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AGRICULTURAL SECTOR ASSESSMENT

HAITI

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AGRICULTURAL PRODUCTION AND MARKETING STUDY FOR THE AGRICULTURAL SECTOR ASSESSMENT

HAITI

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TABLE OF CONTENTS

Page Number

I. INTRODUCTION

II. CHARACTERISTICS OF THE HAITIAN AGRICULTURE

A. Physical Characteristics of Haiti

B. Land Use

C. Farming Systems: Plain vs. Hillside Farms

D. Livestock in the Farming Systems

E. Crops Not Included in the 3rd Draft Report (Fruit crops, beans, beekeeping)

F. Labor: Role of Women in Haitian Agriculture

III. CONSTRAINTS ON AGRICULTURAL PRODUCTION

A. Technical Constraints: Water, Varieties/Cultivars Cultural Practices (soil preparation, weeding, fertilizers and pesticides, harvesting techniques, tools, etc.)

B. Other Constraints: Roads, Storage Facilities, Market, Institutional and Organizational Constraints

C. Prioritizing the Constraints

IV. FOCUS ON RESEARCH

A. Research Institutions

B. Strategy

C. Assessment of Some Recent Technical Innovations: ADS-II Project (Cayes and Jacmel, ODVA, ODN, etc)

V. CONCLUSIONS AND RECOMMENDATIONS

APPENDICES

Tables, Attachments, Figures and Maps Containing Useful Background Information on Haitian Agriculture

I. TABLES

I-1 Comparison des Cultures Pratiques dan Quatre Departments

A. Monoculture
B. Association
C. Combinaison

I-2 Contract Labor Costs by Agricultural Activity and Input Expenditures for fond-des-Freres

I-3 Contract Labor Costs by Agricultural Activity and Input Expenditures for Berault

I-4 Importations de Pesticides

I-5 Importations D'Ingrais Chimiques

I-6 Importations de Semences

I-7 Distribution of Agriculture Tools by Farm Size

I-8 Production, Area, and Yields of Principle Crops by Regions in 1979

II. ATTACHMENTS

II-1 Physiological, Disease and Insect Problems of the Major Corps Grown in Haiti

II-2 Research Service Caphado: Planting and Harvesting Seasons

II-3 Crop Suitability Zoning

II-4 Crop Zones (French)

III. FIGURES AND DIAGRAMS

III-1 Les Cultures Les plus Communes dans Quatre Departments

III-2 Calendrier Cultural

III-3 Crop Calendar

III-4 Small Coffee Farmer Planting Module

III-5 Recommendations pour la Culture sur Pente

IV. MAPS

IV-1 Haiti: Regions Physiographiques

IV-2 Eaux et Climates

IV-3 Haiti: Geology

IV-4 Crop Suitability Zones

IV-5 Sols et Vegetation

I. INTRODUCTION

The objective of this paper is to complete the 3rd draft report: "Haiti Agricultural Sector Assessment", written by the RONCO Consulting Corporation, especially the chapter on agricultural production, and the marketing section. This report assists the senior tropical agronomist and the watershed management specialist of the team.

Specific topics investigated include:

- The farming systems: hillside and plain farming systems;
- Technical constraints to major crops grown in Haiti;
- Performance and potential of the crop varieties recently introduced by the ADS-II project and their acceptance by the peasant farmers, modifications brought to the traditional cropping patterns;
- Constraints on crop production and marketing;
- Role of women in crop production and marketing;
- Perspectives: identify crops with high domestic and export value.

To fulfill this assignment we gathered data from the references of the Ag. Sector Assessment Report and others cited in the bibliography. We talked to the USAID Agricultural office staff, the people responsible for the ADS-II project, the CRDA, the Programmation Unit of the MARNDR, the Plant Protection Service of the MARNDR, the STABV, the ANDAH (Association Nationale des Agronomes Haitiens). Field trips were made to the major plains of the country and some hillside areas (Valley of Artibonite, North Plain, Plain of Les Cayes, Plain of Leogane, Plain of Cul-de-Sac, Cap-Rouge in Jacmel), where we interviewed some peasant farmers, and made some on-site observations.

We developed only the points that we considered neglected in the 3rd report, and that were included in our scope of work. The important issue of legal and illegal importations of rice, sugar and other agricultural commodities was minimized because the "Food Gap Analysis" team is doing a thorough study on this topic.

It was understood that we should synthesize rather than collect new data.

II. CHARACTERISTICS OF HAITIAN AGRICULTURE

A. Physical Characteristics of Haiti

1. Climate

Haiti is classified in the low subtropical region (18-20 degrees north latitude). It is a country free of frost at low elevations, with a temperature range wider than in the tropics, but smaller than in temperate climates.

Seventy-five percent of the land is mountainous; only 29% of the land has slopes less than 10%, while 63% has grades more than 20%, too steep to grow food crops sustainably.

The elevation ranges from sea level to 2680 M. This topography generates a wide range of micro-climates which vary over short distances, making it difficult to plan for agricultural purposes.

Precipitation characterizing most of the micro-climates is influenced mainly by the Northeast trade winds, and the rainfall patterns by the orography (CEP). The CEP, citing the Library of Congress, distinguishes seven principal rainfall areas in Haiti:

a. Northern plain and mountains: more than 1270 mm, with as much as 2500 mm on the highest mountains;

b. Northwest: semi-arid conditions prevail throughout the region, especially around Mole St. Nicolas (508 mm), on the extreme western end of the northern peninsula. Port-de-Paix receives about 1524 mm in the mountainous areas;

c. Western coast (from Mole St. Nicolas to the Cul-de-Sac Plain at Port-au-Prince): very dry with 500 to 1000 mm of rain; a semi-arid area extending back from the coast over the plain to the mountains covered with xerophytic vegetation such as mesquite, thorny shrubs, and cacti;

d. La Gonave island (off the coast): similar cover with rainfall between 508 and 762 mm;

e. The Artibonite Valley: lower portion of the valley is semi-arid, but rainfall increases rapidly up the valley until it reaches a mean annual level of about 3000 mm. However, 40 km away in the Cul-de-Sac plain, at about the same altitude, is the driest area with annual rainfall of about 500 to 750 mm.

f. The Eastern part of the mainland between the two peninsulas: the Central Plateau receives between 1016 and 1524 mm of rainfall;

g. The Southern peninsula: well-watered, with 1524 mm of rain or more in all parts, except the southern slope of the western end and a small area near Anse-a-Pitre in the southeast.

(See Annex: Georges Anglade map "Eaux et Climats" showing the rainfall amount and distribution for the seven areas.)

Although a substantial portion of Haiti receives more than 1500 mm, which could sustain successful rainfed agriculture, the variations between and within seasons make rainfed agriculture hazardous. As a matter of fact, the winters usually correspond with dry periods. It is important to notice, as the CEP pointed out, that "agricultural droughts" (periods of water stress for plants), occur in Haiti. These droughts are not due to inadequate amounts and/or distribution of rainfall, but because of the slow infiltration rate of the eroded soils (NOAA, 1979, cited by the CEP).

2. Soils

The OAS geology study describes the parent materials found in Haiti: (See Annex: Generalized Geologic Map of Haiti from OAS)

a. Limestone 1 - the typical mountain limestone which includes "tif";

b. Limestone 2 - thick yellowish soils;

c. Limestone 3 - coralliferous limestone; NB = the limestone areas account for about 70% of Haiti's land area.

d. Basalt;

e. Andecites and diacites;

f. Quartz diorites;

g. Alluvium - corresponding to the plain areas and constituting most of the good agricultural lands in Haiti.

The BDPA (Bureau du Developpement de la Production Agricole) worked out a set of maps, including soil potential and soil erosion risk maps.

Listed are several general works on climate and soils: Life Zones of Haiti by Holdridge, Agro-Ecological Classification by Holdridge, Soil Potential and Soil Erosion Risk Maps of BDPA for DATPE, Crop Suitability Zones of Hargreaves and Samani (in annex). They do not give information for crop planning on specific sites. Bill

Buffum and Paul Campbell of the Pan American Development Foundation (PADF) in December 1984, proposed a site classification based on parent material, elevation, rainfall and site quality. This classification divides Haiti into 63 site types, useful to evaluate and choose species. They divide elevation into three categories:

low - 0 to 400 meters;
medium - 400 to 800 meters;
High - 800 meters and above.

Each altitude has three rainfall categories:

dry - 500 to 1000 mm per year;
moist - 1000 to 1500 mm per year;
humid - 1500 mm and above.

Moreover, each site is divided into above average, average and below average, according to depth of soils, slope, exposure and moisture retention.

Marshall Ashley (University of Maine) of the AOP improved this classification in 1986 by adding the factor of risk of erosion, using the BDPA (for the DATPE) map.

The system of site classification needs to be improved and developed for agricultural purposes.

B. Land Use Issue

Haiti today is facing a crucial problem of erosion, resulting from land misuse and abuse. More than half of this tropical fragile country should not be cultivated because of grades over 40 %.

Slope (°)	Superficie (in has)	% of total	
0-10	808.840	30	cultivable
10-20	210.933	7	"
20-40	260.103	9	cultivable with restrictions
40 and more	1.499.124	54	non cultivable

The BDPA estimates, from photo interpretation work done between 1978 and 1980, that only 11,3 % of the country has high agricultural potential, while 31,8 % has medium potential, and 56,9 % has very low potential.

Although Haiti used to be considered an agricultural country, in fact it would be more realistic to say that Haiti should be dedicated to forestry or agroforestry since more than half of the country is adapted to perennial crops that provide permanent vegetative cover (coffee, cocoa, fruit trees, forest trees, and permanent pastures).

TABLE 2

DISTRIBUTION OF LAND BY ECOLOGICAL ZONE TYPE

A review of actual land use in Haiti reveals the reason for its declining productivity and its obvious environmental degradation.

Total Land Area	2,700,000 Ha	100 %
Cultivated areas in the mountains	556,300 "	20,5 %
Cultivated areas in the plains	351,500 "	13,0 %
Areas in pasture	500,000 "	18,5 %
Areas in evergreen species	75,000 "	2,7 %
Areas in deciduous species	160,000 "	5,9 %
Mangroves	16,500 "	0,6 %
Eroded areas without or with scarce vegetation	1,020,500 "	37,7 %
Other uses: roads, cities, etc.	30,200 "	1,1 %

Source: MARNDR, 1987 citing BDPA - actual land use in Haiti 1978 - 1980.

The DATPE (1984) gives less detailed data, but reveals about the same situation.

TABLE 3

AGRICULTURAL LAND USE IN HAITI

	HA	PERCENT
Cultivated lands	870,000	31.4
Shifting cultivated lands within pastures	300,000	10.8
Grazing lands	530,000	19.2
Forest lands	250,000	9.0
Non-cultivated lands	820,000	29.6
Total	2,770,000	100.0 percent

Source: CEP, citing DATPE (1986)

According to this table, 2 out of 3 hectares of cultivated lands are in the mountains, twice as much land cultivated than estimated by the FAO in 1983, noted the CEP. Therefore, the soil loss from the mountainous lands where food crops are grown is tremendous. The Division of Natural Resources of the MARNDR estimates soil loss at about 42 million tons per year. It is said that the soil is followed by the peasant farmers to the sea (boat people phenomenon). In 1982, the FAO estimated that about 6000 hectares was lost every year for agriculture.

Moreover, this erosion process affects also the farms in the plains, where it causes flooding, silting and damage to the irrigation systems. The problem is that land use is more determined by human factors such as land tenure, demographic pressure, and socio-economic structure of the society, than by physico-environmental factors, such as the suitability of the soil and climate to the land use selected.

C. Farming Systems

1. Important Crops Grown in Haiti

Food Crops	Botanical Name
corn	Zea mays
sorghum	Sorghum bicolor
pearl millet	Penniseotum typhoides
rice	Oryza sativa
Pulses:	
common beans	Phaseolus vulgaris
pigeon pea	Cajanus cajan
cow pea	Vigna unguiculata
Roots and tubers	
cassava	Manihot esculenta
potatoes	Solanum tuberosum
sweet potatoes	Ipomea batatas
yams	Dioscorea sp.
taro	Colocasia esculenta
Export/industrial crops	
coffee	Coffee arabica
cocoa	Theobroma cacao
sugar cane	Saccharum officinale
cotton	Gossypium hirsutum
" (indigenous)	" barbadense
sisal	Agave sisalanum
tobacco	Nicotiana tabaccum

Oil seed crops

peanuts	Arachis hypogea
sesame	Sesamum indicum

Fruit tree crops

mangos	Mangifera indica
avocado	Persea americana
orange	Citrus sinensis
lime	" aurantifolia
grapefruit	" paradise
sour orange	" aurantium
coconut	Cocoa nucifera
cashew	Anacardium occidentale
arbre veritable/arbre a pain	Artocarpus incisa
Bananas	Musa sapientum (figue-banane)
	" paradisiaca (plaintain)

Vegetable

tomato	Lycopersicon esculentus
onion	Allium Cepa
cabbage	Brassica oleracea
green peas	Posum sativum
eggplant	Solanum melongena
carrot	Daucus carota
beet	Beta vulgaris
lettuce	Lactuca sativa
watermelon	

Essential oils

vetiver	Vetiveria zizanoides
lime	Citrus aurantifolia
bitter orange	" Aurantium
amyris	Amyris basalmifera

2. Farming Systems

Two important features characterize haitian agriculture:

First, the farms are divided into small scattered plots. In fact, apart from big holdings, 28% of the farms are contiguous plots, and 47% are disseminated plots (see table on number of plots/farm). Fifty-nine percent of holdings occupy less that 1 ha, supporting 54% of the peasant population. These holdings represent 21% of the cultivated area. (See Table 5.)

The second feature is that the peasant farmer is aiming for self-sufficiency for himself and his family, selling the small portions of his production which are in excess of family needs. These two characteristics make the development of Haitian agriculture a difficult task.

3. Hillside Farming Systems

The French center of Madian-Salagnac, created in 1977, has been studying hillside agriculture in Haiti. It has undertaken some studies on the structure and the function of the peasant farming systems. Physically, they classified the peasant gardens as:

- Gardens adjacent to the home - These have good soils and the peasants maintain or increase the soil fertility. All kinds of multi-purpose plants for self-family needs are grown.

- Gardens near the home - Located beyond the adjacent gardens, they have characteristics similar to the first ones, and are gardens for home use.

- Gardens further away - Located in open fields with little shade, this is where farmers grow market sale crops. Few efforts are made to improve the soil fertility. These gardens are usually rented, sharecropped or jointly farmed lands.

- Plots far away from home - Called "goat gardens", these are lands of poor quality on which food crops such as sorghum, pigeon peas, corn, cassava, and sweet potatoes are grown.

- Gully wetlands - This is where the peasants grow bananas and taros.

There is a rationale in the farmer's choice of cropping patterns. The peasant knows his physical environment empirically, and uses this knowledge in his culture systems. He has to face a lot of constraints: irregular rainfall patterns, soil types, and altitudes, along with storage and market problems. His many crop associations (the ADS-II project found 440 different associations in Jacmel) throughout the seasons, represent ways of coping with the constraints that are ecological as well as socio-economic, such as land tenure insecurity and market uncertainty. For instance, consider a common type of culture association in the hillside farms of Haiti: corn x sorghum x pigeon peas. Since corn is more demanding in terms of water requirements, they mix it with less demanding sorghum so they can save the sorghum in case of droughty periods in the season. Sometimes, they even have two kinds of corn: a short-cycle cultivar (2 and a half months) and a long-cycle one (in Morne Cabrit). They do this for two reason: first, they have corn for a longer period, with two harvests; second, if the rainy season is short, followed by a long period of drought, they save at least the short-cycle corn. Coffee, the main agricultural commodity exported, is grown under cover in the

TABLE 4

NUMBER OF PLOTS PER FARM AND SIZE OF LOTS (1971)

Dept.	No. of Farms	No. of Plots	Plots/Far-	Avg. Plot (ha.)
Nord	106,400	200,400	1.9	0.85
Nord-Ouest	30,100	53,430	1.8	1.25
Artibonite	140,000	246,600	1.8	0.55
Ouest	177,060	312,100	1.8	0.65
Sud	163,150	305,700	1.9	0.75
Entire country	616,710	1,118,230	1.8	0.75

Source: CEP citing IHS Port-au-Prince.

TABLE 5

SUMMARY STATISTICS ON AGRICULTURAL HOLDING (1971)

Land Holdings (by hectare)	No. of Holdings	No. of parcels per holding	Total Land (Ha)	Population	Average # of Parcels per holding	Average Parcel Size (Ha)	Average # of persons per holding
1 ha & below	361,985	530,480	184,843	1,498,020	1.46	0.34	4.15
1 to 2 ha	141,930	275,510	211,940	666,180	1.94	0.76	4.69
2 to 3 ha	53,600	130,400	137,359	279,990	2,43	1.05	5.22
Cumulative %	91%	84%	62%	88%			
3 to 4 ha	27,370	74,390	96,762	143,800	2.71	1.30	5.25
4 to 5 ha	6,440	39,340	36,790	48,000	3.47	1.32	5.68
above 5 ha	23,385	78,110	193,822	143,030	3.34	2.48	6.11
TOTAL	616,710	1,118,230	863,516	2,779,020	1.81	0.77	4.50

Source: George Anglade, Espace Haitien, 1974.

TABLE 6

IRRIGABLE AND IRRIGATED SUPERFICIE OF THE REPUBLIC OF HAITI IN 1984

Geographic Department	Land Area in Ha and %			
	Irrigable (1)	Irrigated (2)	(1) - (2)	(2) / (1)
Nord & Nordeast	18,500	2,500	16,000	14
Nordwest	6,000	2,000	4,000	50
Artibonite	56,000	46,000	10,000	82
Center	20,000	2,000	18,000	10
West	50,000	36,000	14,000	72
Southeast	10,000	2,000	8,000	20
South	22,000	4,000	19,000	18
Grand Anse	4,000	1,000	3,000	25
Total	186,500	95,500	91,000	51

Source: MARNDR citing, Andre (1985).

mountains, in association with the food crops. This system is ecologically safe, since the coffee and the cover trees (Samanca Saman, Inga Vera and others) are perennial. Unfortunately, the coffee situation (government policy, market structure, price, etc.-see more details in the 3rd Draft Ag. Sector Assessment Report) did not stimulate the coffee producers and a lot of these secular coffee trees have been cut and replaced by food crops. NB: In annex are found two examples of crop associations, one with coffee and the other are food crop associations.

The main constraint of the hillside farming systems seems to be water availability, even in the humid areas (south peninsula), because of soil erosion (infiltration rate is decreased and soil volume available for water retention is reduced). Water has been identified as the main constraint by many peasants, although no systematic national survey has been conducted to identify the main constraints to agriculture.

In a latter chapter, we will see the technical innovations made by some projects to overcome this problem.

4. Plain Farming Systems

In Haiti, the irrigated areas are located in the plains. Only about half of the irrigation potential has been developed (see Table 6).

As shown in the table, the most important irrigated areas are in the Artibonite (82%) and the department of west (Plain of Cul-de-Sac, Leogane, Arcahaie).

We are not going to extend on this question of irrigated and irrigable land in Haiti, since the 3rd Draft Ag. Sector Assessment Report analyzed it more completely and included discrepancies between the different sources.

In the Artibonite Valley the farmers principally grow rice very intensively and often using intermediate technology. In the irrigated areas,the main constraint is water distribution. According to the director of ODVA (Organisme de Developpement de la Vallee de l'Artibonite), it is difficult to establish tertiary canals for water distribution to the plots, since the parcels are too small (60% of the farmers have less than half an hectare). Therefore, the down stream plots are irrigated with drainage water from upstream plots. This lack of control decreases the rice yield, and causes salinization of the lands. About 30,000 ha are cultivated in rice and 1000 are devoted to vegetables (tomatoes, onions, melon) in the valley. In the non-irrigated areas, food crops such as corn, sorghum, cassava, and sweet potatoes are extensively grown in association.

In the other major plains (Plain of Cul-de-Sac, Plain of Cayes, Plain of north, Plain of Leogane), sugar cane is the main crop (see areas cultivated in sugar from the 3rd Draft Report)*. In Les Cayes, the other important irrigated crops are corn and rice.

In the Cul-de-Sac Plain, apart from sugar cane, they grow corn, food crops and vegetables (tomatoes and eggplants mainly). Plaintains are a specialty of the Plain of Arcahaie, while export cotton is mainly grown in the Plain of Gonaives. The closure of the BNDAI plant jeopardized the culture of cotton. We have to notice that, even though some export crops are cultivated by priority in the irrigated areas of the major industrial plains, because of the proximity of processing plant (HASCO in the Plain of Cul-de-Sac, USND in the plain of Leogane, Central Dessalines in the Plain of Les Cayes, Central Citadelle in the Plain of North), food crops such as corn, rice, beans, and bananas are also grown extensively in the irrigated areas, along with some vegetable crops such as tomatoes, onions, etc. Crops that require less water, such as corn, sorghum, cassava and sweet potatoes are cultivated under rainfed conditions.

D. Livestock in the Farming Systems

Generally, livestock raising is integrated in the farming systems in Haiti. Most animals are left free to forage or are staked out. Free roaming livestock is a problem, though, since the animals damage the plantations, and the soil and water conservation structures in the steep areas. Goats, for example, constitute a real constraint to the needy conservation measures in the hillside areas.

Cattle are usually pastured on the harvested fields, to use the crop residues and forages (corn, sorghum and rice stalks). This practice has the advantage of fertilizing the soil with organic manure.

The production techniques of raising livestock are very low: peasants are not used to growing forage crops to feed their animals, or to keeping them in fenced pastures. The level of animal-raising technology is low in Haiti. The main problems are water and fodder constraints.

Cattle and pigs are considered as the saving account of the peasants for sale in such emergencies as funerals or sicknesses.

The African Swine Fever, which justified the killing of many pigs, seriously affected the peasant economy. Some observers even assume that the disappearance of pigs has accelerated the processes of deforestation, since

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* A traditional crop since colonial times.

TABLE 7

INFLUENCE OF CLIMATE, SOIL, GERMPLASM, AGRONOMIC PRACTICES, AND HARVEST/POST HARVEST CONDITIONS ON YIELDS OF 13 CROPS - HAITI

A. Hillside Farming Conditions

	Coffee	Beans	Corn	Sorghum	Cassava	S. Potato	Tomato	Peas
Climate	95	80	60	80	90	80	70	90
Soil	60	30	20	30	40	40	40	40
Germplasm	45	50	40	30	80	60	60	40
Agronomic Practices	55	60	50	60	75	70	60	60
Harvest/Post	60	70	70	70	80	60	60	70
YIELD % of Potential	30	30	20	30	35	40	40	40
Haiti Yield Avg. (kg/ha)	250	540	700	600	4,000	6,000	8,000	368

B. Plains, Irrigated

	Beans	Corn	Cotton	Rice	Sugar Cane
Climate	95	95	95	95	95
Soil	90	90	80	95	90
Germplasm	40	30	70	60	80
Agronomic Practices	40	30	65	40	65
Harvest/Post	60	70	85	65	65
YIELD %	40	25	65	40	65
Haiti Yield (kg/ha)	1,000	1,200	550	2,500	30 MT

B.2. Plains, Rainfed

Climate	70	70	75	n/a	70
Soil	80	90	90	-	90
Germplasm	50	30	75	-	80
Agronomic Practices	60	30	60	-	70
Harvest/Post	70	75	85	-	60
YIELD %	40	20	40	-	60
Haiti Yield (kg/ha)	750	800	210	-	12 MT

there are no animals to value crop leftovers such as the rotten mangos, and avocados. (They then turned to other sources of income generation such as making charcoal.) Improved pig breeds, mainly the large white, have been introduced to repopulate the country and have been distributed to the peasants. However, it seems, if we are to believe the mass media, the rhythm is low and the acceptance of the new system by the peasants is questionable. They argue that these races of pigs are too demanding to raise (habitat, feeding). In fact, many peasants are too poor to afford such expenses as processed feed and sturdy shelters for livestock whose life standing would be higher than theirs. Fortunately, the French cooperation has brought some Chinese and Creole (from Guadaloupe) offspring more suitable for their socio-economic levels.

1. Production Techniques

Half a million hectares in the country could potentially be used for pastures. However, the MARNDR tends to encourage intensive livestock raising in the Plateau Central and the Northeast, since there is not much space to grow food crops and satisfy the population needs (MARNDR 1987). This agricultural institution suggests the improvement of pastures for already tested species in the country (Parnicum, Desmonduim, Digitaria, Tripsacum, Permisetum, Melius, Stylosanthes, Pueraria, etc). This improvement could increase the number of animals raised per hectare from the present one animal per ha.

In hillside farms, the forage species are integrated in the farming systems, fulfulling double purposes: (1) soil conservation treatment when they are planted as hedgerows in contour; (2) fodder from the trees cut and brought to the animals kept in fenced pastures. The construction of cisterns all over the watershed areas would allow the main water shortage constraint to be overcome and avoid long trips by the peasants with their cattle in search of water. Adequate feeding could considerably increase livestock production. The FAO, according to the MARNDR, has proven that indigenous cows could improve their milk yields from 3-4 liters/day to 10 liters. Moreover, the Zebu, as already shown could genetically strengthen the qualities of the indigenous cattle and is adapted to the physical and socio-economic conditions of the peasant farmers. As for work, the buffalos tested in Artibonite for the ploughing are more efficient than cattle. In the Les Cayes Plain, anthrax is seriously affecting the cattle.

E. Crops not Included in the 3rd Draft Report

1. Beans

Beans are the main source of protein in the diet of the Haitian population (Blemur, 1987). They rank second only to cereals as a food crop. Beans are produced in all nine

departments and 15 districts of the nation. The food crop designated as "beans" refers to both beans harvested after they are dry and to beans harvested after the seed is mature but before it is dry ("roasting ear" stage see Table 8). According to DATPE as cited by the CEP (1985), beans rank third after corn and sorghum in area planted and fourth in both value and total production tonnage (Table 9).

a. Beans in Plains and Hillside Agriculture

Among the four agricultural regions of Haiti bean hectarage ranges from 23,000 ha in "north" region to 38,000 in "west" region. Production areas and yields of principal crops are included in Table 1-Appendix. The traditional red beans are the most commonly planted in Haiti. Black, white, and many mixed colored beans are produced for the market. Beans are grown in the irrigated coastal plains, non-irrigated plains, and mountains as a monoculture and in crop associations (see calendar for crops, Appendix).

The growing season for beans on the plains is from November to March. Because of disease pressure from the golden mosaic disease, bean production shifts to the mountains for the April to June growing season. Beans are planted in association with corn, sorghum, pigeon peas and occasionally, tree crops in the mountains. Another bean growing season for monoculture beans in the mountains lasts from early September to November. These beans are largely used as seed for planting in the plains (a clear example of the relationship between agriculture in the mountains and in the plains). Black beans which have resistance to golden mosaic have been introduced in Haiti from the ICTA germplasm collection. The successful introduction of the "Tamazulapa" cultivar of black beans is discussed in Section 4C of this chapter.

b. Bean Culture in Department du Sud

Specific information on crop culture patterns has been gathered by ADS-II (1986, #23) in the Department du Sud. The relationships of annual legumes to cereals, root crops and plaintain are explained in the ADS-II report. Table 10 below includes the data and explanations of data on crop associations. The black bean "Tamazulapa" is rapidly gaining acceptance in this Department of Haiti. Data from the second planting season of 1985 and the first season of 1986 are presented.

2. Fruit Tree Crop Production

Data on fruit production are not precise, since about 80-90% are home consumed and only 10-20% of the production is sold. The consumption of fruit per capita in Haiti, is estimated at 30 kg/year by Menager stated Wiltbank.

It is difficult to estimate the areas planted in fruit tree crops, since 80-100% are in association (ADS-II Report #31).

In terms of number of trees planted, in descending order, the major fruit corps in Haiti are: mangos, bananas, avocados, citrus and coconuts (ADS-II Report #31). The most important fruit production in Haiti is banana (210,230 MT) followed by mango (80 to 90,000 MT per year). (See Table.)

However, a 1975 study estimates the fruits entering Port-au-Prince, in decreasing order: citrus, mango, avocado, coconut and banana. (See Table 12.)

a. Mangos

Mango (mainly Mme Francis cultivars, some "carrot" cultivars by ASDEM, the main fruit exporter in Haiti, some "Tommy Atkins" from Florida brought by Haiti Citrus Corporation) is the largest fresh fruit export from Haiti. In 1983, Haiti exported to the U.S. about 6,227 MT of mangos worth an estimated $4-5 million involving 50,000 farmers. The recent revisions of the EPA (U.S. Environmental Protection Agency) concerning the use of the ethylene dibromide (EDB) for fruit fumigation in order to control fruit flies, were about to eliminate the Haitian mango's export. Fortunately, research conducted at the Service Protection des Vegetaus at Damien found another effective treatment, hot water, to save this young agro-industry activity.

The main mango production in Haiti occurs from April through August, although they are available, in small quantities, all year round, except in September and October. There are about 30-40 cultivars (see Table on mango varieties) grown at low elevations in Haiti. Some "Tommy Atkins" have been brought from Florida by the Haiti Citrus Corporation which planted 150 acres of this mango variety in the Plain of Cul-de-Sac. This introduction was made to extend mango harvest season before May, and to improve acceptance in the U.S. market. According to varied sources, there is a surplus of mango in the areas of production and a more than 30% post-harvest loss caused by poor handling, harvesting techniques, and transportation. Apart for ASDEM

TABLE 8

SUMMARY OF BEAN PRODUCTION IN HAITI
BY DRY AND MOIST HARVESTED BEANS
(SOURCE: CEP 1986, FOR 1979 CROP YEAR)

DEVELOPMENT STAGE OF SEED AT HARVEST	AREA ha	PRODUCTION MT	YIELD kg/ha
Mature and dry	89,678	52,685	588
Mature but not dry	39,174	14,093	360
Total	128,852	66,788	518

TABLE 9

PRINCIPAL FOOD CROPS:

PRODUCTION, AREA PLANTED, VALUE AND RANK ORDER
(SOURCE: CEP 1986; DATA FOR 1979 CROP YEAR

CROP	AREA Ha	Rank	PRODUCTION MT	Rank	VALUE Gourdes	Rank
Corn	233,749	1	183,331	2	135,664	3
Sorghum/Millet	156,696	2	123,282	3	91,228	5
Beans (All)	128,852	3	66,788	4	105,394	4
Rice	53,996	4	122,116	5	268,655	1
Plaintain	97,984	5	301,274	1	225,955	2

TABLEAU 10

PERFORMANCE DE LA TAMAZULAPA DANS LES DEPARTEMENTS DU SUD ET DU SUD EST
JACKEL ET CAYES (TEST DE T) $

	$ Cas	HARIGOT LOCAL NOIR DU ROUGE $				POIS NOIR TAMAZULAPA				Difference Positive	
		Minimum	Maximum	Deviation Standarde	Moyenne	Minimum	Maximum	Deviation Standarde	Moyenne	(kg/ha)	($/ha)
Rendements parcelles paysans (sans essal)	256	33	2,666	454	603						
Association sur pentes montagne (Jacmel, fertile)	214	28	6,250	727	839	44	5,800	987	1,016***	177	159
Association sur pentes (Montagne Cayes, Zones Erodees, non-fertiles)	50	83	738	128	312	71	840	166	386***	74	67
Association plaine (Cayes, Zones Pluviales)	19	220	1,444	322	809	310	1,670	317	837 ns	28	25
Association plaine (Cayes, Zones Irriguees)	10	556	1,111	168	849	556	2,222	555	1,239**	390	351
Monoculture Plaine (Cayes, Zones Pluviales, sans angrais	123	112	1,500	294	582	152	1,630	344	782****	200	180
Monoculture Plaine (Cayes Zones Irriguees, usage d'engrais nodere)	42	200	3,832	806	1,326	300	4,106	850	1,415 ns	89	800
Avec engrais (Cayes, Mont.)	9	225	437	59	298	137	462	95	313 ns	26	23
Gans engrais	9	0	450	-	315	200	500	-	349 ns	34	50

Haricot Local: Rouge a Jacmel, Noir aux Cayes

Test de T pour etablir les differences significatives antre les observations liees.

Source: ADSII, Report #23.

TABLE 11

PRODUCTION OF MAJOR FRUIT CROPS IN HAITI
(in Metric Tons)

Some Tropical and Sub-tropical Fruit Crops in Found Haiti
which could also be developed:

Fruit Crop	Production
Banana	210,230
Mango	80-90,000
Avocado	50,000
Orange, Grapefruit Mandarin	33,000
Lime	7,000

TABLE 12

FRUITS ARRIVING IN PORT-AU-PRINCE
MARCH 1974 TO MARCH 1975

Bananas	877,569 lbs.
Avocados	12,565,691 lbs.
Oranges	7,006,828 lbs.
Shaddocks	14,120,052 lbs.
Limes	4,051,112 lbs.
Mangos	19,567,488 lbs.
Coconut	10,668,218 lbs.
Others	3,544,892 lbs.
TOTAL	72,546,024 lbs.

Source: Production and Marketing of Fruits in Haiti (1).

(Association des Exportateurs de Mangos), CONASA (Conservene Nationale SA) and Haiti Citrus Corporation have the only mango processing plants in Haiti. Although no evaluation has been done, it has been observed that a lot of mango trees are being cut down lately, since the disappearance of pigs, for use as lumber, firewood and for sale.

b. Avocados

The avocado is not planted as frequently as mango for different reasons: (1) it requires a more fertile soil; (2) it is not as drought tolerant as mango; (3) it is susceptible to avocado root rot; and (4) it is easily damaged by high winds. The production of 50,000 metric tons (Wiltbank, citing Menager and Dourille), with 12% marketed in Port-au-Prince is consumed locally.

The main production comes from West Indian cultivars grown at low elevations. In Kenscoff (more than 1,000 mm) there is a cultivar called "Guatemala" which, according to Wiltbank, is a cross between Guatemala and West Indian or Guatemala and Mexican hybrid cultivars introduced by U.S. .missionaries. It is promising for the high elevations. In Damien's station there are also some Guatemalan cultivars, whose harvest season starts in November after the West Indian cultivars have been harvested (from June to November). This represents one way of lengthening the avocado harvest season.

c. Citrus

Different species of citrus are grown in Haiti (see the list of crops grown in Haiti). The mandarin (Citrus reticulata) is a minor fruit crop in Haiti. The citrus production is reported in the table on major fruit crop production in Haiti.

Citrus, according to IICA cited by Wiltbank, is the main fruit product entering the market of Port-au-Prince, possibly because of its resistance to poor handling. Production losses are less that that of mango and avocado production because, apart from its resistance to handling, the mature fruits can be left on the tree without falling and overripening, and still retain a long "shelf-life". For these reasons, citrus should be encouraged in Haiti. Moreover, there is a wide range of species and cultivars, adapted to the different micro-climates of Haiti. A lot of improved varieties and species can be found at the Grand Prie Station in the North, and can be used as scions on some orange and other rootstock.

TABLE 13

VARIETIES AND PRINCIPAL PRODUCTION AREAS OF MANGOES

Varieties	Production Zones	Volume of Production
Fil	Cul de Sac/Leogane	Very High
Muscat	Leogane/Petit Goave	Very high
Francis	Gros Mornee/Cul de Sac	High
Blanc	North Department	Average
Corn	2nd Plain of Petit Goave	Low
Baptiste	North Department	Low

Source: JWK/DARNDR Study Team. (5)

There is no export of citrus fruits. The local consumption of citrus juice (sweet orange, grapefruit) is promising if we observe the consumption of the juice processed but JUNA.

According to Wiltbank, the major constraints to fruit production are: (1) market deficiencies, because of poor road conditions, poor handling, wide price fluctuations and poor condition of the fruits. For export markets, few entrepreneurs have studied the markets. Technical assistance is required for fresh fruit harvesting, packaging, storage and shipping and processing; (2) lack of infrastructure: adequate roads, cheap electricity and reliable clean water supplies are required for processing plants and marketing; (3) lack of technical assistance, educational programs, plant quarantine services and production input supplies for the farmers; (4) lack of farm and market credit facilities.

It is important to notice that fruit trees could play an important role as perennial crops because of their soil conservation role on hillside farms (see Table 14).

Endomychorhizal inoculation with spores or vegetative byphase adaptable to soil and climate conditions of Haiti would enhance the survival of the fruit trees mainly in the low-fertility soils and semi-arid areas of the country (Webb, R., 1987).

Cashew nuts are also a promising crop. They could be grown in the Nordwest and the Plateau Central, apart from the north and the northeast. Varieties resistant to anthracuosis could be obtained from India, Brazil and Tanzania (Webb, R., 1986).

Projects such as the Fruit Tree Improvement Project (ORE: Organization for the Rehabilitation of the Environment and SHEEPA) improving the quality of fruit trees through grafting, should be encouraged.

d. Beekeeping

There are a lot of possibilities for the development of beekeeping in Haiti. The activity could be easily integrated in the farming systems and constitute another source of review for the peasant farmer. Besides, bees favor the pollinization of annual and perennial crops improving the yield, while producing honey, wax and other bee products.

The production of honey in Haiti, stays around 300 MT, 80% of which is consumed locally and used in fine pastry (SHABISCO). Only 50 are exported. The demand for honey is increasing in developing countries (about 500% in the USA in

TABLE 14

SOME TROPICAL AND SUB-TROPICAL FRUITS WHICH MIGHT BE INCLUDED IN HILLSIDE PLANTINGS AND THEIR RELATIVE DROUGHT TOLERANCE

DROUGHT TOLERANCE		
HIGH	MEDIUM	LOW
Pineapple	Plantain	Banana
Mango	Avocado	Papaya
Sapodilla	Lychee	
Macadamia	Longan	
Mamey Sapote	Carambola	
Genip	Annonas	
Starapple	guava	
Cashew	Citrus	
Tamarind	Akee	
Acerola	Passifloras	

Source: Wiltbank.

ten years), as well as the demand for the other natural products. Therefore, the price increased from 500 dollars to 700 dollars between 1976 and 1981. The same tendency has been registered for wax which passed 2.200 dollars to 3.500 dollars a ton.

Unfortunately, so far, apart from a few entrepreneurs, the level of technology of the 1200 beekeepers is very low. The production per beehive is about 28 kg (5.6 kg of honey = 1 gallon) of honey and 1 kg of wax per year. The bees are kept in drums (made up of tree trunks 50-60 cms long and 30-35 cms in diameter). With the Langtrost box, the HACHO (now ODNO) has been able to double yields. A bee cooperative in the northeast is also making some efforts to increase their production.

The problems met in the production of bee products in Haiti are, according to different sources:

- Low level of technology: bees raised in drums, no sanitary care, low yield races. They should spread more Italian races;

- Degradation of the environment: the bees need melliferous species to make up their products. In Haiti some forestry species such as Haematoxylon campechianum, Prosopis Sp., Acacia Sp., Moringa obeifera Guayacum oficinals, all found in semi-arid zones could be more vulgarized. Since they are melliferous, mango and citrus plantations could be combined with beekeeping, which would increase the revenue per ha. Honey made from Haematoxylon campechiaium and mango pollen is especially demanded. Other species such as castor plant (Ricinus communis) tamar and (Tamarindus indica) are also melliferous;

- Lack of technical assistance: few Haitians are trained in this specialty;

- No credit; and

- No organization of the market.

F. Labor: The Role of Women in Haitian Agriculture

It is generally believed that women are specialized in marketing agricultural products, because they invest the markets at 90% or more. However, women play also an important role in crop production. During the colonial period. according to Moreau de St. Mery, women were responsible for cultivating what they have called the "places a vivres",

TABLE 15

TOTAL BANANA PRODUCTION SEPARATED INTO MONOCULTURES, ASSOCIATED PLANTINGS AND SCATTERED, INDIVIDUAL PLANTS

(In Metric Ton)

AGRICULTURAL DISTRICT		B A N A N A			
		Production TOTAL	Production in MONOCULTURE	Production in ASSOCIATED PLANTINGS	Production of SEPARATE PLANTS
	HAITI	210.230	49.214	128.436	31.580
1.1	Port-au-Prince	23.822	4.318	9.504	10.000
1.2	Petit-Goave	8.770	4.335	3.466	969
1.3	La Gonaive	864	455	363	46
2.4	Cap-Haitien	35.282	2.896	29.682	2.704
3.5	Fort-Liberte	17.053	5.312	9.261	2.480
4.6	Port-de-Paix	16.849	14.491	2.262	96
5.7	Cayes	30.972	2.596	27.702	674
6.8	Jacmel	9.312	1.530	3.152	4.630
6.9	Belle-Anse	5.845	-	4.645	1.200
7.10	Jeremie	20.029	2.636	17.358	35
7.11	Miragoane	13.974	4.290	9.644	40
8.12	Hinche	2.103	234	1.856	13
8.13	Belladere	1.537	576	571	390
9.14	Gonaives	12.975	4.907	3.970	4.098
9.15	St. Marc	10.843	638	6.000	4.205

Source: AGRICULTURAL STATISTICS SERVICE/DARNDR (14).

TABLE 16

NUMBER OF PLANTS OF COCONUT, ORANGES AND GRAPEFRUITS WITHIN THE 15 AGRICULTURAL DISTRICTS OF HAITI

Year: 1978
(Plants)

AGRICULTURAL DISTRICTS		COCONUTS AND FRUITS			
		COCONUT	MANGO	ORANGE	SHADDOCKS
	HAITI	1.467.788	4.458.638	2.118.313	1.362.124
1.1	Port-au-Prince	128.809	117.686	8.280	14.959
1.2	Petit-Goave	148.226	210.456	43.578	191.340
1.3	La Gonaive	27.382	75.859	3.922	8.198
2.4	Cap-Haitien	129.962	652.937	757.111	433.415
3.5	Fort-Liberte	92.688	586.086	254.982	54.794
4.6	Port-de-Paix	59.106	253.319	177.952	59.375
5.7	Cayes	313.697	620.643	199.957	144.179
6.8	Jacmel	100.715	409.810	295.343	135.932
6.9	Belle-Anse	6.653	29.051	11.144	27.194
7.10	Jeremie	164.895	231.620	192.530	108.271
8.12	Hinche	11.298	305.606	30.917	18.687
8.13	Belladere	26.728	186.196	36.024	49.401
9.14	Gonaives	47.410	506.927	57.220	24.675
9.15	St. Marc	17.933	123.213	2.014	1.197

Source: AGRICULTURAL STATISTICS SERVICE/DARNDR (14).

used to grow food crops for the slaves. They used their agricultural experience from Africa, in addition to the new techniques acquired in the country. Men were too busy working for their masters, in the sugar cane plantations and factories. They were not allowed to waste time in other activities. The "melting pot gardens" had the same characteristics of those met today. The women were also used in coffee harvesting operations in the mountains.

During the 1804 independence war, most of the big sugar cane plantations were burnt. After independence, the women transmitted their experience cultivating the "places a vivres" to the men. The word "placer", which is a customary peasant marriage, originated from this expression. Today, the role of women in crop production is more important than noticed in Haiti.

1. Women help men to cultivate the different plots of their farms: on each scattered plot, the man places a woman with whom he develops intimate relationships and family ties (children).

2. While men are usually involved in soil preparation, requiring physical strength, harvesting is almost totally woman's work in parts of the country such as the Artibonite Valley. Processing and marketing work is done mostly by women making the prices of the agricultural products "madam sara". On the border with the Dominican Republic, where the high migration rate creates a lack of workers during peak agricultural operations, women and children carry out even hard work, such as soil preparation (at Seguin, Thomazeau for example).

3. Women are involved in the acceptance or rejection of the new varieties of food crops, since they sell and cook them. Processing quality and taste are criteria of choice of food crops. This is why it is unrealistic to put aside women in vulgarization programs. They are a major constraint even in the adoption of those new high performance varieties.

Source: Marguerite Blemur.

A study on the role of women in agricultural production in Haiti should be done, since there is no relevant data on this topic, and their role has not been analyzed completely.

III. CONSTRAINTS ON AGRICULTURAL PRODUCTION

Many constraints impede the development of agriculture in Haiti. They are physico-ecological, technical, logistic, institutional, organizational, socio-economic, etc.

A. Psysico-Ecological Constraints

Some people consider that the physical configuration of Haiti, 75% mountainous, steep slopes, is a constraint to agriculture. This fact is aggravated since Haiti is located in the intertropical zone, with fragile ecosystems (heavy rains). Others, conversely, think that the wide range of climates and soils, free of frost, is an advantage to exploit.

In fact, this situation is a "two edge sword". It is a benefit if you know how to manage, it is a disadvantage if you do not. Haiti could be a paradise in the mountains planted with perennial crops such as coffee, cocoa, fruit trees, or permanent pastures. At the same time under permanent vegetation the watershed would be protected from soil erosion, as would the downstream irrigation systems which water the intensive crop cultivation in the plains.

B. Technical Constraints

1. Low water use efficiency: there are usually no tertiary channels to deliver the water to the plots. This is tied to the excessive parcelization of the lands.

2. Decline of soil fertility because of soil erosion: in the plains, flood and sedimentation resulting from intensive deforestation in the watersheds damage irrigation structures and plantations.

3. Lack of maintenance of the irrigation structures: the Director of ODVA (Organisme de Developpement de la Vallee de L'Artibonite) relates this problem to the non-payment of the irrigation taxes which are already too low, $11/ha/year, a rate fixed more than fifty years ago. They have calculated that users should pay $120/ha/year to maintain the irrigation systems in the valley. People refuse to pay these already low taxes (after February 7th, only 10% of the taxes had recollection versus 7% before February 7th, according to the Director) due to the political unrest prevailing after Duvalier's fall.

4. Low yield and long cycle varieties/cultivars: for example, the traditional sorghum cultivars planted during the rainy season in April-May have to wait until December to flower.

5. Low seed quality: this explains why the peasants put so many seeds per hole. They do not practice thinning since this operation requires more labor.

6. Late weeding: this probably occurs because of lack of labor or lack of knowledge concerning the impact of this cultural practice on crop yield. For example, the peasant weeds his corn fields at least one month after sowing. But, after 15 days, if you harvest 4500 kgs of weeds in the corn field, you have already lost 1500 kgs of corn.

7. Lack of tools: the peasant uses rudimentary tools, mainly hoes, machetes, and sickles. Few farmers have access to tractors, plows, or motocultors to prepare their soil, even in the irrigated areas of the plains. However, the vulgarization of the annual plowing in the north plain and Les Cayes Plain and the use of motocultors in the Artibonite Valley are promising (see Table __).

8. Rudimentary, manual harvesting techniques.

9. Reduced use of inputs such as fertilizers and pesticides: fertilizers are mainly used in the Balley of Artibonite for rice production, and in Kenscoff in vegetable production. Some are used through projects giving credit inputs such as BCA, BNDAI, intensive food crop cultivation program (MARNDR), Coffee Project, and others. We have to notice that the formulas and the quantity of fertilizers recommended are not always adequate. Besides, sometimes the farmers who benefit from inputs to a project sell them to other vegetable growers at a higher price.

   Few pesticides are used. Pest control is usually accomplished in traditional ways, such as scarecrow to control birds. In fact, a balance-of-nature situation exists; there are few diseases of economic importance.

10. Crop associations: too many crops are often put together, sometimes crops with similar nutrient requirements.

11. Salinization: inadequate cultural and irrigation practices lead to the salinization of the lands in the plains; moreover, groundwater abuse causes salinization. In the Plain of Cul-de-Sac, for instance, a drop in the aquifer has been noticed because of the unregulated construction of boreholes and groundwater exploitation. A severe increase salt in the groundwater was observed between November 1983 and August 1985. There is an increase of 5 km of area filled with salt water in the area. The 600 ppm curve has been replaced by the 1000 ppm curve. One thousand ppm is considered as limits for suitable drinking water (Latortue, 1987).

C. Other Constraints

1. Lack of road infrastructure: apart from the national roads, there are few secondary roads drivable in rainy seasons.

2. Poor or non-existent storage facilities: traditionally, the farmers store grains in "calebasse", drums hung up in a tree, as in the case with corn ears.

3. Lack of drying facilities: crops are usually sun-dried.

4. Transport of unprepared crops: crops not properly wrapped.

5. Confusion in the land tenure.

6. Parcelization of the farms: farm size is not economic. For example, the typical peasant of the Vailey of Artibonite has less than half an ha and cannot compete with the rice of subsidized farmers in Brazil, Colombia or the U.S. Moreover, legal fees paid to lawyers, notaries and surveyors are too high for the peasants.

7. Lack of farm workers: in the Artibonite Valley there are seasonal migrations, bringing the 200,000 habitants to 700,000, according to the director of ODVA, during peak labor time, such as soil preparation and harvesting. They offer certain advantages to these people from the north and the northwest, to ensure labor (home, food, etc.). The daily wage is $3, the same or more than that for factory workers.

8. Extreme poverty of the peasants.

9. Lack of education of the farmers: about 95% are analphabets. A huge gap exists between the technician and the farmer.

10. Lack of motivation and training for technicians: typically they are underpaid.

11. Lack of incentives and credit.

12. Lack of organization: after February 7th, the propaganda against peasant 'groupements' has been accelerated, discouraging peasant organizations.

13. Lack of agricultural policy from the government, represented by the MARNDR.

14. Lack of price policy to protect the production of the farmers: these latter cannot afford to compete with the U.S. rice farmers, for example, since the U.S. farmers are producing rice on large areas and are subsidized by their government. In Brazil, it would not be economical for a farmer to go into rice production with less than 300 ha. The sugar cane farmer cannot compete with the Dominican sugar which is produced at 7 cents a pound against 25 cents a pound for the Haitian sugar.

15. Lack of continuity in institutional actions.

16. Lack of drying and storage facilities: the post-harvest losses estimated at 15% and 30% for fruit crops, are important, from harvest through storage places and transport to market. However, nobody to our knowledge, has assessed the loss percentage.

D. Prioritizing the Constraints

The MARNDR ranked the many constraints to agricultural development in order of priority: major, moderate, and minor constraints. (Source: CEP)

1. Major constraints: farm-level constraints (access to productive resources - low level of technology), soil erosion and related man-made constraints, supply constraints, handling and transport costs, administrative/managerial/technical capacities, cooperatives and other farmer organizations, research, land tenure and land redistribution policies, general government support for agricultural development.

2. Moderate constraints: land and land tenure, capital, natural disasters, climate, soils, topography, water resources, insects, diseases, rodents, demand constraints, lack of storage facilities, production credit, input supplies, extension, other services, tax policy, price policy, credit policy, policies affecting rural levels of living and income distribution.

3. Minor constraints: labor supply, concessional food grain imports, dispersed production, lack of uniform weights, measures, grades and standards, lack of inventory financing, lack of market information, monetary policy, employment policy.

Note: the MARNDR considers bilateral, international agency and GOH procedures to be significant constraints.

This ranking appears to be realistic, and it matches, more or less with the opinions of most people we have talked about, directors of projects, technicians, etc. It is clearly understood that the main constraints are constituted by the Haitians themselves: the socio-economic structure of the society reflected in the land tenure pattern, the weakness of the institutions, and the lack of education and organization.

Note: After Duvalier's fall, market has been a major constraint because of the free competition policy, allowing legal and illegal importations of food crops.

IV. FOCUS ON RESEARCH

Research has been ranked as a major constraint by the MARNDR. As a matter of fact, according to FAO, Haiti could feed its population, but not with the actual low levels of technology, and not with present land misuse and mismanagement, which have brought the country to "the very edge of survival". To survive, Haiti is forced to find ways to raise the level of technology of its farmers, and for this, research is needed—Israel invests more than 60% of the budget allowed for agriculture in research to support its agricultural development.

Unfortunately, research institutions are deficient in Haiti. Some people, even among agricultural technicians, think that research is a waste of time and money. For them, we are too poor to spend money in research, we just have to transfer the results of research already done in developed countries.

A. Research Institutions

Since 1981, CRDA (Centre de Recherche et de Documentation Agricoles) has been working within the FMV, in place of the SERA (Service d'Etude et de Recherche Agronomique) within the MARNDR. It uses the services of about 30 full-time qualified teachers who are supposed to do research and teaching. It has worked hard at putting structures for research in place, developing valuable coordination and applied research programs, until an unexpected crisis jeopardized its future. The CRDA was recently recuperated by the MARNDR.

B. Research Strategy

Considering that small peasant farmers (with less than one ha) form the majority of Haitian farmers (more than 70%), the CRDA chose to focus on applied research to increase the small farm productivity, at a minimum cost, and in a minimum length of time. It might be influenced by the CIMMYT (Centro Internacional de Maiz Y Trigo) and the French Center of Madian-Salagnac approaches: Research-Vulgarization or Research-Development. Below is the strategy proposed:

Focus on small farmers

1. Quick reconnaissance survey completed by Agricultural survey of chosen households in the zone of the project (6 weeks).

2. Work out hypothesis for Experiments and identify agro-socio-economic needs (4 weeks).

3. Experiments with socio-economic survey (1st season - 6 months).

4. Experiments and pre-vulgarization trials, socio-economic surveys and adoption of some technologies developed through the pre-vulgarization trials.

5. Vulgarization trials: a continuous process.

The PDAI, the ADS-II, ODN, and other projects have used this strategy successfully so far, whenever it is done seriously and continuously.

C. Recent Technical Innovations

Since the ADS-II is going to end in less than one year, it has concentrated its efforts on the vulgarization of its most promising innovations. A study was conducted to evaluate the adoption of the new techniques in Les Cayes in April 1987, at its four sites of intervention. Three are the plain, and one, Fonds-des-Freres is in an hillside area, at 300-350 meters above sea level.

According to the results of this survey, 75% of the respondents know at least one activity of the project. The highest participation rate, 58%, was achieved for the soil conservation practices (tree planting, planting of perennial grasses, living terraces, dry walls). This is understandable, since soil erosion problem is most felt by the farmers and for which they most need technical assistance. The goat breeding program had the least success.

The emphasis of the research were put on variety:

For sorghum, M 5009 has been adopted to some extent, by the farmers. This variety has been introduced by Texas A&M team within the PDAI. For rice, CIAT 16, (from CIAT, the Centro Internacional para Agricultura Tropical) yielding more than three times than Mme Gougousse in farmer's conditions, has been adopted. The most preferred variety was Amina, yielding 7-8 tons against 1-2 tons of Mme Gougousse (12 tons has been reached in the Artibonite Valley). This variety (IR-5931-113-1) has been developed by IRRI (International Rice Research Institute). It has been chosen for high-yield, taste and for east in cooking (consumes little cooking oil), according to the farmers we interviewed, although they do not agree concerning the taste.

The creation of 50 member coop seed multiplication center at Bruny, near Torbeck followed this rice introduction. The objective of the coop is to produce 30 tons of seed each season on 10 ha, to distribute to rice farmers of the plain. They are also building storage facilities. It is a permanent center for demonstration, financed by the A.I.D. Small Development Support. The Amina has spread from 1 kg of seed coming from IRRI. Ti Rose has also been adopted to a less extent.

Another innovation is Tamazulapa black beans from ICTA, Guatemala. It has been adopted by the farmers because of its high yield, 600-850 kg in farmer's conditions, compared to the local cultivar (its potential is 2000 kgs/ha). Introduced by the PDAI, ADS-II used it, tested it in such different conditions as plain and hillside, in monocrop or in association with corn. In

TABLE 17

AWARENESS AND PARTICIPATION IN ADS-II INNOVATIONS

Innovations	Recognition Number	%	Number	Participation %
Rice	66	64	14	14
Maize	126	69	35	19
Sorghum	134	67	38	21
Black Bean	110	60	20	11
Pig	118	64	46	25
Rabbit	114	62	7	4
Goat	32	100	1	4
Soil conservation	42	100	14	58
Rice Thresher	25	24	10	10

all cases, it gave better results than the local red beans "manze jout" and black beans (see Table 10). It is also drought resistant and mosaic virus resistant. It was first vulgarized in the 2nd season of 1984 in Les Cayes and Jacmel.

For corn, selected varieties of local Chicken corn have been preferred to La Maquina from CIMMYT, because of yield and ear covering, giving more security for storing, and for color (yellow is preferred). We should notice that the socioeconomic status of the adopters has not been defined. The variety is distributed with the technological package (density, fertilizer, etc.).

In Haut Cap rouge, a hillside area, another innovation concerns agronomic practice. The peasant used to plant yam and cassava in the same mound. The agronomists demonstrated on-farm, that it is more economic to plant them separately since the two crops have about the same nutrient requirements.

They have also introduced cabbage culture in Haut Rouge, which is a market crop and more profitable than food crops, after the building of five cisterns to collect rain water.

At ODVA, research is focused on the purification of some improved varieties used time ago by the rice farmers:

Star Bonnet	2 ton/ha (4 months cycle)
Mme Gougousse	" (3 months and half)
Cica	4-5 tons/ha
La Crete-a-Pierrot	4-5 tons/ha (4 months)

La Crete-a-Pierrot is a cross between Chiasne 11 and Mme Gougousse, made by the Chinese 8 years ago. CIAT was introduced in 1979. People do not like its taste but sell it to be mixed with other superior rice. It also takes more cooking oil than Mme Gougousse. To choose, people look also at the mill yield and the paddy/grain ratio, which should be around 50%.

At ODN the Cica 8 rice was introduced with intermediate technology at Grison Garde, last October 1986.

Other promising trials at ODN:

- Cassava: CNC40 from Brazil, yielding 20 tons against 10 tons of the local cultivar (North Plain, a cassava production zone with some small processing plants).

- Sweet potatoes: varieties from IITA resistant to cycles formicarius but having the qualities required by the Haiti consumers which are firmness, white flesh, few fibers, and a taste that is not too sweet.

Moreover, the 1 ton silos whose design is from Guatemala could be more widespread since they have been known more than ten years at the Levy farm.

Another big issue is the individual and collective tank by the French Center of Madian-Salagnac being spread by the Service of Watershed Management of the MARNDR to overcome the water constraint in the hillside areas. Because of this innovation, cabbage culture was made possible in the Rochebois Plateau about 3-4 years ago, and now at Haut Cap Rouge (Jacmel).

Research should also be focused on agronomic practices such as fertilizer experiments, to find the right formula and dose of fertilizers. To avoid pollution, decreases in the use of fertilizers, fight against water stress and disease, nitrogen fixation and mychorrizal research (more relevant these days), needs to be encouraged. There has been a nitrogen fixation research at the FAMV for about 4 years.

V. CONCLUSIONS AND RECOMMENDATIONS

After analyzing the agricultural situation, we can say that Haiti will be forced to adopt adequate measures in order to face the food needs of its population, and at the same time get enough currencies from its export agricultural commodities to start and maintain its development. The solutions should be short-, medium- and long-term. The present actual level of the majority of the inhabitants, the peasant farmers, agro-industry and export-oriented agriculture, will not necessarily result in the well-being of the peasants.

The first issue concerns the land use, since there is an ecological disaster threatening the country. It is vital that perennial crops (coffee, cocoa, fruit trees permanent pastures, forest trees, etc.) be encouraged in the hillside areas. This can be achieved, not by the usual small sporadic projects but by long-term well planned integrated projects, setting organizations such as coops, giving credit and training and education, building roads, drying areas, storage facilities, small processing plants in the rural areas with the people concerned. Appropriate technologies for hillside farm management exist (see IITA and ICRAF and others). The PSTO (Proje Sove Te Okay) is a good example of a hillside project to spread because it aims at mountains land productivity. CARITAS has also made a valuable proposition concerning the hillside farm management. We also recommend decreasing the pressure on the hillside farms by creating complementary activities such as fish farming and beekeeping which can increase the peasant's income, and other activities such as hand crafting, etc.

Certain constraints can be overcome by simple organizations. For instance, the main physical constraint appears to be water. The construction of individual and collective tanks has proved very adequate to solve this problem in hillside areas. With this innovations, the peasant can grow high-value vegetable crops (cabbage and others).

In the irrigated plains, it is urgent that the water users be organized and trained for better water distribution to the plots. The development of the rest of the irrigation potential is a long-term project. Besides, sugar cane, the lazy man crop should be moved to the mountains and more high-value crops such as soybeans, peanuts, bananas, tomatoes grown in the plains. This would be a long-term project.

To raise the level of technology of the peasants, a well established research vulgarization system is needed. The research strategy proposed by CRDA has proved successful but takes institutional support. We recommend that a parastatal research institution working in close relationship with the FAMV be created and structures. The research topics should include:

1. Farming systems, hillside and plains. Priority will be given to agroforestry systems.

2. Study of the crop associations improvement not only for nutrient requirements but for biological pest control.

3. Crop varietal cultures improvement and introduction - food crops, fruit trees, forest trees, coffee, cocoa, industrial crops, etc.

4. Study on pest problems. Incidence, economic importance.

5. Study and trials (on-farm research) on agronomic practices. Tillage, no-tillage (for hillside areas), density, fertilizer experiments, weeding, water requirements.

6. Mechanization.

7. Harvest techniques and improvement.

8. Post harvest study.

9. Biological research on nitrogen fixation and myconhizal (ecto and endo) research to escape the use of fertilizers and to arm plants in harsh environments.

For agricultural planning purposes, we recommend:

1. Soil survey and monographies of the different ecological zones (plain and mountain) giving type and depth of soil, risk of erosion, rainfall amount and pattern to determine the land crop capabilities. The project catalogs by the STABV are a step.

2. The cadastre to clear this question of land tenure, an important incentive that could be used by the Agrarian Reform Institute which must be created according to the 1987 constitution.

3. A permanent data base. MARNDR is not structured to continue the ADS-II work. A data unit is still needed in the MARNDR.

To achieve all this work human institutional factors are the keys. Institutional and organizational reform are number one work to doe and the general atmosphere should be favorable. the Bruny seed production coop is a good example of peasant organization, and should be encouraged and spread.

A Edouard Saouna said in his speech on the last 16th October, the Food Day dedicated to small farmers. It mainly takes good will, competence and organization to feed all the population of the world.

APPENDICES

TABLES, ATTACHMENTS, FIGURES AND MAPS CONTAINING USEFUL BACKGROUND INFORMATION ON HAITIAN AGRICULTURE

APPENDIX I

TABLES

TABLEAU I-1 : COMPARAISON DES CULTURES PRATIQUEES DAN QUATRE DEPARTEMENTS
(2eme Saison, 1986)

A. MONOCULTURE (en hectare)

	DEPARTEMENT DU SUD		DEPARTEMENT DE LA GRAND-ANSE		DEPARTEMENT DE LA SUD-EST		DEPARTEMENT DE L'QUEST		TOTAL
CULTURE		CV		CV		CV		CV	
Mais	8100	0.15	2400	0.18	1600	0.13	1900	0.15	14000
Sorgho	23600	0.15	1800	0.18	1000	0.16	4400	0.13	30800
Riz	6000	0.28	1100	0.13	100	0.52	6600	0.31	13800
Haricot	200	0.49	200	0.16	300	0.37	300	0.23	1100
Pois Congo	1200	0.16	2500	0.40	300	0.16	3100	0.32	7000
Pois Inconnu	*	0.40	*	0.48	*	0.52	200	0.24	300
Pois Noir	3400	0.27	2500	0.36	700	0.46	200	0.45	6700
Pois Blanc	8	n.d.	100	0.36	*	0.52	100	0.27	200
Pois Sinistre	*	0.70	100	0.36	100	0.35	*	0.53	200
Arachide	500	0.20	100	0.28	*	0.47	400	0.25	1000
Manioc Amer	1400	0.15	900	0.33	100	0.38	800	0.17	3200
Manioc Doux	400	0.23	600	0.17	100	0.39	500	0.22	1600
Patate	5700	0.16	1700	0.20	400	0.18	3300	0.18	11100
Igname	600	0.32	2000	0.36	*	0.43	*	0.50	2600
Pomme De Terre	*	n.d.	*	0.50	*	0.35	400	0.40	400
Malanga	300	0.24	1600	0.50	100	0.50	*	n.d.	2000
Mazumbel	300	0.23	500	0.17	*	0.69	200	0.53	900
Canne A Sucre	4600	0.21	1900	0.30	*	0.62	10200	0.22	17700
Tabac	500	0.37	100	0.33	*	0.70	*	0.53	700
Vetiver	400	0.27	*	0.37	*	n.d.	*	n.d.	400
Coton	100	0.44	*	n.d.	*	n.d.	*	n.d.	100
Sisal	100	0.45	*	0.55	300	0.70	100	0.41	400
Giromon	*	n.d.	*	0.36	*	0.47	*	0.50	100
Tomate	100	0.39	200	0.44	*	0.69	900	0.29	1300
Choux	*	0.45	200	0.34	*	0.47	100	0.40	400
Cafe	1000	0.19	3100	0.37	800	0.20	300	0.31	5300
Ananas	*	n.d.	*	n.d.	*	n.d.	*	0.41	*
Figue-Banane	100	0.28	*	0.36	*	n.d.	400	0.26	500
Banane	3100	0.10	3600	0.09	200	0.20	3300	0.22	10200
Autre	200	0.32	*	n.d.	*	n.d.	200	0.27	400
Total	62100		27200		6100		38100		131300

* Moins de 50 hectares
n.d. Non disponible

B. ASSOCIATION (en hectare)

	DEPARTEMENT DU SUD		DEPARTEMENT DE LA GRAND-ANSE		DEPARTEMENT DE LA SUD-EST		DEPARTEMENT DE L'QUEST		TOTAL	
CULTURE		CV		CV		CV		CV		CV
Mais	15500	0.14	32200	0.15	8600	0.12	5800	0.13	62200	0.09
Sorgho	22900	0.16	33800	0.15	6800	0.12	8000	0.11	71500	0.09
Riz	1100	0.30	4300	0.15	*	n.d.	400	0.44	5800	0.13
Haricot	1000	0.29	1200	0.18	500	0.15	700	0.37	3400	0.13
Pois Congo	21400	0.11	44400	0.11	5700	0.15	9000	0.18	80500	0.07
Pois Inconnu	400	0.30	1600	0.21	600	0.13	900	0.24	3600	0.12
Pois Noir	6300	0.23	13000	0.17	2600	0.22	100	0.24	22000	0.12
Pois Blanc	*	0.42	500	0.37	100	0.25	*	n.d.	700	0.28
Pois Sinistre	100	0.31	500	0.29	200	0.34	*	n.d.	900	0.20
Arachide	2000	0.31	1900	0.21	100	0.51	1800	0.20	5800	0.14
Manioc Amer	9600	0.14	18600	0.11	1800	0.17	7900	0.15	37900	0.07
Manioc Doux	3200	0.21	8400	0.27	1400	0.19	600	0.22	13700	0.18
Patate	11700	0.19	14800	0.11	3000	0.15	5300	0.14	34700	0.08
Igname	10900	0.15	10400	0.08	2900	0.20	100	0.34	24400	0.08
Pomme De Terre	*	n.d.	*	0.27	100	0.20	300	0.40	500	0.25
Malanga	5300	0.25	9500	0.14	300	0.24	*	0.57	15200	0.13
Mazumbel	1200	0.25	2400	0.13	300	0.32	*	0.57	3900	0.1[illegible]
Canne A Sucre	500	0.17	1600	0.27	800	0.20	1000	0.28	3900	0.14
Tabac	*	0.41	100	0.52	*	0.64	*	n.d.	100	0.40
Vetiver	*	0.56	100	0.37	*	0.37	*	n.d.	200	0.29
Coton	100	0.40	100	0.17	*	0.38	*	0.69	100	0.1
Sisal	100	0.39	*	0.70	*	0.47	*	n.d.	100	0.3
Giromon	300	0.37	4600	0.21	100	0.18	100	0.30	5100	0.1
Tomate	*	0.70	400	0.38	*	0.25	*	0.49	500	0.3
Choux	*	n.d.	900	0.27	100	0.27	100	0.40	1200	0.2
Cafe	7900	0.29	12100	0.14	4600	0.09	100	0.40	24800	0.1
Ananas	300	0.41	*	0.37	*	0.25	*	n.d.	300	0.3
Figue-Banane	3200	0.23	2600	0.16	200	0.36	2300	0.30	8400	0.0
Banane	13700	0.19	15100	0.12	4800	0.10	1600	0.16	35200	0.0
Autre	300	0.29	200	0.24	600	0.25	200	0.33	1300	0.0

* Moins de 50 hectares
n.d. Non disponible

C. COMBINAISON (en hectare)

	DEPARTEMENT DU SUD		DEPARTEMENT DE LA GRAND-ANSE		DEPARTEMENT DE LA SUD-EST		DEPARTEMENT DE L'QUEST		TOTAL
CULTURE		CV		CV		CV		CV	
Mais	23600	0.10	34600	0.14	10200	0.10	7800	0.10	76200
Sorgho	44600	0.11	35500	0.14	7700	0.10	12500	0.08	102300
Riz	7100	0.24	5500	0.12	100	n.d.	7000	0.30	19600
Haricot	1300	0.26	1400	0.15	800	0.17	1100	0.26	4600
Pois Congo	22600	0.11	46800	0.10	6000	0.14	12000	0.15	87500
Pois Inconnu	500	0.28	1700	0.21	600	0.12	1100	0.20	3900
Pois Noir	9800	0.18	15500	0.15	3200	0.20	200	0.35	28700
Pois Blanc		n.d.	700	0.30	200	0.23	100	n.d.	900
Pois Sinistre	100	0.29	600	0.26	300	0.27		n.d.	1100
Arachide	2500	0.25	2000	0.20	100	0.38	2200	0.16	6800
Manioc Amer	11000	0.12	19600	0.11	2000	0.16	8600	0.14	41100
Manioc Doux	3600	0.19	9100	0.26	1500	0.18	1200	0.16	15300
Patate	17400	0.14	16500	0.10	3400	0.13	8600	0.11	45900
Igname	11500	0.14	12400	0.09	2900	0.20	200	0.30	26900
Pomme De Terre		n.d.	100	0.24	200	0.17	700	0.29	900
Malanga	5600	0.24	11100	0.14	400	0.22		n.d.	17200
Mazumbel	1400	0.20	2800	0.11	300	0.32	200	0.44	4800
Canne A Sucre	5100	0.19	3500	0.20	900	0.20	11100	0.20	20600
Tabac	500	0.36	200	0.29		0.49		n.d.	800
Vetiver	500	0.25	200	0.32		n.d.		n.d.	600
Coton	200	0.32	100	n.d.		n.d.		n.d.	200
Sisal	200	0.33	0	0.44	300	0.67	100	ERR	500
Giromon	300	n.d.	4700	0.21	100	0.17	100	0.26	5200
Tomate	100	0.35	600	0.29		0.25	1000	0.28	1700
Choux		n.d.	1100	0.23	200	0.24	300	0.28	1600
Cafe	8900	0.26	15300	0.14	5500	0.08	400	0.24	30100
Ananas	300	n.d.		n.d.		n.d.		n.d.	400
Figue-Banane	3400	0.22	2600	0.15	200	n.d.	2700	0.26	8900
Banane	16700	0.15	18700	0.10	5100	0.09	5000	0.16	45400
Autre	600	0.21	200	n.d.	600	n.d.	300	0.21	1700

Moins de 50 hectares
n.d. Non disponible

TABLE I-2

CONTRACT LABOR COSTS BY AGRICULTURAL ACTIVITY AND INPUT EXPENDITURES FOR FOND-DES-FRERES (IN GOURDES/HA)

Activity/Expenditure	Crop					
	Maize	CV	Sorghum	CV	Bean	CV
1. Seeds	20	27%	32	42%	226	20%
2. Soil Preparation	268	47%	252	54%	264	44%
3. Seeding	94	33%	116	45%	142	51%
4. 1st. Weeding	230	47%	161	66%	189	64%
5. Harvesting	116	43%	104	49%	97	56%
6. Threshing	-	-	67	48%	-	-
SUBTOTAL (Excluding Item #6)	728		665		918	
TOTAL	728		732		918	

N.B. The values are averages calculated from the number of households responding to each activity and not from the number of households interviewed per crop.

CV Coefficient of variation.

(-) Data not applicable and/or not available.

TABLE I-3

CONTRACT LABOR COSTS BY AGRICULTURAL ACTIVITY AND INPUT EXPENDITURES FOR BERAULT (IN GOURDES/HA)

Activity/Expenditure	Crop									
	Maize	CV	Sorghum	CV	Bean	CV	Paddy Rice	CV	Upland Rice	CV
1. Seeds	50	48%	46	42%	424	35%	283	41%	180	30%
2. Soil Preparation	210	16%	265	30%	273	22%	377	60%	423	41%
3. Seeding	108	58%	87	69%	116	58%	-	-	52	43%
4. Transplanting @	-	-	-	-	-	-	206	41%	-	-
5. 1st. Weeding	194	69%	145	40%	168	74%	150	39%	188	44%
6. 2nd. Weeding	-	-	91	40%	104	30%	80	0%	81	38%
7. Irrigation	-	-	-	-	65	13%	-	-	-	-
8. Apply Fertilizer	-	-	57	34%	66	9%	77	30%	-	-
9. Fertilizer	211	31%	227	52%	286	62%	401	39%	-	-
10. Apply Insecticide	-	-	62	31%	48	0	-	-	-	-
11. Insecticide	-	-	101	60%	82	47%	-	-	-	-
12. Harvesting	61	39%	106	29%	73	37%	357	32%	264	68%
13. Transport	77	8%	68	43%	80	0%	93	64%	80	0%
14. Threshing	106	8%	79	43%	93	71%	347	13%	-	-
SUBTOTAL of 1-3, 5, 9, 12	834		876		1340		1568		1107	
TOTAL	1017		1334		1878		2371		1268	

@ Applicable to paddy rice only.

N.B. The values are averages calculated from the number of households responding of each activity and not from the number of households interviewed per crop.

C.V. Coefficient of variation.

(-) Data not applicable and/or not available.

Apply Fertilizer Application of fertilizer.

Apply Insecticide Application of Insecticide.

TABLEAU I-5

IMPORTATIONS D'ENGRAIS CHIMIQUES
(1977 - 1982)

Importations Engrais Annee	Quantite Kilos	Valeur en Gdes
1977-1978	2.163.843	3.029.380
1978-1979	7.585.757	10.869.280
1979-1980	3.707.902	5.233.203
1980-1981	8.363.422	16.457.957
1981-1982	5.760.885	3.790.442
TOTAL 1977-1982	27.581.809	44.380.262

Source: Administration Generale des Douanes, Haiti.
MARNDR, 1987.

TABLEAU I-4

IMPORTATIONS DE PESTICIDES
(1977 - 1982)

Importations Pesticides Annee	Quantite Kilos
1977 - 1978	528.620
1978 - 1979	460.862
1979 - 1980	649.248
1980 - 1981	735.338
1981 - 1982	1.054.210

Source: Administration Generale des Douanes.

TABLEAU I-6

IMPORTATIONS DE SEMENCES
(1977 - 1982)

Importations Semences	Quantite Kilos	Valeur en Gdes.
1977 - 1978	116.616	712.541
1978 - 1979	507.656	2.317.833
1979 - 1980	94.824	944.809
1980 - 1981	478.948	1.864.029
1981 - 1982	340.084	2.233.152

Source: Administration des Douanes, Haiti. MARNDR, 1987.

TABLE I-7
DISTRIBUTION OF AGRICULTURE TOOLS BY FARM SIZE

NUMBER OF TOOLS BY TYPE

Farm Size	Number of:													
	Farms	Tractors	Plow	Hoes	Machetes	Sickles	Picks	Dig/Bars	Spades	Rakes	Shovels	Sprayer	Other	Total
Global	1,500	-	7	1,493	1,314	960	277	286	30	22	37	-	52	4,478
0,01-0,49	600	-	-	525	443	285	60	45	15	7	7	-	7	1,394
0,50-0,99	420	-	7	465	375	293	60	53	15	-	15	-	30	1,313
1,00-1,99	345	-	-	375	353	270	135	143	-	7	15	-	15	1,313
2,00-4,99	120	-	-	113	128	97	15	37	-	-	-	-	-	390
3,00-9,90	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10,00-19,90	15	-	-	15	15	15	7	8	-	8	-	-	-	68

TABLE I-8

PRODUCTION, AREA AND YIELDS OF PRINCIPAL CROPS BY REGIONS IN 1979 (1)

	Production MT					Area Hectares					Avg yield, Kg/ha.				
Crop	N	T	W	S	Haiti	N	T	W	S	Haiti	N	T	W	S	Haiti
Maize	23903	61377	35930	62121	183331	36334	74438	53018	69959	233749	658	825	768	888	784
Millet/ Sorghum	3330	53975	10453	23524	123282	10325	66687	41902	38051	156696	331	839	965	618	787
Rice	13055	94015	4721	10325	122116	7059	36340	3158	7419	53996	1850	2587	1494	1392	2262
Beans (dry)	11576	13047	16885	11190	52695	16128	21554	28460	23536	89678	718	605	593	475	588
Pigeon Peas	3473	10070	6417	5651	25541	7240	24829	18744	18567	69380	480	406	342	304	368
Beans	4002	4992	2856	2243	14093	6886	14029	9839	6420	39174	450	355	290	349	360
Peanut	9762	6872	12277	6629	36629	12860	8872	17560	7770	47062	753	776	699	853	754
Sesame	1362	1528	491	744	4125	4609	5549	1342	2387	13887	296	275	366	312	297
Manioc	63927	76037	51041	62351	253356	14909	19374	12732	15846	62861	4288	3925	4008	5197	62861
Yams	17486	27466	21277	43928	110157	6777	6174	11909	33639	2583	3129	3446	3689	3275	
Sweet Potato	49868	78993	65436	70491	264788	12209	18179	15715	16427	62530	4085	4345	4164	4291	4714
Plaintain	79020	100939	52649	68666	301274	10364	14.802	8825	13493	47484	7624	6819	5966	5089	6345
Coco Yam	3959	15472	6015	13683	39129	1869	8728	3431	7176	21204	2342	1773	1753	1907	1845
Banana	52335	44307	48613	64975	210230	9642	7362	6738	12876	33618	6056	6018	7215	5008	6253
Total Food	337057	571090	350061	446521	1740746										
Coffee (4)	7117	5876	10032	12844	35900	33678	18196	40047	45617	137618	1262	1929	1496	1632	1558
Cocoa (3)	2052	2088	1814	5502	11456	632	645	188	3105	4570	3252	195	1771	1507	
Cotton	491	2472	1039	5589	1342	5046	4419	2819	13646	366	490	133	369	410	
Rural Pop. 1971 (1000)	582	1007	1027	913	3529										
Food Prod. (2) per capita	579	579	341	389	493										

(1) From DATPE Ministry of Plan: Regions et Stratégie de Développement Régional (1984)
(2) Based on rural population
(3) Cocoa production has remained on average around 3000 Mt per year, but 1979 was an exceptionaly good production year.
(4) Coffee figures are from OPRODEX

N = North region
T = Transversal region
W = West region
S = South region

APPENDIX II

ATTACHMENTS

TABLE II-1

PHYSIOLOGICAL, DISEASE AND INSECT PROBLEMS OF THE MAJOR CROPS GROWN IN HAITI (FROM VARIED SOURCES)

CROP	PHYSIOLOGICAL PROBLEM	DISEASE	CONTROL	INSECTS/ENEMIES	CONTROL
Corn	N Deficiency	Helminthosporiose (leaf spot) (f.)	Pungicide (Beulate, Capten)	Spodoptera frugiperda (eat the leaves)	Insecticide,cultural practice alternate rows of sun-flowers or cotton
		Ustilago maydis[2] (f.) (Charbon)	Pungicide, Resistant Variety		
		Cercospora maydis (spots on the leaves) (f.) (ST Raphael)	Pungicide		
		Downy Mildew	Resistant Variety	Heliothis sp (ear worm)	Insecticide as Sevin, Malathion
		Corr Stusit (Virus Mycoplasma)	Resistant Variety		
Sorghum/Millet	N Deficiency Weeds[3] Sterility	Tolyposporium penicillarias "charbon" of the pamicle (f.) caused by Sphacelotheca reiliana	Pungicide, Resistant Variety	Cecidoniyis, Geromya Permiseti, Contarinaria Sorghicola	Early maturing Varieties
		Mildew (f.) (Sclerospora granimicola)	Pungicide		
Rice	N Deficiency Zn Deficiency	Piriculariose (Piricularia oryzae)	Cultural Practices Decrease N doses Adequate Irrigation	Rats caused 15% of loss in the Artibonite Valley during rainy seasons	Zn Phosphorus and other raticides
		Helminthosporiose	Good Drainage silicium	Bugs (Nezara viridula) During cooler seasons	Insecticide
		Blast Rust			
		NB - For all grains in stocks bacterias and fungi in humid conditions.	Pungicide	Birds - "madam sarah"	Scarecrow
				Grain stock insects	Drying

CROP	PHYSIOLOGICAL PROBLEM	DISEASE	CONTROL	INSECTS/ENEMIES	CONTROL
				Sitophilus orizae Tribolium spp. Colandra orizae Trogodermia granarium Rhizoperta dominica Rats, mice	Insecticide Raticide
PULSES					
Common Beans		Golden Mosaic (V. in the plains Anthracnosis (f.) Angular spot disease Rust (the last three diseases in the highlands)	Resistant varieties such as Tamazulapa Pungicide Resistant Varieties	Belrisia, tobacci vector of mosaic, Empoasca fabae (leaf hoffers)	Insecticide Insecticide
Cow pea		Mosaic	Resistant Variety	Cowpea weevil Aphids Beetles (in storage)	Insecticide Insecticide Insecticide
ROOTS AND TUBERS					
Cassava		Cercospora			
Sweet Potatoes				Cylas formicarius (weevil) Beetles	Resistant Varieties from IITA, Cultural practices
Yam				Heteroligus Soil insects in general	Insecticide such as Diaziuon cultural practice
Potatoes		Pseudomonas solanacearum (b.)	10-80% attacks Resistant Variety from CIP	Phtorimaea opercullela Diabrotica	Insecticide Insecticide

CROP	PHYSIOLOGICAL PROBLEM	DISEASE	CONTROL	INSECTS/ENEMIES	CONTROL
		Phytophtora (f.) infestans (mildew) Rhizoctonia solani Alternaria solani Powdery scab Mosaic (v.)	Fungicide not used (important disease) Fungicide	Epitrix Aphid (Myzus persicae) Aspidielli attack tubers in stocks	Insecticide
EXPORT/INDUSTRIAL CROPS					
Coffee	Aging, too much shade	Cercospora coffeicola Roselinia necatrix (f.) (f.) in Petit Goave Fumagina (f.) Rhizoctonia solani (in nurseries)	Fungicide Fungicide Fungicide	Leaf miners (Leucoptera coffeicola) Pianococcus citri Nematods	Insecticide Insecticide Nematicid
Cocoa	Too much shade	Phytophtora palnirvora (f.) Monilia sp.	Fungicide resistant variety	Helopeltis (miridae) nematods	
Sugarcane		Anthracuose loss 5-15% in Les Cayes in Plateau Central Rust from Dominican Republic	Project - 20 resistant varieties financed by PL480 Title III	Pyraustia rubilalis (borers)	Insecticide Cultural practices
Cotton				Boll weevil	Cotton plow down Insecticide
FRUIT TREE					
Coconut		Lethal yellowing disease (v.)	Dwarf resistant varieties. Trial with var. from Ivory Coast at CRUDEM Farm	Stratasgus quadrifoveatus (rhinoceros)	Insecticide

CROP	PHYSIOLOGICAL PROBLEM	DISEASE	CONTROL	INSECTS/ENEMIES	CONTROL
Mango		Authacuosis (Collectotrichum gloeasporioirdes) Powdery Mildew (Oidium sp.)	Resistant varieties from Indonesia and and Philippines	Scab (Elsinoe mangifera)	
Avocado		Phytophtora (root rot) in low lands			
Banana	Fe deficiency in calcareons soils	Moko disease (b.) (cul-de-sac) Cercosporioce (leaf spot)	Resistant varieties	Cosmopolites sordidus Nematods	Insecticide Nematicide
Citrus	Mg deficiency	frimagina (f.) (most common) Tristera (v.) or sour orange used as root stock	Fungicide Resistant varieties	Aphid Mealy bugs (Planococcus citri)	Insecticide Insecticide
Cashew	Aging	Authracuosis serious problem in producing areas	Resistant Varieties from Brazil, India Tanzania	Thrips	
VEGETABLE					
Tomato		Tobacco mosaic Fusanium (f.) authracnosis damping off	Resistant varieties Fungicide	Cut worms, flea, beetles, white flies, fruit worm, aphids, ants, beetles, bugs, worms, mites are the most common insects.	Insecticide

NB - Legend: f = Fungal Disease
b = Bacterial Disease
v = Viral Disease

Control = Chemical pest control (insecticide, fungicide...) are not used by the small traditional farmers except in some areas and for high-value crops such as rice, vegetable or some industrial crops as sugar cane and cotton.

Poor agronomic practices hide the effects of the damage made by the pests. A thorough study to identify the pests, their incidence, the resistance of the traditional varieties is needed.

The Plant Protection Service of the MARNDR is soon going to publish a booklet on the main pests affecting the major crops in Haiti. This work is financed by the PL480 Title III.

2 This disease, Ustilago maydis affects the varieties from CIMMYT. Since corn with this disease is a favorite dish in Mexico, the varieties are not selected against this disease. It is different for the Haitians. Therefore, the cultural aspect should be taken into account in the introduction of crops and varieties.

3 Weed pests are not included in the table. Crops are not weeded on time generally.

TABLE II-2

RESEARCH SERVICE CAPHADO
/
Julio Barthelemy, DARNDR
HAITI

Beverages	Planting Season	Harvesting Season
Cacao (main crop)		
(spring crop)		March - June
Coffee (up to 1000 ft.)	May - June	August - October
(1000 - 3000 ft.)	May - June	September - November
(over 3,000 ft.)	May - June	Throughout Year
Cereals and Grains		
Corn (Mountains)	July - September 1/	October - November
(Plains)	February - April (N)	September - November (N)
	January - February (S)	April - May (S)
Rice 2/ (Artibonite)	October - November	March - April
(South Coast)	April - May	August - September
Feedstuffs		
Bengal Beans	April - May	August - September
Kudzu	May - June	December - January
Fibers		
Cotton (Annual)	September	November - January
(Perennial)	January - April	January - April
Sisal	April - November	Begins 3 years after planting
Fruits		
Avocadoes	April - May (S)	June - November
	September - October (N)	June - October (N)
Bananas	October - November (N)	Throughout Year (N)
	April - May (S)	Throughout Year (N)
Breadfruit	September - October (N)	June - November (N)
	April - May (S)	April - November (S)
Citron	March - April (S)	June - November (S)
	September - October (N)	June - November

1/ (N) Northern part of Haiti
(S) Southern part of Haiti
2/ Can be planted anytime water is available.

Coconut	April - May (S)	June - November (S)
	October - November (N)	June - November (S)
Limes	September - October	June - November (S)
Mangos	September - November (N)	June - August (N)
	April - May (S)	April - September (S)
Sweet Orange	May - June (S)	November - April (S)
	September - October (N)	November - April (S)
Papaya	April - May (S)	Throughout Year
	September - October (N)	Throughout Year
Oilseeds		
Peanuts	April - August (S)	August - September
	October - November (N)	March - April (N)
Miscellaneous Crops		
Sage	March - April	
Sugarcane	April - May (S)	January - July
	October - November (N)	January - July
Tobacco (Seedbeds)		
Saint-Marc Area	July - August	
Bassin Bleu Area	July - August	
St. Raphael	February - March	
Tobacco (Transplanting)		
St. Marc Area	September - October	December - January
Bassin Bleu Area	September	December - January
St. Raphael	April - July	September - October
Vanilla	April - May	
Vegetables		
Artichoke (Mountains)	April - June	January - August
Kidney Beans (Mountains)	April - September	June, July, Nov., Dec.
(Plains)	November - December	February - March

Lima Beans	April	September - October
Cabbage (Mountains) (Plains)	April - June September - December	August - March January - March
Cantaloup (Plains)	April - May	August - November
Cassava[3/]	April - June (S) October - November (N)	12-24 Months Later 12-24 Months Later
Cauliflower (Mountains)	September - December	January - April
Chili Pepper	April - May September - October	Throughout Year Throughout Year
Eggplant	August - November	Throughout Year
Garlic	April - May (S) September - October (N)	
Lettuce (Mountains)	November - January	January - April
Onions (Low Elevations)	September - December	March - April
Congo Peas	Perrennial but mainly planted in April	All year but mainly September - October
Cowpeas	March - April	July - August
Potatoes (Mountains)	October - December March - April	April - May August - October
Tomatoes	October - December	February -April

3/ Called Manioca in Brazil.

N.B. Further information will give much more complete data on all crops grown in Haiti. This is just a draft guide which is to be revised in the near future.

Julio Barthelemy
Research Agronomist

TABLE II-3

CROP SUITABILITY ZONING

A computer analysis was made of the MAI values for Haiti.

The number of consecutive months with MAI values exceeding 0.33 and the average MAI for those consecutive months were calculated. These calculations were used to zone Haiti into six climatic divisions.

The following zones are shown on a map presented as Figure: A-1

ZONE 1

This zone is generally not suitable for the production of cultivated crops without irrigation. Locations having all months with MAI less than 0.33, those with only one month with MAI greater than 0.33 and bi-modal climates with one month with MAI exceeding 0.33 then several dry months and then another month with MAI greater than 0.33 are including. The MAI values for the rainy month are usually low.

ZONE 2

The areas of lower rainfall are generally characterized by bi-modal precipitation. The two rainy periods are usually separated by two or more dry months (usually June and July). Zone 2 generally has two rainy months followed some months later by two or more rainy months with MAI values exceeding 0.33. Climates with two rainy months and then later one month of usable rainfall or one month followed later by two months are also included. For the periods of two rainy months the average MAI value found is 0.51 with a standard deviation of 0.10 (68 percent of the MAI values are between 0.41 and 0.61).

Average potential evapotranspiration for the two months is about 320 mm. Rainfall is dependably available to supply somewhat more than half this amount. Crops requiring 60 days or less for production can be produced. Application of fertilizers should not exceed about 50 percent of normal amounts. Some millets and mungbeans mature in 60 days or less.

Rainfall is useful for plant growth only when it enters the crop root zone and becomes available to the plant. Some measures may be necessary in order to conserve rainfall.

ZONE 3

The precipitation in this zone is also bi-modal. The minimum growing season consists of three rainy months and in some areas there may be both a three month and a four month rainy season. The average MAI for these three and four month periods is 0.63 with a standard deviation of 0.17.

Some varieties of beans, groundnut, millet, sorghum, soybeans and vegetables can be produced. Yields under rainfed agriculture will be low. Application of somewhat more than half or normal rates of fertilization may be considered.

Experience with the black soils at ICRISAT (International Crop Research Institue for the Semi-Arid Tropics) in India under similar conditions of rainfall amounts and climate has indicated the advantages of broad (1.5 m width) beds and furrows on flat (about 0.5 percent) slopes. On the heavier soils this system improves surface drainage and also slows runoff increasing the opportunity time for water to penetrate into the soil. Increases in gross crop value have usually been threefold.

ZONE 4

The rainy season (number of consecutive months of precipitation such that MAI values exceed 0.33) in this zone varies from five to six months. The average MAI is 0.70 with a standard deviation of 0.12. Rainfall is usually dependable enough that with the application of somewhat over 100 kg of nitrogen good yields of maize (corn) can be produced on the better soils under good management. If conditions are favorable, yields of six to eight tons per hectare should be possible. Good drainage is a requisite. Some double cropping is possible.

ZONE 5

This zone has a rainy season of seven to nine months. The average MAI IS 0.86 with a standard deviation of 0.15. With good water conservation, adequate drainage management the climate is suitable for production of high yields of a large number of crops.

Large areas are mapped as zone 5E. These locations have two or more months of excessive rainfall. Good natural or artificial drainage is required for most general crops. Rainfed rice production is recommended on the areas of favorable soils and topography. Grapefruit and sugarcane can be considered for rainfed production on suitable soils and topography. Coffee produces well at suitable elevations.

ZONE 6

The rainy season extends to from ten to twelve months. Most of this zone is mountainous. On suitable soils and topography rice, bananas, plaintain, grapefruit, pineapple and sugarcane can be considered. The average MAI is 0.92 with a standard deviation of 0.10. Significant areas have two or more months of excessive precipitation. These locations are shown as zone 6E.

Rainfall is generally sufficient so that normal applications of fertilizers should be considered provided other management practices are satisfactory.

TABLE II-4

CROP ZONES (FRENCH)

Zone 1

Cette Zone designe les regions ou les chutes de pluie sont insuffisantes pour les cultures toute l'annee. Dans certains cas, il peut y avoir suffisamment de pluie deux mois par na, mais avec des chutes de pluie favorables separes par plusieurs mois secs. Par consequent l'irrigation est generalement requise pour la culture dans cette zone.

Zone 2

Cette zone designe les regions d'Haiti a faible chute de pluie avec deux saisons pluvieuses d'environ deux mois de duree, separees par plusieurs mois secs. Dans certains cas, une saison pluvieuse peut durer de un a trois mois. On pourrait dire qu'avec de bons sols et des pratiques de labourage adequates, cette zone conviendrait a des denrees annuellles a saison courte (60 jours).

Zone 3

Cette zone designe les regions d'Haiti qui ont deuz saisons pluvieuses qui durent de trois a quatre mois. Bien que les rendements pourraient etre vas, un grand nombre de produits resistant a la secheresse peuvent y pousser.

Zone 4

Cette zone designe les regions d'Haiti qui ont seulement une saison pluvieuse qui dure de 5 a 6 mois. Dans cette zone l'humidite n'est pas une contrainte pour un grand nombre de cultures annuelles.

Zone 5

Cette zone designe les regions d'Haiti qui ont une saison pluvieuse qui dure de 7 a 9 mois. Dans cette zone l'humidite n'est pas une contrainte pour un grand nombre de cultures annuelles et perennes.

Zone 5 E

Cette zone designe une sous-region de la zone 5 dans laquelle au moins deux des mois de la saison pluvieuse ont de tres fortes averses qui pourraient reclamer un drainage pour la production de certaines cultures.

Zone 6

Cette zone designe les regions ou la saison pluvieuse s'etend sur dix a douze mois. Des pluies excessives dans cette zone representent une grande contrainte a la production d'un grand nombre de denrees.

APPENDIX III

FIGURES AND DIAGRAMS

Figure III-1
LES CULTURES LES PLUS COMMUNES
DANS QUATRE DEPARTMENTS - 2eme Saison

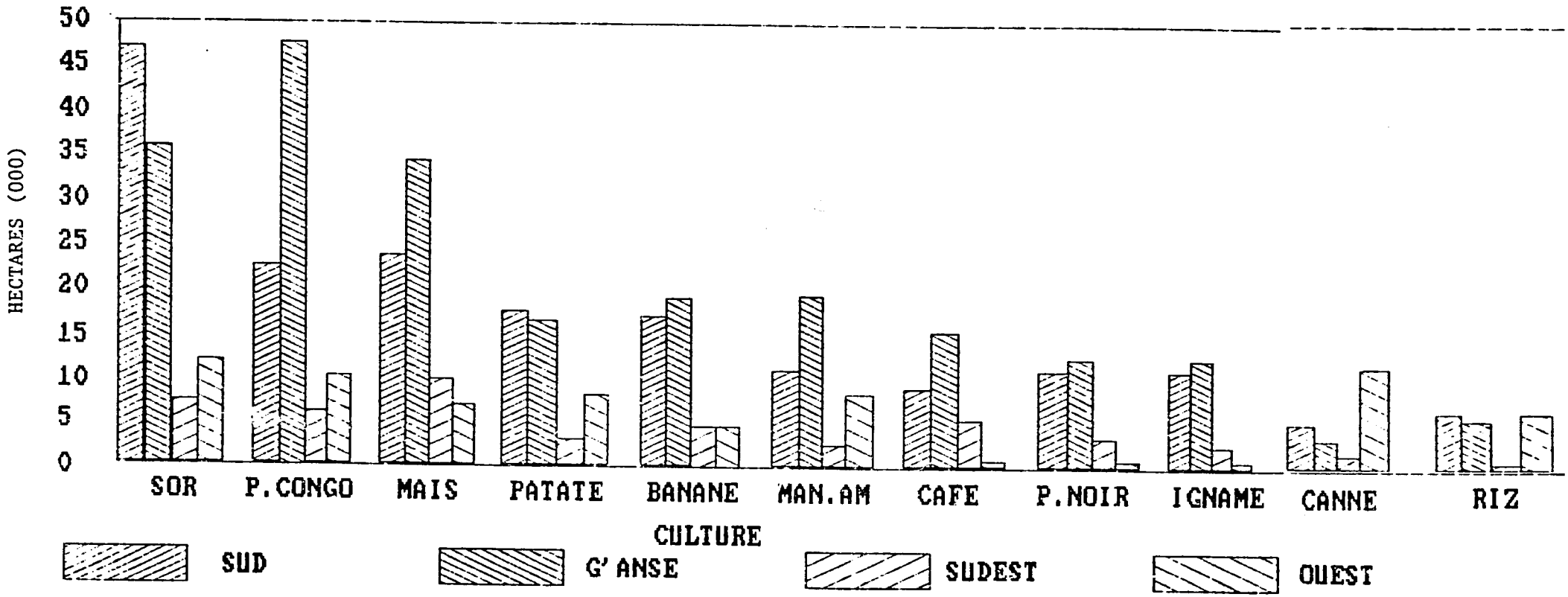
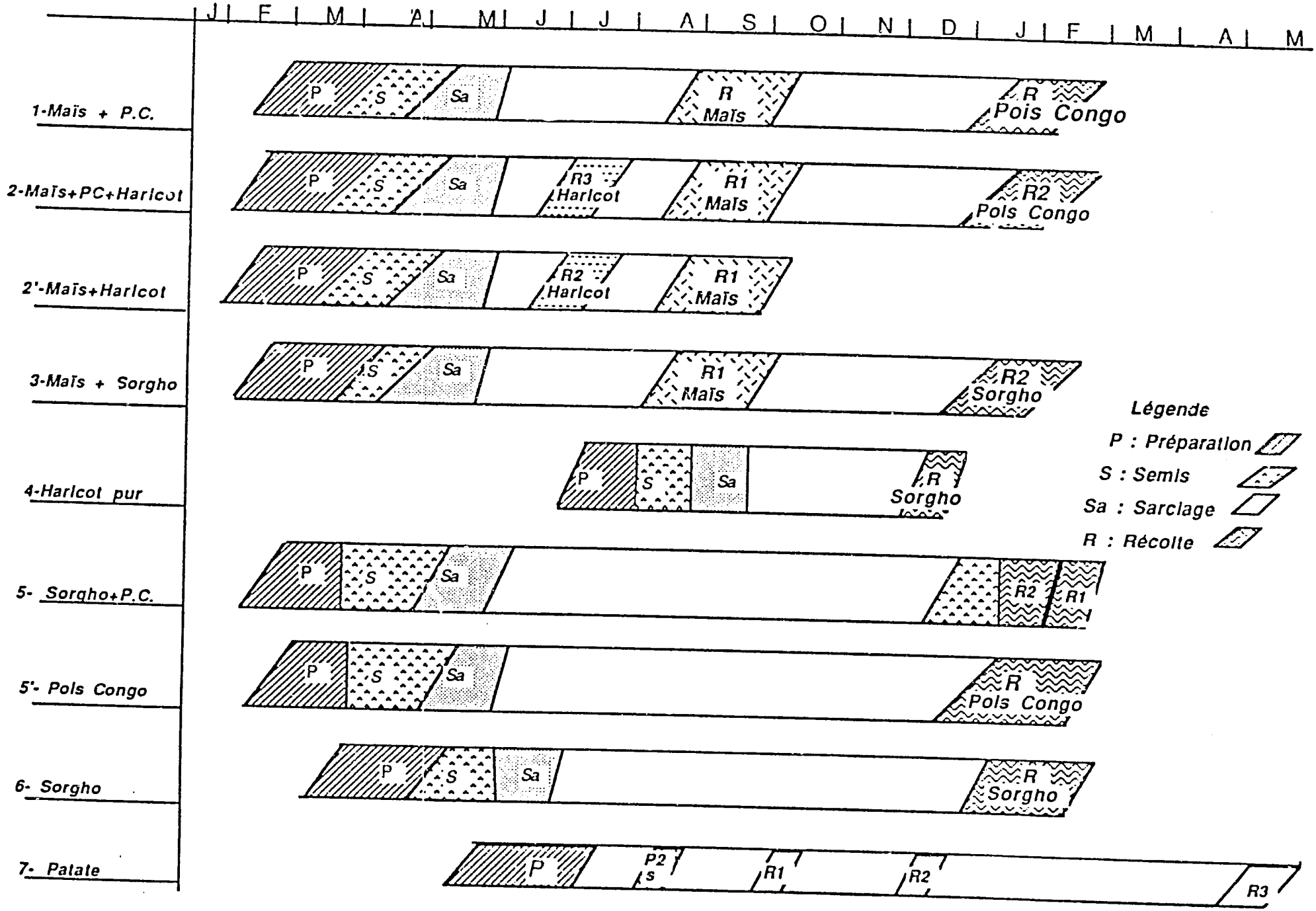


FIGURE III-2

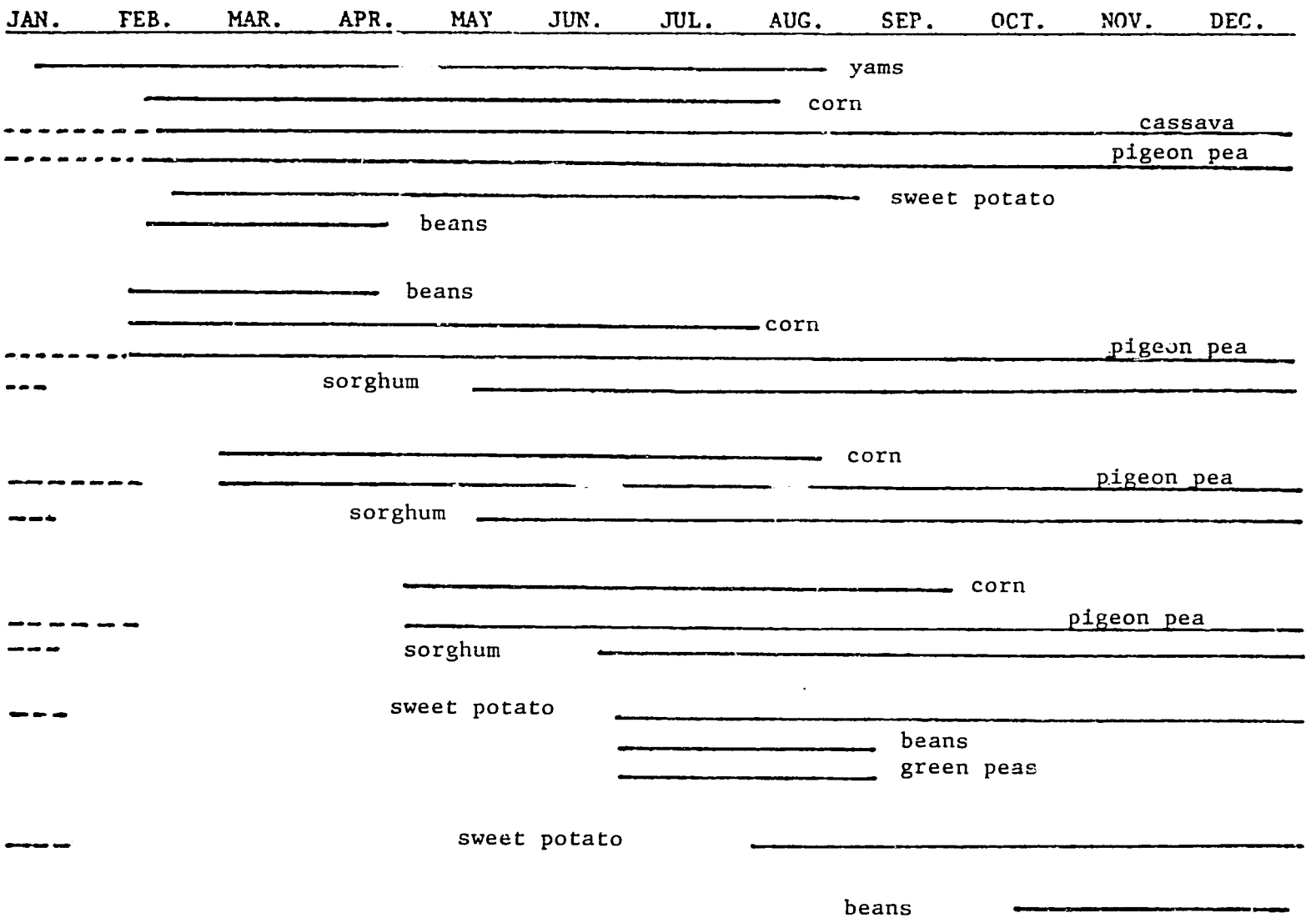
CALENDRIER CULTURAL



Source: STABV, 1987. Catalogue

FIGURE III-3

CROP CALENDAR

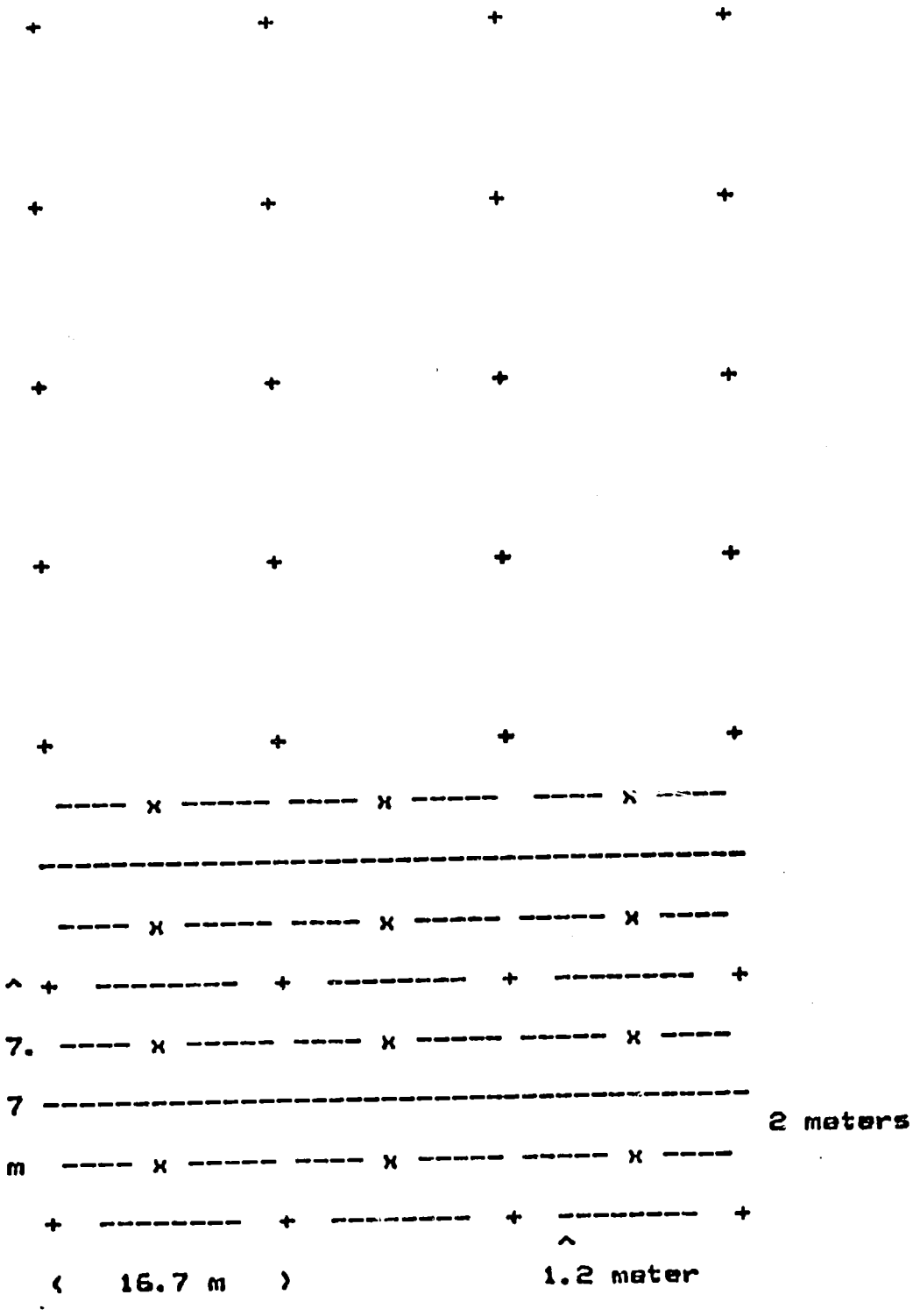


Source: Bellaude, A., 1985

FIGURE III-4

"SMALL COFFEE FARMER PLANTING MODULE"

1/4 HECTARE



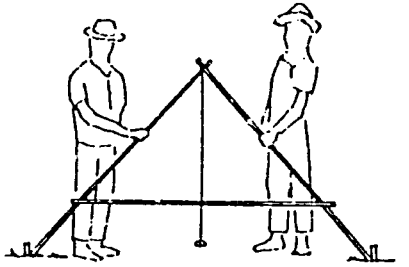
Legend: Interspace of 2 meters vegetable crops; 1 to 1/2 years + fruit trees; x Bananas; - Coffee.

[Not on Scale]

FIGURE III-5

RECOMMENDATIONS POUR LA CULTURE SUR PENTE

Structures permanentes
labourage du terrain
plantes pérennes
et semi etablies
en courbe de niveau
avec le „NIVO A"



Pois congo

Pois congo

Pois congo

Mur sec
légumineuses
arbustives

Petit terrasse
Banane
Canne à sucre
Arachides
Légumes

Culture saisonale
sur billon
Manioc
Batate douce
Pois divèrs

Canal contour
ou fossé
d'infiltration

légumineuses
arbustives

herbes
fourragères

∢ 35-50%

Culture
saisonale
Maïs
Sorgho, Millet
Pois divèrs
Manioc

Petites
terrasses
en courbes
de niveau

légumineuses
arbustives

herbes
fourragères

∢ 35-50%

Culture saisonale
Maïs
Sorgho, Millet
Pois divèrs
Manioc

plus ∢ 50%

Reboisement

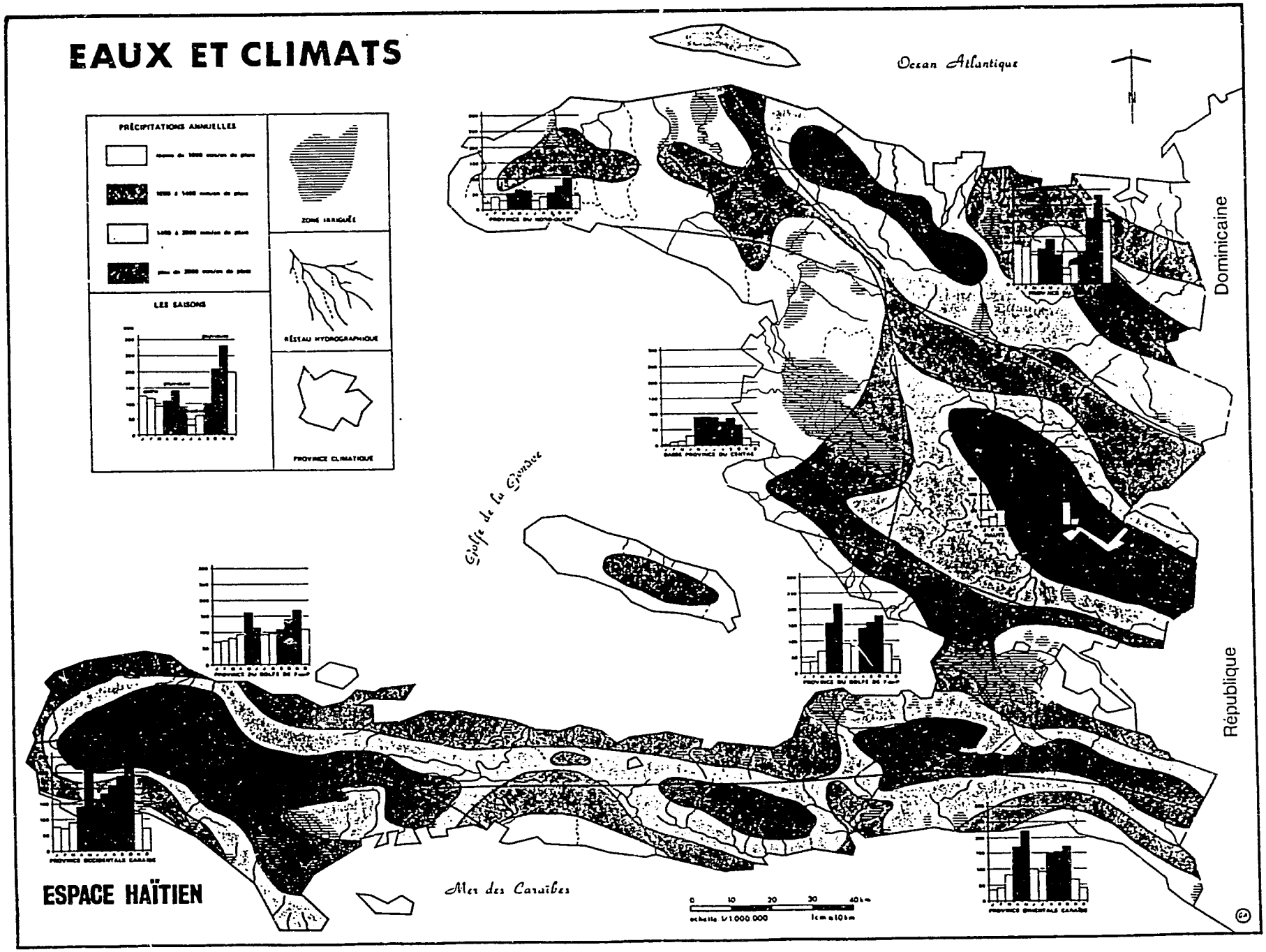
herbes et légumineuse
fourragères

8

APPENDIX IV

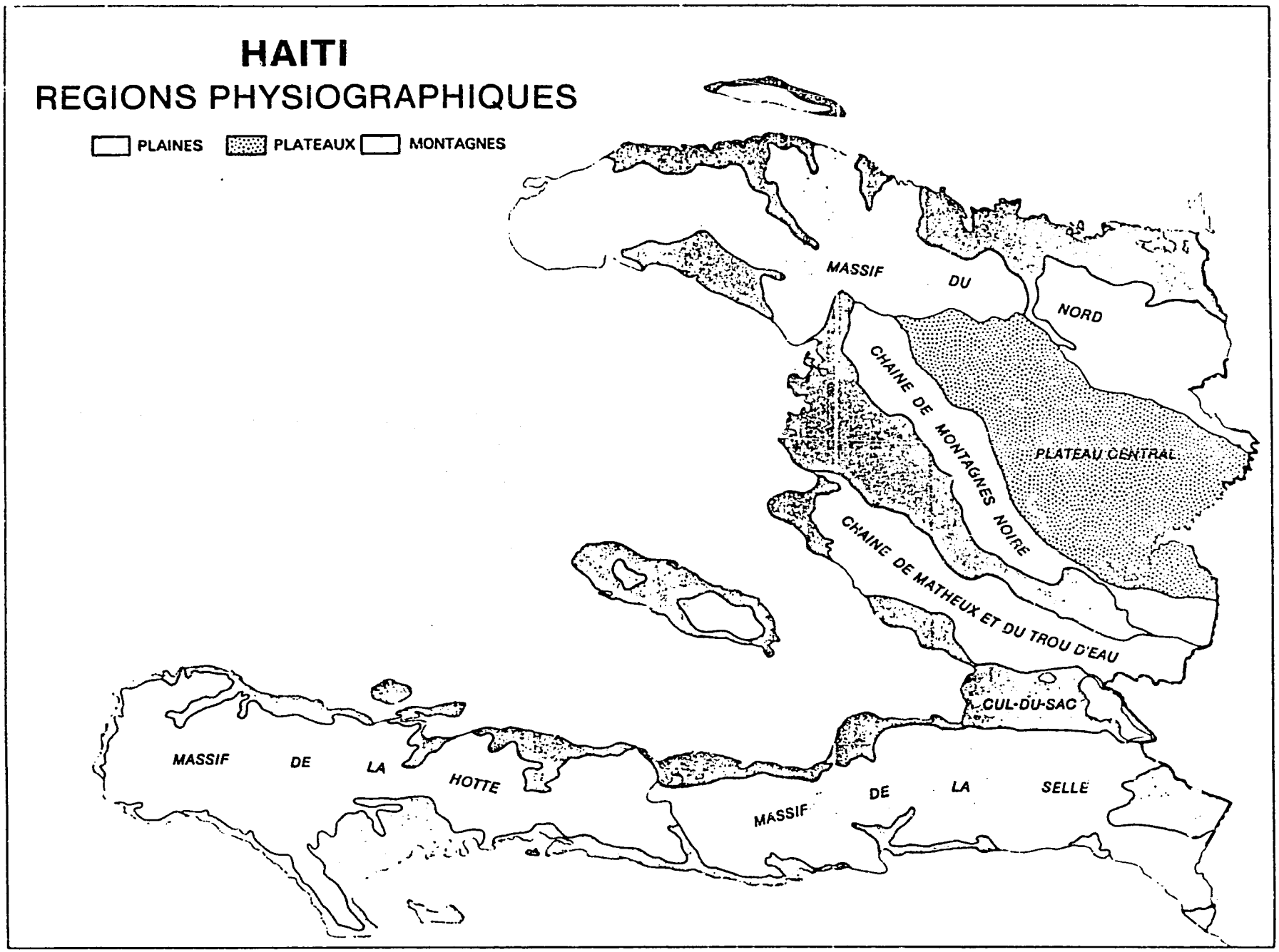
MAPS

MAP IV-1



Source: Georges Anglade, 1982

MAP IV-2



General Physiographic Region of Haiti
Source: CEP

PREPARED BY WILCOX ASSOCIATES

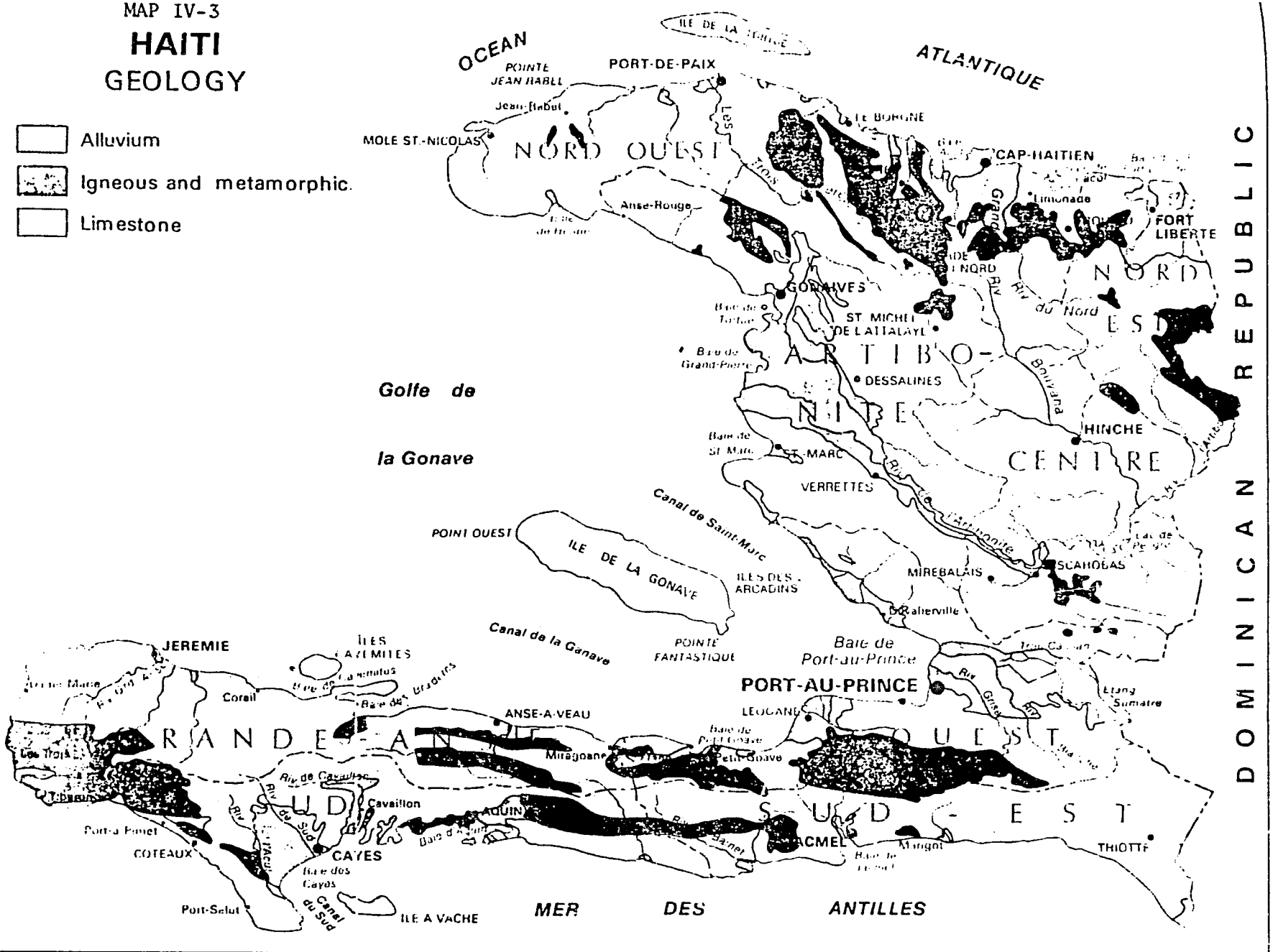
MAP IV-3

HAITI
GEOLOGY

Alluvium

Igneous and metamorphic.

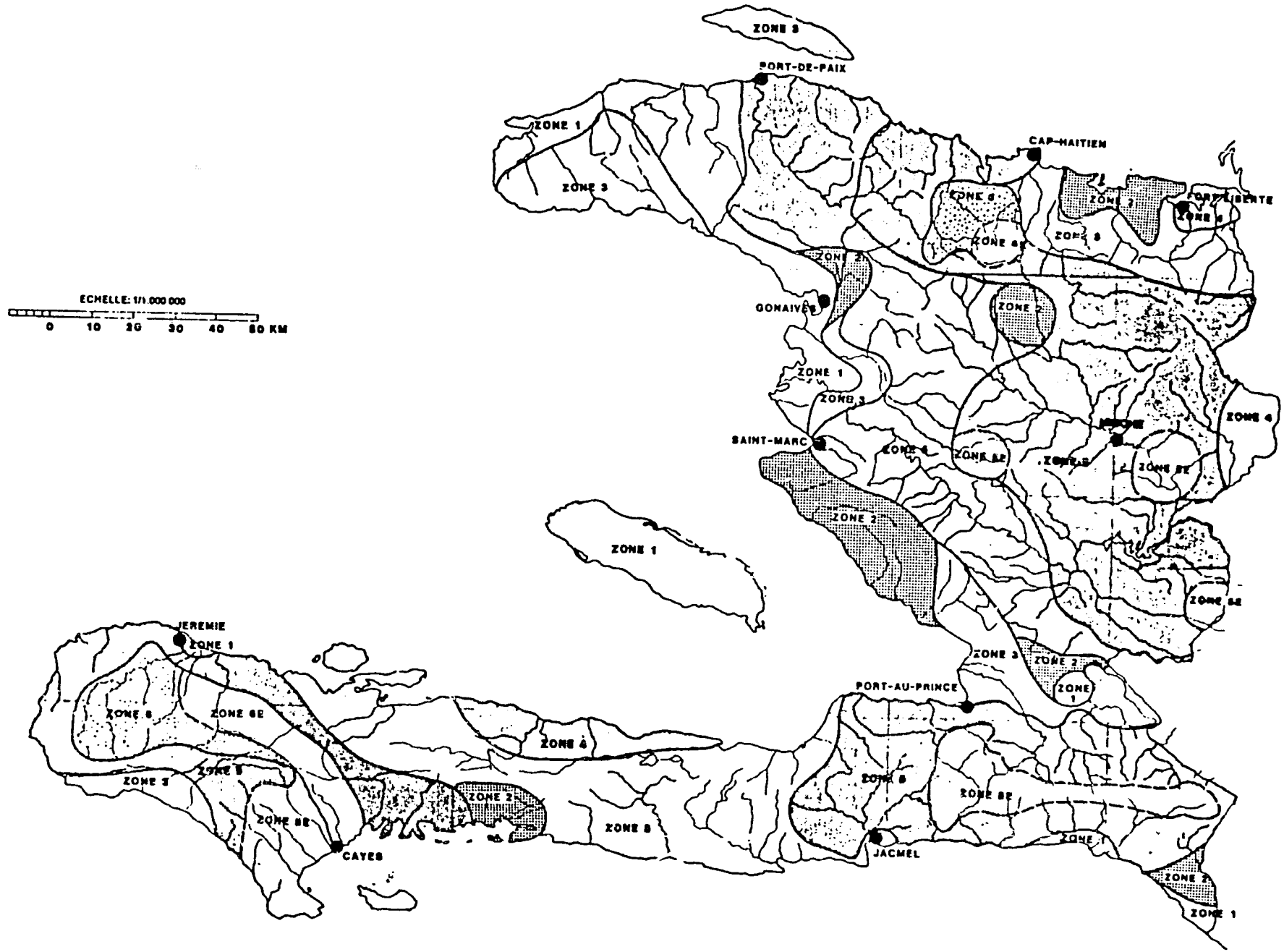
Limestone



PREPARED BY WILCOX ASSOCIATES

Generalized geologic map of Haiti from OAS, 1972
Source: CEP

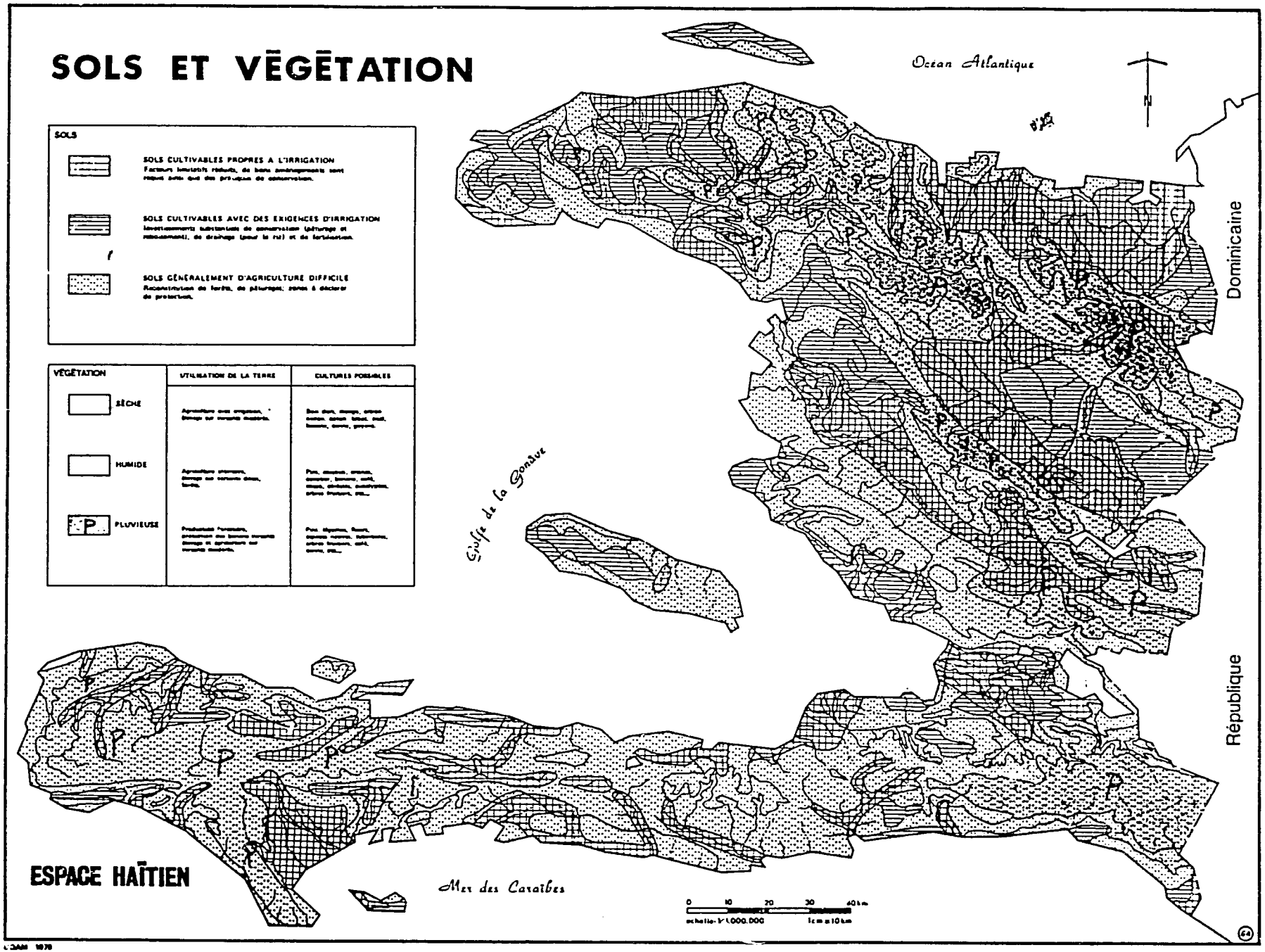
MAP IV-4



Crop Suitability Zones

Source: Hargreaves G. and Z.A.S. ANI, 1983.
From CEP

MAP IV-5


SOLS ET VÉGÉTATION
SOLS
SOLS CULTIVABLES PROPRES A L'IRRIGATION
SOLS CULTIVABLES AVEC DES EXIGENCES D'IRRIGATION
SOLS GÉNÉRALEMENT D'AGRICULTURE DIFFICILE
VÉGÉTATION
SÈCHE
HUMIDE
PLUVIEUSE
UTILISATION DE LA TERRE
CULTURES POSSIBLES
Océan Atlantique
Golfe de la Gonâve
Mer des Caraïbes
Dominicaine
République
ESPACE HAÏTIEN

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