG in joint-venture arrangements for designing, implementing and developing the Project and for undertaking the assessment and evaluation of several (22) mixed cropping systems used at the start. The APP was originally programmed for a period of four years but inclusion of the sub-project at the Olive River station to undertake comparative studies using non-bench terraced soil conservation practices extended the project life to about six years.

4. Organisation

A coordinating committee with overall project responsibility consisted of MINAG's Director of the Western Agricultural Region in which the project was located, the Director of Soil Conservation, the Parish Agricultural Manager for Trelawny and the IICA/Jamaica Office Representative. This committee directed a Field Execution Committee which was the main implementing mechanism and which had charge of a field unit.

IICA had responsibility for providing technical assistance to the agronomic activities (linked with the soil conservation activities) and the performance of the cropping systems developed. Through a Korean technician assigned by the Korean Government, IICA provided leadership (in joint-venture arrangements with MINAG) for establishing the soil conservation measures at Olive River and for studying the results when non-bench terraced methods were adopted. IICA also executed the agro-socio-economic survey for the APP area.

5. Achievements

The project's evaluation indicated that through the cropping systems adaptive research approach important technologies were developed appropriate to soil conditions of the crops produced by farmers, as well as development of a livestock element in their cropping systems.

The project also provided administrative experience and training in various aspects of planning, co-ordination of small farmers agricultural project activities and contributed to institution-building. In specific performance terms the following results were achieved:

- a reduction of the number of cropping progressively systems from 22 to 8;
- a tripling of the quantity of useful biomas produced;
- a doubling of net farm income;
- an enhancement of the nutritional profile of farm families;
- a significant increase in employment opportunities;
- early adoption by some farmers of elements of the improved cropping systems developed.

6. Olive River Sub-Project

Bench-terracing measures were found to be very expensive under Jamaican conditions, resulting in an interest in identifying more cost-effective measures. A site was selected at Olive River in the Parish of Trelawny, some 6 miles from the Allsides project to develop non-bench terraced measures in association with appropriate farming systems.

Activities for this sub-project included:

- Construction of run-off plots (infrastructure).

- Assessment of rainfall profile-intensity, frequency and total precipitation.
- Measurement of soil loss.
- Sampling of sediment.
- Testing selected production cropping systems.
- Developing cropping systems.
- Constructing soil conservation structures.

These elements were unique in that they brought together a structured approach included planning and evaluation, linkages between agencies, and ability to develop bench marks for comparative purposes to provide a basis for future planning.

The advantages of the Olive River site included nearness to Allsides, similarities in conditions relating to slope categories, soil types, physical features, weather, and crops grown in the Allsides area, particularly yams. A sub-project was formulated for testing and developing appropriate multi-cropping production systems using alternative soil conservation measures to bench-terracing, emphasizing results from three main variables namely: Production, Soil Conservation and Costs.

The soil conservation measures applied, using as a control individual mounds (the traditional method of planting yams, the major regional crop) were continuous mounds, grass buffer strips and hillside ditches.

Elements of the adaptive research methods pursued at Allsides were applied at Olive River in determining soil nutrient status, crop suitability and fertilizer requirements, as well as other production inputs.

7. Elements considered in formulating APP

The main elements considered in the implementation and formulation of the APP included:

- National programmes and institutions;
- Problems and limitations of agriculture;
- Role of adaptive research in generating a body of knowledge in hillside agriculture technology;
- Technology transfer;
- Farmer involvement;
- Collaboration between personnel of national institutions and IICA-Jamaica.

8. Recommendations

Important recommendations were made with respect to:

- Development of watershed areas into management units;
- Package of projects to be productive, social and institutional;
- For joint efforts, the formal division of responsibilities between collaborators is important.

9. Institution-building

The strategy pursued involved:

- Working in tandem with agencies of MINAG to improve institutional performances;
- Demonstrating the ability to produce results in the field;
- Making the findings generally available;
- Assisting in building national capabilities for programming and implementing projects.

10. Major Accomplishments

- Significant improvement in the potential for agro-socio-economic performance, due to the significant increase in output.
- Developing a body of previously unavailable knowledge on profitable production systems for making more effective and efficient use of soil and water resources in hilly zones.
- Renewed desire for spreading the use of systems developed through field days, seminars, etc.
- A proposal for increasing the target area and expansion of the pilot experiment through a larger area - Pilot Hillside Agricultural Project (PHILAGRIP) which was expected to be the forerunner of a National Programme for Hillside Agriculture.

VI. CROPPING SYSTEMS RESEARCH PROJECT

1. Rationale

The rationale for the implementation of a cropping systems research project in Jamaica was predicated on two important factors:

(i) Investigations by the Agricultural Research and Development Division (AR&DD) of MINAG being confined to only a few of the crops traditionally produced for domestic consumption. Research for export crops (sugar cane, bananas, coffee, cocoa and coconut) was pursued mainly by Commodity Specific Statutory bodies operating outside the framework of MINAG's AR&DD.

(ii) Most small farmers producing domestic food crops through complex farming systems lacked ready access to the results of the research generated.

Much of the technology was developed for a wide variety of crops on research stations with little adaptive research being done on farmers' holdings. It was concluded that the uni-disciplinary mono-crop approach pursued had not succeeded in effectively addressing the complex interactions within existing cropping systems. Also, rather tenuous linkages between Extension and Research Development resulted in relevant technology not reaching the small farming sector. Of several options

considered for solving the problems, the Farming Systems approach was considered the most interesting alternative for generating technology appropriate for small farmers.

The project was one of the earliest efforts in Jamaica in which a farming systems research (FSR) approach was used. In 1984 the International Development Research Centre (IDRC) approved a grant for IICA and MINAG to undertake the project for a period of three years. In 1987, a second three-year phase of the project was funded.

2. Objectives

Overall objective

Test the feasibility of applying a Farming Systems Research/ Extension (FSR/E) approach for generating and transferring technologies adaptable to small farmers producing on Jamaican hilly lands.

Specific Objectives

The specific objectives were to:

(i) Initiate and implement a structured farming systems Research (FSR) programme in two different ecological zones of the St. Catherine Land Authority.

(ii) Initiate and support adaptive research and a programme for technology generation.

iii) Improve production and productivity through improvement of major cropping systems in the selected areas.

(iv) Provide training in concepts and methodologies of Farming systems Research and Extension (FSR/E).

(v) Determine whether the alternative methodology would generate technologies acceptable to small farmers.

Project Initiation Strategy

The strategy formulated and applied in the project initiation included:

(i) Selection of Project Teams (Core Team and Field Team).

(ii) A two-week orientation period for project teams (one for each area selected) to discuss basic concepts and activities of an on-farm research programme, using a farming systems approach.

(iii) Provision by Extension personnel of the initial interface between the project team and the farmers.

(iv) Determination of specific criteria for the selection of participating farmers related to:

- farm suitability;
- adequacy of land to facilitate plot for on-farm trials without unduly affecting farmer's cropping programme;
- farmers' contributing (in-kind) some of the labour by assisting in planting,

weeding, spraying, reaping; and
- termination of project for non-cooperation.

(v) Selecting problems to be addressed initially from those identified through the project-preparation which remained unresolved, giving priority to deeper-rooted problems;

(vi) Verification by project teams on a continuing basis of lingering problems which existed, and gathering information on problems of which they had no previous knowledge.

3. Implementation

The CSRP was initiated in 1984 as a part of the strategy for developing a structured Farming Systems Research (FSR) programmme. IICA had responsibility for providing technical assistance, project monitoring and administration of funds. The Research and Development Division (R&DD) of MINAG had responsibility for on-farm research. Implementation was pursued through a multi-disciplinary team consisting of a Core Team and two Field Teams, one for each zone.

Workshops were organized jointly by MINAG and IICA for enhancing the Cropping Systems approach, and for facilitating its transition into a Farming Systems Research (FSR) programme. The workshops main objectives were to:

(i) Assist participants in understanding:

. Farming Systems Research and Development concepts and limitations in the application of various features of the CSRP; and

. The signification of the various processes of team-building for undertaking the FSR programme.

(ii) Assist in the identification of the skills, needs and capabilities of team members selected for implementing the FSR approach.

A major recommendation following the workshops regarded giving attention to institutionalizing the CSRP so as to enable Extension Technicians to benefit from the research being pursued under the programme.

The workshops, which preceded all field operations, provided a conceptual definition of farming systems and emphasized that low financial risk was a characterization of traditional production systems used by small farmers. Also, an initial methodology was developed for design of on-farm trials; selection of collaborating farmers; intervention on farms; problem selection; and risk-taking by farmers.

4. Overview of Project Activities

An important aspect of the project was a strategy for risk-sharing, to attract collaborating farmers to

participate in on-farm research. The strategy was one in which progressive risk-sharing was implemented, with the project bearing most of the risk of the initial interventions with the proportion of risk borne by farmers increasing over time. Thus, the increments of risk were based on reducing project responsibility and increasing farmer responsibility. It became evident that active farmer participation in the initial "project-managed" intervention stage resulted in much faster progression to the "farmer-managed" stage. The initial interventions on farms consisted of field testing new technologies in comparison with farmers' technologies.

In the first year, project activities concentrated on producing information that could improve the tubers-vegetables-legumes components of the major cropping systems in the project areas. The market orientation of farmers guided the project during the second and third years to work only with those crops that farmers could easily market.

After the first three years, an assessment of the project impact was conducted. An important finding was that the close interpersonal relationships established between farmers and researchers enhanced confidence in the results of on-farm trials, and that farmers accepted recommendations more readily than those generated on research stations. On the negative side, however, the evaluation showed that a shortage of staff and transportation, limited the pace of incorporating new farmers in the on-farm research. Also that the lack of extension counterparts slowed the rate of technology transfer to other farmers.

In phase II, the project's focus was mainly on validation of improved technologies identified in the first phase, and the use of demonstration plots. In the fifth year, technology validation and transfer continued with an effort to incorporate farmers who had not previously participated in the project. In the final year, the introduction of technologies developed or adapted in the project was carried out on a much larger number of farms than in previous years. A total of 145 farmers participated in demonstration trials with yam, potato, cabbage, green corn, coffee rehabilitation, integrated cropping systems (annuals and perennials) and poultry (small-scale broilers). All of the on-farm activities were farmer managed.

5. Achievement

A major achievement of the project was the large number of on-farm trials conducted with extensive farmer participation. As a result, experimental results appropriate to small-farmer needs were generated and disseminated to farmers within the project areas. However, this body of knowledge was not incorporated into the organi-

zational framework in a way that made it accessible to other researchers or extension staff. In short, there was little institutionalization of the project nor was there much of a multiplier effect achieved, both of which limited the transfer of project technology beyond the immediate project areas.

One reason for the lack of institutionalization of the project was that when the project ended, the trained project personnel who had become competent in FSR/E were not incorporated into R&DD. Although the third year project evaluation emphasized that the FSR programme "should be institutionalized in the Research and Development Division of the Ministry of Agriculture" this objective was not accomplished. Thus, while a methodology for OFAR was developed and implemented, and found to be effective in generating relevant hillside technologies, it was not "transplanted" into the national research system; the result was a "gap" in the system caused by the absence of an OFAR capability. When the project ended, so did the OFAR capability that had been developed.

VII. HILLSIDE AGRICULTURE SUB-PROJECT (HASP)

1. Background and Objectives

The Cropping Systems Project led to a USAID-funded project implement by MINAG and IICA -- the Hillside Agriculture Sub-Project (HASP). This sub-project, which began in 1989 and concludes December 31, 1993, is part of the Hillside Agriculture Project (HAP) and operates in St. Catherine parish. The specific purpose of the sub-project is to develop economically viable tree crop production systems which enhance sustainable income for hillside farmers while conserving watershed resources and strengthening farmer participation.

In the original project document, the final sub-project products or outputs are as follows:

* Economically efficient tree crop farming systems.
* Improved watershed management practices.
* Farmer organizations that support production and marketing activities of individual farmers.
* Recommendations on improved marketing systems.
* Recommendations for research, extension and agricultural policy to increase productivity and expand acreage of perennial crops.
* Farming systems methodology institutionalized within MINAG R&D Division.

Although many of these outputs were addressed throughout the life of the project, a plan-of-work prepared for 1993, the final year of the project, concluded that the number of on-farm trials originally planned was excessive and that

it was necessary, in order to obtain useable research results, to limit the number of trials. It was evident that even had it been possible to go directly to the field and immediately carry out OFAR, four years was the minimal time to generate reliable research results. In the case of establishment trials, many fruit trees only begin to yield in the third or fourth years. Clearly, the time allocated to tree-crop OFAR in the original project design (four years) was inadequate.

In general, the HASP approach can be described as an "Integrated Farming Systems Research and Extension (FSR/E) methodology. Working through a multi-disciplinary team, the HASP included OFAR with tree crops and companion crops; farmer organization and participation (FACTs); a Market Fair; and a pilot input supply programme (farm store and credit).

2. Project Components

Following a 1992 review of the research (OFAR) component, which was intended to provide guidelines for improving research outputs, the number of trials was limited to the following:

- One (1) ackee fertilizer trial;
- Two (2) coconut fertilizer trials;
- Three (3) coffee establishment trials;
- One (1) mango variety trial;
- Three (3) cocoa rehabilitation technological package desegregate trials;
- Fifteen (15) cocoa rehabilitation technological package trials; and
- Six (6) annual/perennial intercropping trials.

In addition, the HASP agronomic team (three researchers and three assistants) were to maintain 33 demonstration plots with the assistance of RADA extension agents.

The complete team consisted of a plant protection specialist, an agricultural economist, a rural development specialist (rural sociologist) and a project coordinator. An important project component was the economic programme which, among other things, provided economic evaluations of on-farm trials, crop optimization models and farm record keeping procedures.

Another component of the project was farmer participation through Farmer Action Committee Teams (FACTs) of which 14 were organized and maintained in varying degrees of effectiveness. Collaborating farmers for OFAR were chosen from the FACTs. Also, the FACTs, and in particular the Local Management Committee (LMC), were important in the successful implementation of a Farmers' Market Fair, intended to reduce the control of the higglers over marketing; a Farm Store, to provide ready access to inputs at reduced

costs; and a Credit Programme to provide supervised credit to a small number of farmers on a pilot basis. It is significant that an assessment of the HASP in 1993 concluded that, while the FACTs took valuable time from the research effort, they were "an excellent vehicle for empowering the farmers as stakeholders in the research and extension process" (Hildebrand, 1993).

3. Project Assesement

With OFAR, in which farmer participation is critical, there are often problems beyond the researcher control (e.g., lack of plot maintenance by farmers) which hinder the research. In the case of HASP, two factors, among others, which weakened the OFAR were high plant mortality and the fact that the three project researchers were required to carry out a large number of non-agronomic activities (e.g., farmer organization, delivery of inputs). A baseline survey of the project area, which was intended in part to guide OFAR, was delayed and not completed until June, 1993.

One of the objectives of the HASP was a farming systems research methodology institutionalized within the MINAG Research and Development Division. This is implemented at a slow pace, in large part because of the lack of research staff to implement the on-farm research as intended in the original project design which stated that R&DD should be responsible for "the management of project execution in the field" including "executing all on-farm trials." However, because of limited R&DD research capability, the HASP team were "consultants" whose link to R&DD was nominal. Nonetheless, a team of well trained technicians was developed which provides the basis for institutionalization of adaptive research in the national research system.

It was also evident that while HASP carried out OFAR and operated generally within a FSR/E perspective, it did not deal with farms in a systems fashion but instead had a tree-crop bias with only limited work done on perennial/annual intercropping. Essentially, it was OFAR with a pre-determined crop focus that resulted from the tree-crop emphasis of HAP. However, small farmers grow many different crops, both annual and perennial, usually in association. In this respect, it is significant that an evaluation of the HAP recommended that greater emphasis be placed on the farm system than the tree cropping aspect only.

The HASP strategy for farmer collaboration in research was based on "risk/management sharing" similar to the approach used in the Cropping Systems Research Project. It was envisioned that farmer participation in OFAR would progressively increase from sub-project financed/managed trials to sub-project financed/farmer managed trials

and finally to farmer financed/managed trials. Actually, farmer participation did not progress much beyond the first stage. However, while farmer financing/ management of the trials was minimal, FACT farmers, as noted above, did identify strongly with the HASP and felt that they were stakeholders in its activities. At the conclusion of HASP it was evident that some FACTs, and especially the LMC, were likely to continue to provide a mechanism for farmers to collaborate in marketing, input supply and as a means to access RADA and MINAG services.

VIII. SUMMARY OF IICA'S INVOLVEMENT IN ADAPTIVE RESEARCH HILLSIDE AGRICULTURE

IICA's overall purpose for becoming involved in adaptive research on hillside agriculture was to assist the Government of Jamaica (GOJ), through its Ministry of Agriculture, in enhancing performance in an appropriate area of the agricultural sector.

An analysis of the sector performance indicated that small farmer agriculture (domestic food crops production) was the appropriate area for mutual action by MINAG and IICA/Jamaica. Jamaican small farmer agriculture is virtually synonymous with hillside agriculture, underlining the importance of sound land use practices.

IICA's adaptive research in hillside agriculture in Jamaica coincides almost entirely with the period for which MINAG has been engaged in the topic on a structured basis. Since 1977 MINAG and IICA/Jamaica have been engaged in OFAR activities on a collaborative, joint-venture basis. The application of OFAR required establishing, maintaining and developing good working relationship with the supporting agencies that influenced success or failure (e.g., USAID). IICA has played a key role in adaptive research by assisting MINAG to obtain funding from donor agencies, providing advice, technical assistance, and leadership and managing project aspects on MINAG's request.

In terms of some lessons learned, on-farm trials have demonstrated a potential for accelerating farmer adoption. This was aided by careful identification of problems to be addressed, selection of farmers to collaborate, as well as incentives to ensure their continued participation in on-farm trials. Farmers selected on pre-determined criteria agreed to playing a transfer role to other farmers in the project areas which had a multiplier effect in terms of technology transfer. However, it was evident that if continued adoption by collaborating and other farmers was to be achieved, then farmers participating in OFAR should have borne the non-experimental costs of on-farm trials from the beginning. Unless farmers are

responsible for the "real costs" of technology and are fully involved in its management, they can not realistically evaluate it and, having become dependent on project inputs, are unable or unwilling to purchase then when the project ends.

The integrated farming systems approach was an effective mechanism for bringing together various on-farm production factors (e.g. multiple crops, improved practices, resource conservation). These in turn have been coupled with credit, marketing, and farmer organization which resulted in an integrated FSR/E approach. Another beneficial aspect has been the interface between researchers, extension agents and farmers which in addition to improving the technology generation and transfer process, assisted in identifying training needs for both technicians and farmers.

An important lesson gained from the MINAG/IICA adaptive research experience in Jamaica is the need for more attention to the institutionalization of OFAR within the ministry research division. While various technical teams drawn from MINAG and IICA have successfully collaborated on OFAR projects, often breaking down barriers inherent in joint efforts between separate bureaucracies, the formation of an adaptive research unit housed within MINAG is a must.

This was an intended outcome of both the Cropping Systems and HASP projects, and while there was within both projects a formalized delineation of responsibilities for both IICA and MINAG with R&DD responsible for conducting on-farm research, budgetary constraints limit R&DD to assume the OFAR. The importance attached by MINAG to the enhancement of small-farmer hillside agriculture based on the allocation of research resources, both human and material, to developing technology for this sector is to be fostered. The fact remains that after more than a decade of donor-funded OFAR in MINAG, at present there exists a limited capability within R&DD to design, implement and analyze on-farm research. While the explanation lies partly in the drastic funding reductions suffered by MINAG, there is also some question concerning the importance given in the national research system to the technology generation needs of small resource-poor farmers.

It is evident from the Cropping Systems Project and HASP that high priority should be given to institutional development if OFAR sustainability is to be achieved. The sustainability of OFAR is ultimately dependent on a supportive institutional framework for the generation and transfer of technology. It is unlikely that OFAR institutionalization will take place in the absence of MINAG positions dedicated to OFAR. The strong small-farmer orientation in R&DD and a commitment to developing a relevant research programme is being materialized.

IICA has perhaps contributed to the institutionalization problem in a number of ways. For example, during the course of the projects, IICA moved from being responsible for providing technical support to MINAG to becoming more the implementing agency. While this may have been necessary in terms of meeting project goals, it meant that MINAG felt little, if any, direct responsibility for the outcome of the projects.

IX. STRATEGY FOR APPLYING THE ADAPTIVE RESEARCH HILLSIDE AGRICULTURE APPROACH ELSEWHERE IN THE CARIBBEAN

1. Generalizations

A number of regional Caribbean countries, especially some of the English-speaking Caribbean countries have a similar background to Jamaica in relation to land features; settlement, occupancy and land use; scarcity of land in relation to demand; objectives for engaging in agriculture; and a relatively large dependence on Hillside Agriculture.

There is also much similarity in the crops grown and the traditional cropping systems employed as an inheritance from earlier occupiers of hillside land. Given the agro-socio-economic importance of the Hillside Agriculture Sub-Sector (HASS) the question is raised concerning the extent, if any, to which the IICA/Jamaica approach to Adaptive Research for Hillside Agriculture (ARHA) could be recommended for adoption elsewhere in the region.

In a land scarcity situation such as exists in Jamaica, emphasis is placed on more intensive cropping systems. For hilly terrain a pre-requisite is the provision of appropriate land and soil conservation measures which must be effectively controlled and managed.

The generation of technology for cropping systems developed for ultimate adoption by farmers must be fully integrated into the conservation measures. Achievement of this objective requires the pursuit of adaptive research on a continuing basis to ensure the development of technological packages which will accommodate intensive agricultural systems while conserving the land and achieving the agro-socio-economic results expected.

Any strategy for 'extending/exporting' the IICA/Jamaica experiences in Adaptive Research for Hillside Agriculture (AHRA) subsumes certain basic pre-conditions. These include an identified Hillside Agriculture sub-sector (or its equivalent), indications of its performance and a potential for its development.

2. Procedures

Identify the existence of a HILLSIDE AGRICULTURE SUB-SECTOR (HASS). Required -

indications that it exists as a recognizable part of the Agricultural Sector.

Obtain and/or prepare a Profile of HASS. This is essentially a State-of-the-Art of the HASS, the major elements of which include:

(i) Overview of HASS

- Roles
- Functions
- Policies and Objectives
- Scope and extent of area covered
- Operational and management Structure
- Liaison with other agencies/institutions
- Supporting agencies (including external agencies where applicable)
- Financing
- Achievements

(ii) Resources

(a) Natural Resources

. Land and water availability
. Physiography
. Agricultural land distribution according to land use
. Soils - main types
. Forests

(b) Human Resources

. Farmers - socio-economic aspects
. Technicians - training levels in disciplines of technical personnel engaged in Agricultural Sector in general, and HASS and ARHA in particular.
. Creation of a Unit of ARHA as an integral part of MINAG's services.

(c) Financing

. Agencies for infrastructure
. Agencies for agricultural development on hillsides

(iii) Other factors associated with land use

. Number, sizes and distribution of farms by size groups
. Land settlement, land tenure and occupancy
. Soil conservation
. Cropping systems/farming systems

(iv) Existing HASS PROGRAMME

. Major agricultural projects: cropping systems etc.
. Technology base including measures taken for improvement and expansion
. Soil conservation (included here for emphasis, but must be integrated into the total technology package)
. Farmer participation
. Performance, Achievements, Benefits
. Programme financing

X. A SAMPLE PROJECT FORMULATION

The following is a sample of the components for formulating a project on adaptive research for hillside agriculture.

1. Objectives

Overall Objective

To increase production and farm income through the application of more intensive agricultural practices while managing and maintaining appropriate soil conservation systems.

2. Specific Objectives

(i) To initiate and/or pursue adaptive research for the development of technology for intensive agriculture with minimum risk, on appropriately soil- conserved hillside land.

(ii) To develop and/or maintain appropriate soil conservation practices for defined terrains in respective areas used for hillside farming.

(iii) To develop improved cropping systems for the major economic crops produced on hillside land which support intensive farming systems for generating attractive agro-socio-economic results.

3. Methodology

(i) Integrate national and regional agencies which are administratively and functionally responsible for the Agricultural Sector in general and the Hillside Agricultural Sub-Sector (HASS) in particular.

(ii) Incorporate the agricultural ministry personnel, or their equivalent, who have functional responsibility for Agricultural Research in general and Adaptive Research in Hillside Agriculture (ARHA) in particular in obtaining state-of-the-art information.

(iii) Devise a strategy for securing and up-dating, on a continuing basis, a comprehensive data and information base.

(iv) Determine problem areas for which adaptive research is needed, indicating the additional information required.

(v) Create joint-venture activities for Training Courses, Workshops, Seminars, Field Days for Extension personnel, and for Subject-matter Specialists, Agronomists, Foresters, Soil Conservation Specialists, all having clearly defined responsibilities.

(vi) Participate in activities with multi-disciplinary groups which include representatives of support services.

(vii) Support measures for farmer representatives at appropriate stages.

(viii) A multi-disciplinary approach is required whenever feasible in:

- preparation of experimental designs;
- fertility assessments;
- varietal trials;
- evaluation of soil conservation programme;
- preparation and evaluation of cropping systems and farming systems (including livestock inputs);
- ensuring appropriate recording systems;
- preparation of reports on research findings;
- designing, conducting and preparing reports based on agro-socio-economic surveys.

(ix) Integrate National Agencies where feasible in:

- initiating and/or updating a comprehensive data base;
- designing, implementing and evaluating Adaptive Research Hillside Agricultural (ARHA) Projects;
- institutionalizing ARHA technicians into Agricultural Sector research systems;
- securing support from external agencies for research, in-service training, project financing etc.

4. Products expected

- Improved farming systems;
- Appropriate soil conservation systems;
- Awareness of the values of soil conservation in reducing soil loss and improving crop yields;
- Fuller and more effective use of farm land;
- Enhancement of expertise in ARHA and increase in number of trained persons;
- Greater involvement and adoption by farmers of improved systems;
- Increased employment opportunities;
- Improved and enhanced farm output and income and levels of living;
- Institutionalization of Adaptive Research for Hillside Agriculture (ARHA) into the National Agricultural Research Systems. (A discrete Unit should be provided for ARHA.)

ANNEXES

ANNEXES

ANNEX I

LITERATURE REVIEW

I. Documents taken as numbered from Resume Of IICA's Publications - Publication # ISSN. - 0534-5391, A2/JM-92 - 003.

1. AGRICULTURAL RESEARCH IN JAMAICA - BARKER, WAHAB, BELL, 12/77.

2. HILLSIDE AGRICULTURE - INTENSIVE SHORT COURSE - MINAG/IICA (3/78).

3. BRIEF OVERALL DIAGNOSIS OF HILLSIDE FARMING - D.D. HENRY (4/78).

4. PRODUCTION AND MARKETING OF YAMS IN ALLSIDES AND CHRISTIANA - FARQUHARSON (5/78).

5. FERTILITY ASSESSMENT OF NEWLY TERRACED LANDS - USING THE MICRO-PLOT TECHNIQUE - THE ALLSIDES CASE - MINAG/IICA - (8/87).

14. WATERSHEDS OF JAMAICA AND CONSIDERATIONS FOR AN ORDINAL SCALE OF THEIR DEVELOPMENT - H. STENNET (7/97).

15. HILLSIDE FARMING IN JAMAICA - PROCEEDINGS OF TRAINING SEMINAR - MINAG/IICA - (12/78).

16. PERFORMANCE OF RED PEAS (PHASEOLUS VULGARIS) MINAG/IICA (9/79).

17. AGRO-SOCIO-ECONOMIC SAMPLE SURVEY OF ALLSIDES - IICA (9/79).

18. AN APPROACH TO AGRICULTURAL SETTLEMENT OF HILLY LANDS - MINAG/IICA, (5/79).

19. TREE CROPS OF ECONOMIC IMPORTANCE TO HILLSIDE FARMERS IN JAMAICA - SEMINAR - MINAG/IICA (11/79).

20. PRODUCTION AND MARKETING OF PEANUTS - C. McLEAN, (11/79).

21. PRODUCTION AND MARKETING OF RED PEAS IN HILLY AREAS - J.S. JOHNSON (1/80).

23. RESPONSE OF PEANUTS ON A NEWLY TERRACED ULTISOL - MINAG/IICA, (1/80).

24. AGRO-SOCIO-ECONOMIC SURVEY - PILOT HILLSIDE AGRICULTURAL PROJECT (PHILAGRIP), SOUTHERN TRELAWNY MINAG/IICA, (2/80).

25. ALLSIDES FARMERS' PRE-COOPERATIVE - M.. WEDDERBURN (3/80).

27. THE COOPERATIVE INPUT IN THE DEVELOPMENT OF THE PILOT HILLSIDE PROJECT - M. WEDDERBURN, (4/80).

28. RESEARCH AND DEVELOPMENT OF FRUIT TREES, SEMINAR, MINAG/IICA/CARDI, (6/80).

29. TRADITIONAL SYSTEMS IN HILLSIDE FARMING - L. HENRY, (6/80).

30. PILOT HILLSIDE AGRICULTURAL PROJECT - PROJECT DOCUMENT - VOLS 1-1V, MINAG/IICA, (10/80).

31. HIGHLIGHTS OF THE PILOT HILLSIDE AGRICULTURAL PROJECT AT ALLSIDES - MINAG/IICA, (7/80).

33. THE ALLSIDES POST PEASANTS - IICA (8/80).

35. THE ALLSIDES PROJECT IN JAMAICA. DEVELOPMENTAL POTENTIALS OF HILLSIDE AGRICULTURE - IICA, (9/80).

37. ASSESSMENT OF EMPLOYMENT AMONG SMALL SCALE HILLSIDE FARMERS IN JAMAICA - IICA, (9/80).

39. IICA EVALUATION OF THE FIRST PHASE, FSB, ALLSIDES PROJECT, - IICA, (11/80).

40. SEMINAR ON MULTIPLE CROPPING - MINAG/IICA/CARDI, PROCEEDINGS, (12/80).

45. COUNTRY LEVEL ACTION PLAN (PANP) - IICA (5/81).

48. EXPERIENCE OF JAMAICA IN THE MANAGEMENT OF AGRICULTURAL PRODUCTION ON HILLSIDES - IICA, (7/81).

49. YIELD RESPONSE OF YELLOW YAMS - MINAG/IICA, (1/82).

51. CROP PRODUCTION ON HILLSIDES USING NON-BENCH TERRACING HILLSIDE MEASURES OF SOIL CONSERVATION - IICA/MINAG,(9/81).

52. AGRICULTURAL PRODUCTION AT ALLSIDES, ALLSIDES PROJECT CASE STUDY - IICA, (9/81).

56. COUNTRY LEVEL ACTION PLAN (REVISED), - IICA, (10/81).

68. OLIVE RIVER RUN-OFF PLOTS - MINAG/IICA, (1/82).

71. CROP PRODUCTION ON HILLSIDES USING NON-BENCH TERRACING ALTERNATIVE SOIL CONSERVATION MEASURES - MINAG/IICA, (2/82).

93. FARMING SYSTEMS WORKSHOP (CROPPING SYSTEMS PROJECT) - MINAG/IICA, (12/85).

II. Other documents as listed in Miscellaneous Publication # 367, Series ISSN -0534-5391, titled REVIEW OF TECHNICAL DOCUMENTS PRESENTED IN THE IICA/JAMAICA SERIES - AGRICULTURE IN JAMAICA.

1. BASIC AGRICULTURAL INFORMATION ON JAMAICA -FRITZ ANDREW SIBBLES, (1/77).

2. AGRICULTURAL PLANNING IN JAMAICA - YVONNE LAKE, (6/77).

3. AGRICULTURAL EDUCATION IN JAMAICA - DR. A.S. WOOD, (8/77).

4. MARKETING OF AGRICULTURAL PRODUCE IN JAMAICA -ULI LOCHER, (10/77).

6. LAND SETTLEMENT IN JAMAICA - JOHNSON,I., STRACHAN, M., AND JOHNSON, J., (12/77).

7. GOVERNMENT OF JAMAICA AGRICULTURAL POLICY PAPERS -MINAG (Agricultural PLanning Unit), - (2/72), (2/73), (1/73).

8. THE COMMUNAL ENTERPRISE - JOSE EMILIO ARAUJO, (2/80).

11. A NATIONAL PROGRAMME FOR THE DEVELOPMENT OF HILLSIDE FARMING IN JAMAICA - MINAG (M. STRACHAN).

III. Documents on Hillside Agricultural Project

IMPROVING WATERSHED MANAGEMENT AND INCREASING SOCIO-ECONOMIC WELL-BEING THROUGH FARMING SYSTEMS RESEARCH AND DEVELOPMENT - A MINAG/IICA SUB-PROJECT OF THE GOJ/USAID HILLSIDE AGRICULTURAL PROJECT, VOLUME I, PROPOSAL, FINAL VERSION.

ANNEX II

Table 1. Distribution of Land Area in Jamaica by Broad Use

Land Use	Acres	Hectares	%
Forest Land	655,000	265,160	24.1
Other Woodlands	538,000	217,820	19.8
Agriculture & Pasture Land	1,258,000	509,320	46.4
Natural Range & Grassland	103,000	41,700	3.8
Swamp	50,000	20,250	1.8
Mining	7,000	2,840	0.3
Urban, including built-on	100,000	40,490	3.7
Barren	4,000	1,620	0.1
All Uses	2,715,000	1,099,200	100.0

Source: Physical Planning Unit - Physical Plan for Jamaica 1970

Table 2. Distribution of Surveyed Land Area According to Slope

Slope	Acreage	Hectares	%
0° to < 2°	77,445	31,354	3.1
2° to < 5°	322,395	130,524	13.0
5° to < 10°	549,046	222,286	22.1
10° to < 20°	314,087	127,161	12.6
20° to 30°	502,231	203,332	20.2
30° +	720,368	291,647	29.0
All	2,485,572	1,006,304	100.0

Source: Department of Statistics, Census on Agriculture, 1978/79

ANNEX II

Table 3. Percentage Distribution of Land in Farms Producing Domestic Food Crops by Size Group, 1978

Farm Sizes (Acres)	Number	%
Under 5 Acres	101,967	38.3
5 to under 25 acres	95,670	35.9
25 to under 100 acres	27,141	10.3
100 to under 500 acres	17,648	6.6
500 and over	23,778	8.9
All Size Groups	266,204	100.0

Source: Basic Data from Department of Statistics Census of Agriculture 1978/79

Table 4. Percentage Distribution of Farms by Acreage and by Income Activity

Major Agricultural Income Activity	Farms		Area		Average Farm Size Acres
	No	%	Acres	%	
Export Crops	56,703	30.8	567,018	42.7	10.0
Domestic Food Crops	86,803	47.2	266,204	20.1	3.1
Mixed Crops	15,703	8.6	106,400	8.0	6.8
Livestock & Poultry	10,669	5.8	307,150	23.2	28.8
Other	6,505	4.1	36,108	2.7	5.6
None	7,585	100.0	44,165	3.3	5.8
Total	183,988	100.0	1,327,045	100.0	7.2

Source: Department of Statistics - Agricultural Census 1978/79

Table 5. Agricultural Sector Gross Domestic Product (GDP) by Sub-Sectors
Jamaica 1981 - 1990 in Absolute and Relative Terms
(GDP Unit; J$M)

Agr. Sub-Sectors	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	TOTAL	10 Yr. Avg.
Domestic Agriculture GDP	78.56	69.22	75.14	87.05	85.66	82.22	86.59	78.21	67.56	75.20	785.56	78.55
% Agr. Sector GDP	50.33	48.14	48.75	57.64	52.62	51.52	51.35	49.05	44.25	44.04	49.15	
Livestock GDP	44.07	41.28	46.13	47.50	44.17	43.74	48.02	46.85	51.30	62.25	475.31	47.53
% Agr. Sector GDP	28.23	28.71	29.91	28.18	26.59	26.99	28.47	29.38	33.60	36.46	29.74	
Export Agr. GDP	24.91	24.41	23.65	24.48	23.74	23.06	22.74	24.66	24.51	24.70	240.86	24.09
% Agr. Sector GDP	15.95	16.98	15.33	14.52	14.59	14.45	13.48	15.46	16.05	14.47	15.07	
Fishing GDP	7.68	7.91	8.07	8.08	8.08	9.43	8.97	7.60	7.67	8.25	81.74	8.18
% Agr. Sector GDP	4.92	5.50	5.23	4.80	4.96	5.91	5.32	4.17	5.02	4.83	5.11	
Forestry & Logging GD	0.88	0.96	1.20	1.45	2.03	1.81	2.33	2.14	1.64	0.34	14.78	1.47
% Agr. Sector GDP	0.56	0.67	0.78	0.86	1.24	1.13	1.38	1.34	1.08	0.20	0.93	
Agr. Sector GDP	156.10	143.76	154.24	168.56	163.68	160.26	168.65	159.46	152.68	170.74	1598.25	159.82
% National GDP	8.32	7.58	7.95	8.76	8.91	8.58	8.50	7.92	7.26	7.82	8.14	
National GDP	1876.70	1897.80	1941.20	1924.2	1836.1	1867.2	1983.4	2912.6	2104.0	2184.2	19627.6	1962.7

Source: Planning Institute of Jamaica - Economic and Social Surveys 1981 - 1990
Statistical Institute of Jamaica - National Income and Product 1985 to 1990

FECHA DE DEVOLUCION			