AGRICULTURAL DEVELOPMENT SUPPORT II
HAITI

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HOW CAN SMALL FARMERS INCREASE THEIR MAIZE YIELD IN HAITI ?

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#36

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I. INTRODUCTION

I.1 THE IMPORTANCE OF MAIZE IN HAITI.

Informal observations and organized surveys have shown that the Indian corn or maize (Zea mays) constitutes one of the most important crops in Haiti. In irrigated and rainfed areas, at different altitudes, in monoculture or in different crop associations, there are usually two planting seasons of maize in Haiti each year. The first planting season starts with the first rains of February or March. Following a relatively dry period in June and July, the second planting season begins with the first rains of August. Table 1 presents summary results of surveys conducted in 1984 in two areas of Haiti (Jacmel, Les Cayes) by the Agricultural Development Support II (ADS-II) Project with mountain and plain sites in each one. (See Table 1, Page 2).

In Haut-Cap-Rouge/Jacmel, between 600 and 800 meters, a sample of 60 households cultivating a total of 288 plots representing 65 carreaux (1) was studied. According to these farmers, maize was the principal crop coverering 78 to 88% of the plots in both the first and the second seasons respectfully. On only 29 to 39% of the plots did sorghum constitute the principal crop. In Haut-Cap-Rouge (HCR), maize is generally cultivated in association with common bean.

In Bas-Cap-Rouge or BCR/Jacmel, between 0 and 100 meters, with a sample of 60 farmers cultivating 270 plots totalizing 94 carreaux, maize was the most important first season crop occupying 59% of the plots. In the second season in BCR, maize covered 20% of the plots, but it was surpassed by sorghum (36%) and bitter manioc (24%). This may be explained by a lack of moisture. Farmers can be expected to rather produce sorghum, bitter manioc and pigeon pea whenever there is low rainfall and little or no water for irrigation. In BCR maize is often associated with cowpea, sweet potatoe, peanut and cassava or manioc.

In Maniche/Cayes, maize was the most important first season crop (42% of the plots) while sorghum constituted the most important second season activity. In Bérault, Cayes, where there was much irrigation water, maize was reported as the most cultivated crop for both seasons.

More elaborated surveys which show the importance of maize were implemented in 1985 in the Department of South by the ADS-II Project. Among more than 28 crops considered, maize in monoculture and in association was found to occupy about 14900 hectares (1) comprising

Table 1. - The Importance of Maize as Related to Other Crops in the South-East Department (Jacmel) and in the South Department (Cayes) in 1984.

	Haut Cap Rouge, Jacmel Dept: South-East Atl.: 500-800 m. Rainfed 60 farmers/288 plots 64.60 carreaux (1)		Bas Cap Rouge, Jacmel Dept: South-East Alt.: 0 - 100m. Partly irrigated/Rain-fed 60 farmers/270 plots 93.52 carreaux (1)		Maniche, Cayes Dept: South Alt.: 100 - 350m. Rainfed/Irrigated 77 Farmers/358 plots 91.31 carreaux (1)		Berault, Cayes Dept: South Alt.: 30 - 100 m. Partly irrigated/ Rainfed 70 farmers/311 plots 80.61 carreaux (1)	
CROPS	Frequency (plots)	%	Frequency(plots)	%	Frequency (plots)	%	Frequency (plots)	%
1st Saison								
Maize	253	77.8	160	59.3	149	41.6	206	66.2
Sorghum	84	29.2	50	18.5	10	2.8	23	7.4
Rice	0	0.0	0	0.0	0	0.0	36	11.6
Kidney bean	257	89.2	2	0.7	0	0.0	1	0.3
Pigeon bean	2	0.7	34	12.6	108	30.2	1	0.3
Sour cassava	14	4.9	66	24.4	67	18.7	13	4.2
Sweet cassava	10	3.5	12	4.4	26	7.3	42	13.5
Sweet potato	110	38.2	22	8.1	35	9.8	90	28.9
Sugarcane	0	0.0	10	3.7	1	0.3	46	14.8
Banana	24	8.3	52	19.3	61	17.0	38	12.2
2nd Season								
Maize	254	88.2	54	20.0	28	7.8	136	43.7
Sorghum	113	39.2	98	36.3	145	40.5	98	31.5
Rice	0	0.0	0	0.0	18	5.0	15	4.8
Kidney bean	257	89.2	20	7.4	0	0.0	1	0.3
Pigeon bean	2	0.7	39	14.4	113	31.6	5	1.6
Sour cassava	1	0.3	65	24.1	64	17.9	16	5.1
Sweet cassava	0	0.0	12	4.4	28	7.8	51	16.4
Sweet potato	125	43.4	45	16.7	17	4.7	118	37.9
Sugarcane	0	0.0	7	2.6	1	0.3	28	9.0
Banana	23	8.0	60	22.2	87	24.3	46	14.7

*(1): 1 Carreau = 1.29 hectare (ha) = 3.186 acres

irrigated and rainfed plains, mountains with a more or less heavy rainfall and plain or valley rural villages. About 45% of the associations observed in rural villages contained maize. This last information shows the importance of maize in direct consumption. As a matter of fact, maize is in Haiti the only cereal that can easely be directly or indirectly consumed at any development stage. Even in the preblooming stage, if the maize producer judges that for some reasons - pests, bad wheater conditions - the production will not be efficient, he may then harvest his maize field as forage to feed the farm animals. A large amount of the maize production is harvested green and toasted or boiled for direct consumption. This is a well known street business in Haiti's towns and villages. Various preparation methods of maize food are known all over the country. Maize is a staple food for the urban and rural poor. The dry maize spathe is used in artwork like making straw hats and bags. The maize stalks play an important role in feeding large animals and in improving agricultur l soil structure and nutrient. Finally the corncobs are used as fuel in cooking fires.

2. INCREASING MAIZE PRODUCTION IN HAITI.

The necessity to increase the Haitian maize production is unquestionable. This is justified by the need to feed the evergrowing urban and rural slum masses and the need to generate feedstuff for the recently imported swine (2) population. Different ways and means to produce more maize may be considered.

2.1 Introducing a new Maize Variety is not the Appropriate Solution.

Many agriculture development professionals have planned and implemented a relatively large number of maize variety trials in Haiti. They have all a common goal: attempting to increase the maize yield by introducing new maize varieties into the Haitian peasant cropping system. It is indeed difficult if not impossible to achieve such a feat under the socio-economic conditions of the Haitian farmer. However, the ADS-II Project followed this blind alley initially as well. A part of our experience in this matter is reported in this present section.

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(2) The native Haitian swine population was eradicated in 1982 because of the African swine fever. New breeds are now being introduced from the U.S.A. and from other islands. Swine foodstuff is the most important drawback to the development of the new swine population.

2.1.1. Comparison 1. -

During the second cropping season of 1984, the local maize population known as Alizéne was compared to three new varieties in HCR. Thirteen farmers participated as replications. In each farmer's trial plot there were two blocks. Each block was subdivided into four treatment plots (Fig. 1) of 6m x 6m. All varieties of maize were associated with the local common bean (Phaseolus vulgaris).

Fig. 1 Comparison of four maize varieties in HCR.

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      6m
    :----:----:----:----:   T1:  Local Maize Alizéne
 6m : T3 : T1 : T4 : T2 :
    :----:----:----:----:   T2:  Maize La Maquina 7827

    :----:----:----:----:   T3:  Maize La Maquina 7928
    : T4 : T2 : T1 : T3 :
    :----:----:----:----:   T4:  Maize Les Anglais
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Farmer pratices were not changed. Yield data were collected from a plot of 9 square meters within each treatment plot. Eleven farmers returned data. Results are presented in Table 2. There were no significant differences among compared means.

Table 2 - Comparison of means of four Maize Varieties associated with the local Bean in HCR, Jacmel (August - November 1984)

Treatment	Yield of dry Maize Grain in Kg/Ha	Yield of dry Local Bean Grain in Kg/Ha
T1: Local Maize Alizene + local Bean	1580	509
T2: Maize La Maquina 7827 + local Bean	1464	536
T3: Maize La Maquina 7928 + local Bean	1065	599
T4: Maize Les Anglais + local Bean	1258	566
L S D	198	35
C V %	47	23
F (0.05)	0.19 N.S.	1.91 N.S.
Number of Participants	11	11

2.1.2. Comparison 2, 3 and 4.

Other variety trials were implemented in 1985. A similar experimental design was used. Farmers participated at all stages of the experiments. Results of these different trials are presented in Tables 3, 4 and 5.

Table 3 - Comparison of Yield Means of two Maize Varieties Associated with the local Bean and the local Yam in HCR, Jacmel (March - November 1985).

Treatment	Dry Maize in Kg/Ha.	Dry L. Bean in Kg/Ha	Yam in Kg/Ha.	Net Profit in Gdes(3)/Ha
T1: Local maize + local bean + yam	2008	527	10329	13729
T2: Maize La Maquina 7827 + local Bean + local yam	2153	519	10562	13908
CV %	28.44	24.49	25.07	58.90
F (0.05)	0.84 NS	0.05 NS	0.11 NS	1.37 NS
No. of participants	28	28	28	28

Table 4 - Comparison of Yield Means of Two Maize Varieties Associated with local Bean and the local Yam in HCR, Jacmel (March through November 1985).

Treatment	Maize Kg/Ha	Local Bean Kg/Ha	Yam Kg/Ha	Net Profit Gdes(2)/Ha
T1: Maize local + Bean + Yam	2222	487	10578	15439
T2: Maize Les Anglais + Local Bean + Yam	1634	596	10370	17493
CV %	58.42	26.26	20.43	58.84
F (0.05)	3.68*	7.94* (4)	0.13 N.S.	0.61 NS
No. of Particiapnts	27	27	27	27

(3) Gourde or Gde: Haiti money - 1 Gde = U.S. $0.20

(4)* Significant difference at p = .05.

Table 5 - Comparison of Yield Means of three Maize Varieties Associated with the local Cow Pea in BCR, Jacmel (March-JUNE 1985).

Treatment	Maize Kg/Ha	Cow Pea kg/Ha	Net Profit Gdes/Ha.
T1: Local Maize + Cow Pea	1976	110	530
T2: Maize La Maquina 7827 + Cow Pea	1800	85	240
T3: Maize Les Anglais + Cow Pea	1737	98	234
LSD (Duncan's)	231.47	20.29	229.97
CV %	28.25	46.68	153.95
F (0.05)	2.27* (4)	1.14 N.S	4.31* (4)
No. of Participants	20	20	20

2.1.3 Variety Comparison in Cayes.

The ADS-II Project implemented variety trials in Cayes too. From March through June 1985 the improved variety La Maquina 7827 was compared in monoculture to the local Maize variety known as chicken corn. The experimental design was the same as the one discribed above for Jacmel (Fig. 2). The comparison took place under two conditions: (1) farmers practices; (2) improved practices.

T4	T2	T3	T1
T1	T3	T2	T4

T1: Maize local + farmer practices (no fertilizers)

T2: Maize local + improved practices (fertilized)

T3: Maize La Maquina 7827 + farmer practicies (no fertilizers)

T4: La Maquina 7827 + improved practicies (fertilized).

The experiment was realized in two different locations: (1) Berault (partly irrigated plain); (2) Maniche (rainfed valley).Summary results for the two locations are presented in Table 6.

Table 6 - Comparison of Yield Means of two Varieties of Maize in Monoculture. Implemented in Bèrault and in Maniche, Cayes, (March - June 1985).

Treatment	BERAULT Maize Grain Kg/Ha	MANICHE Maize Grain Kg/Ha
T1: Maize local (farmer practice)	1703 B (5)	1645 BC
T2: Maize local (improved practice)	2285 A (5)	1919 B
T3: La Maquina 7827 (farmer practice)	1773 B	1468 C
T4: La Maquina 7827 (improved practice)	2256 A	2440 A
LSD (0.05)	206.4	288.2
CV %	27.59	32.99
F (0.05)	9.66* (4)	10.724 (4)
Number of Participants	13	17

*(5) Alphabetical classification based on the Duncan test

2.1.4. Potentialities of the Local Varieties.

Four local varieties of maize are mentionned in the above tables 2, 3, 4, 5 and 6: (1) BCR Azilene, (2) HCR Alizene, (3) Berault Chicken Corn, and (4) Maniche Chicken Corn. Three improved varieties were used for comparison: (1) La Maquina 7928, La Maquina 7827, et (3) Les Anglais. More than the above presented trials were implemented. But the results for all of the trials had a common profile: local and new varieties of maize tend to show equal potentialities. Given similar management practices, in many cases the local varieties even appeared a little bit more productive than the new ones. Only in Maniche, under improved management conditions, did La Maquina 7827 outpass somewhat the local chicken corn.

2.1.5. Problems Hampering the Introduction of a new Variety.

It must be admitted that only three new maize varieties were tried in only two major places, Jacmel and Cayes. But well before the inception of the ADS-II Project in 1984, many attempts were made to introduce other varieties and even hybrids to other places. All previous tried new varieties and hybrids have desappeared while La Maquina 7827 and Les Anglais become today's most popular improved maize varieties in Haiti's experimental stations.

Had the failure of the above-mentionned varieties to far outpass the local ones been the only reason to discourage the extension process of new varieties in Haiti's small farm areas, it might then have been rightfully suggested that other varieties be tried in other places. But the cross pollinating characteristics of Maize and the uncertain socio-economic conditions of the farmers constitute the two basic conditions that seriously hinder the adoption process of new maize varieties in these areas. It is unrealistic to expect all small farmers of a given community to spontaneously reject at the same time their local heterogeneous population of maize and adopt a new homogeneous variety. Therefore it is very difficult for the small farm early adopters of a new variety to produce genuine seeds since female flowers of the new variety will be poilinated by other breeds. Some agriculture specialists suggest that early adopters isolate their maize field in time and/or in space. Time isolation means that farmers willing to produce genuine seeds from a homogeneous maize variety should plant before or after the other farmers. This is very difficult to realize by small and poor farmers in rainfed areas. However, experience has shown that small farmers may organize themselves to isolate their field in space. In August through November 1985, 18 Haut-Cap-Rouge small farmers put four hectares of land together in an attempt to produce genuine La Maquina 7827 seeds. Maize seeds would then be selected within a ten meters broad isolating belt. Unfortunately La Maquina 7827 has another weakness that we did not foresee at this time: susceptibility to late season precipitations. A steady daily rain in HCR during the late October and November 1985 caused most kernels to decay in the field. As a

result, HCR farmers became reluctant to use La Maquina 7827 seeds in their field. Many BCR plain small farmers are still favorable to the use of La Maquina 7827. But the seed production problem is posed more acutely in BCR since most BCR maize fields are harvested green.

Had HCR farmers in the above experiment been successful in their first attempt of quality maize seed production, would they then have conserved their harvested seeds until the next cropping season and continued the process? We doubt it. We have observed that farmers with low income tend to sell everything that family members do not consume directly after harvest because money is always badly needed. A striking example is the case of the black bean Tamazulapa which has been adopted by some HCR farmers because of its high productivity. Tamazulapa seeds are rarely available in HCR at planting seasons. A few field technicians and farmers believe that the Ministry of Agriculture should produce the needed improved seeds, but the Haitian Gouvernment historically has never been successful in such ventures. Other concerned observers believe that commercial private firms can take over the responsibility of quality seed production. This may work for a few farmers and for certain crops. In other terms, as in the case of fertilizers and pesticides, only farmers who can afford it might buy maize seeds from commercial firms.

2.2 Alternatives for Increasing Maize Production must be considered

Since on-farm trials have shown that local maize varieties and imported varieties have similar potentialities, appropriate methods and technologies to improve the productivity of local maize varieties should be considered. With this objectif firmly in place, the ADS-II Project has been working in Haiti on alley cropping, soil conservation, seed selection, date of planting, amount of fertilizers, fertilizing methods, planting density and pest control.

2.2.1 Alley Cropping.

This is an agroforestry and animal production system in which cropping is practiced in alleys made of relatively small trees. Leuceuna and gliricidia constiitute the plant species more frequently used in these practices. These trees which relatively grow quickly are legumes, that is nitrogen generators. They are pruned regularly to control their competition for light and space with cultivated crops like maize, bean and vegetables. The legume tree branches and leaves are used to feed animals and/or scattered on the ground where they quickly decay. We expect this system to help greatly in recuperating, improving and protecting slope soils. This will further increase agricultural production in general and the maize production in particular. We have been working on alley farming in Jacmel and in Cayes since September 1986 after two of our young program agronomists participated at a training seminar in alley cropping at the International Institute Tropical Agriculture (IITA) in Ibadab, Nigeria. The experiment is in progress. There are positive signs. Results will be published soon.

2.2.2 Soil Conservation.

Since a large part of maize grain is produced in Haiti on watershed steep eroded slopes, it is obvious that soil protective structures such as contour dry walls, c. ditches, c. terraces, and plant rows, simple and/or combined should help control erosion and consequently retain and generate increasingly fertile soil. We believe this could have a positive impact on the maize production. Since September 1985, to now, the ADS-II Project and the HCR and Maniche farmers have established contours dry walls and ditches combined with vegetative barriers on more than 100 hectares. Field technicians in Jacmel have begun to receive informal positive feedback from plain farmers about the effect of the watershed soil conservation structures on the mountain bottom springs. A more steady increase flow of irrigation water may mean more maize produced. However, supportive statistics concerning direct data from soil conservation efforts are not yet available.

2.2.3 Seed Selection.

In September 1985, the ADS-II Project began selecting for local maize seeds in HCR and BCR, in Jacmel. The selection process has been based on such characteristics as - (1) number of days in field (110 - 120), (2) heights of plants (1.60m - 1.80m), (3) height of ears (1m - 1.10m), (4) state of ears (good appearance, well proctected by the hulls, well filled with at least 10 rows of yellow kernels) and (5) free of disease and/or parasites. In March 1986, about 100 lbs of selected maize seeds were planted in Haut and Bas Cap Rouge. In August 1986, grain selected from fields of selected seeds planted in March 1986 were compared to non-selected seeds in HCR. Data were gathered on the number of harvested pockets/ha, number of harvested ears/ha, and yield in kilograms of dry maize grain/ha. Forty farmers participated in the experiment. But a large number of the maize plots were destroyed or damaged by animals and/or bad weather. A t-test was applied to data collected from 26 farmers. Results are presented in Table 7.

Table 7 - Comparison of Yield Means of Local Maize Selected Seeds and Local Maize Non-Selected Seeds in Haut Cap Rouge, Jacmel (August - November 1986).

Treatment	Average # of pockets harvested p/ha.	Average # of maize plants harvested p/ha.	Average # of maize ears harvested p/ha.	Yield of maize grain in kg/Ha.
T1: Non-selected seeds	9103	26496	25342	1585
T2: Selected seeds	9274	28077	27820	2030
CV %	22.70	18.23	20.55	30.12
t	0.86 N.S	1.48 N.S	1.63 N.S	***4.66
Number of Participants	26	26	26	26

According to informal farmers evaluation, the fields with selected seeds produced better plants and better ears than the fields of non-selected seeds. At p = .001 the mean yield from the selected seeds was higher than the mean yield of the non-selected seeds. The selection process continues and efforts are made for a larger farmers participation.

2.2.4 Date of Planting.

As Haut Cap Rouge maize producers approach the planting seasons, many prepare their soil in advance so that they may plant with the very first precipitations. Others will plant about 22 days later because they do not have, in time, enough money to pay labor, and to buy seeds or fertilizers. Therefore, Haut Cap Rouge farmers plant on a continuum of 1 to 22 days starting after the first precipitation of the season. From August through November 1986, an attempt was made to compare the yields among two planting dates set at a 15 days interval. Sixteen planters identified as "early farmers" were selected among those who planted their maize on August 16, 1986. Eight of these early farmers planted on plateaux* (6). The other eight ones planted on slopes. Sixteen other planters described as "late farmers" were further selected among the farmers planting their maize on September 1st 1986, eight on plateaux* (6) and eight on slopes. All early and late farmers planted their maize in association with common bean and were given an equal amount of fertilizers and pesticides. Results of the experiments are presented in Table 8.

Table 8 - Comparison of Different Planting Dates of Maize in HCR, Jacmel (August through November 1986).

	Early Plateau Farmers & Maize yield in Kg/Ha	E.Slope Farmers & Maize yield in Kg/Ha	Late Plateau Farmers & M.Yield in Kg/Ha.	L. Slope Farmers & Maize yield Kg/Ha
Minimum	1222	222	889	1000
Maximum	2778	4333	944	1000
Average	2129	1377	-	-
CV%	26.71	97.44	-	-
Number of Participants	8	8	8	8
Return Data	6	7	2	1
% Return Data	75	85	25	13

* (6) Plateau (plateaux, plural): Flat lands with less than 10% of slope in high altitudes.

Data were collected for 6 out of the 8 early plateau farmers, while 7 of the 8 early slope farmers returned the expected data. The early plateau farmers produced an average of 2129 Kg/ha of maize with a C.V. of 27% while the early slope farmers showed an average yield of 1371 kg/ha of maize with a C.V. of 97.44. Data were collected for only two of the late plateau farmers (25%) and for only one of the 8 late slope farmers (13%). Almost all of the late planted maize was reported destroyed by drought. Some early missing data were reported destroyed by animals.

We must acknowledge that reliable conclusions cannot be drawned based on only one planting season. However, we did observe in the presently reported experiment that yields from the early farmers could not be properly compared to yields of the late farmers because the late planted maize was destroyed by drought. If further observations validate this first one, appropriate assistance will have then to be considered to help all farmers plant with the first precipitations of the planting season.

2.2.5 Amount of Fertilizers.

Haut Cap Rouge farmers, who can afford it, will apply about 140 kg/ha of any fertilizer formula to their maize fields. Our agronomists judged reasonable to apply about 300 ka/ha of complete fertilizer formulas in their experimental plots. In an effort to improve fertilizing procedures in Haut Cap Rouge, an appropriate trial was planned and implemented with 32 participating farmers in August through November 1987. In each farmer's site there were two experimental blocks. Each block was subdivided into four treatment plots. (Fig. 3).

Figure 3 - Randomization of Treatments (Amount of Fertilizers) in one Farmer's Site.

T2	T4	T1	T3
T4	T3	T2	T1

T1:	Control (no fertilizer applied)		
T2:	30kg N/ha	15-30kg P2 O5/ha	30kg K2 O/ha
T3:	100kg N/ha	40-45kg P2 O5/ha	40-45kg K2 O/ha
T4:	60kg N/ha	30-60kg P2 O5/ha	60kg K2 O/ha

All fertilizers were scattered on the ground at the planting time except for the T3 Nitrogen which was subdivided into two parts: one half was applied with the P205 and the K20 and the other half was applied per pocket about 50 days after planting that is before the male blooming stage of the maize. As it is usually done in Haut Cap Rouge, Maize was associated with common bean. At harvest time, data were collected from 26 farmers sites. An ANOVA followed by a Duncan specific test was applied. Results are partly presented in Table 9. (See page 17).

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Table 9 - Comparison of the Effects of four Amounts of Fertilizers on Local Maize associated with Local Bean in HCR, Jacmel (August - November 1986).

Treatment	Average Number of Maize pockets harvested per Ha.	Average Number of Maize plants harvesper Ha.	Average Number of Maize ears harvested per per Ha.	Yield of Dry Maize grain per Kg/Ha.	Average Number of Kidney Bean plants per	Yield of Dry Kidney Bean in Kg/Ha.
Slopes > 10%						
T1	9375 A	25208 ABC	23611 ABC	1128 B	120763 A	194 B
T2	10208 A	29861 A	27916 A	1398 B	137291 A	344 AB
T3	9166 A	25138 ABC	22569 BC	1246 B	142569 A	274 B
T4	9375 A	25208 ABC	22638 BC	1163 B	135485 A	233 B
Slopes < 10%						
T1	8611 A	22916 C	21319 C	975 B	131041 A	408 AB
T2	9791 A	27708 ABC	26597 AB	2111 AB	145486 A	406 AB
T3	8541 A	23888 BC	22916 BC	1267 B	136736 A	442 AB
T4	9652 A	28958 AB	26527 AB	3118 A	153194 A	843 A
PPDS	1494	4459	4320	1480	30945	465
C.V. %	22.82	29.11	30.35	162.72	32.03	168.54
F (0.05)	0.38 NS	1.13*	1.09*	1.15*	0.40	1.04*
Number of Participants	26	26	26	26	26	26

In slopes > 10%, T2 (farmer practices with fertilizer) produce more maize plants and ears and also a little more bean, but there was no significant difference among the yields for maize produced in these slopes. However, in plateaux or slopes < 10%, the average yields of maize and bean (respectively 3118 Kg/ha and 843 Kg/ha) corresponding to the application of 300 kg/ha of a complete fertilizer formula were higher than the mean yields of the other treatments.

The excessively high C.V.s 162.72 and 168.54 observed in Table 9 for the Maize and the common bean yields are probably due to some extent to differences in dates of planting and the soil topography. As a matter of fact, the planting dates scaled from August 4 through August 20 while one half of the trial plots was located on plateaux or flat lands and the other half on slopes. Late planted fields in rainfed areas seem to suffer more drought. The interaction amount of fertiliser/topography was further illustrated by figures 4 and 5.

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Fig. 4. Interaction of Amounts of Fertilizers x slopes concerning Maize yields in Kg/Ha.

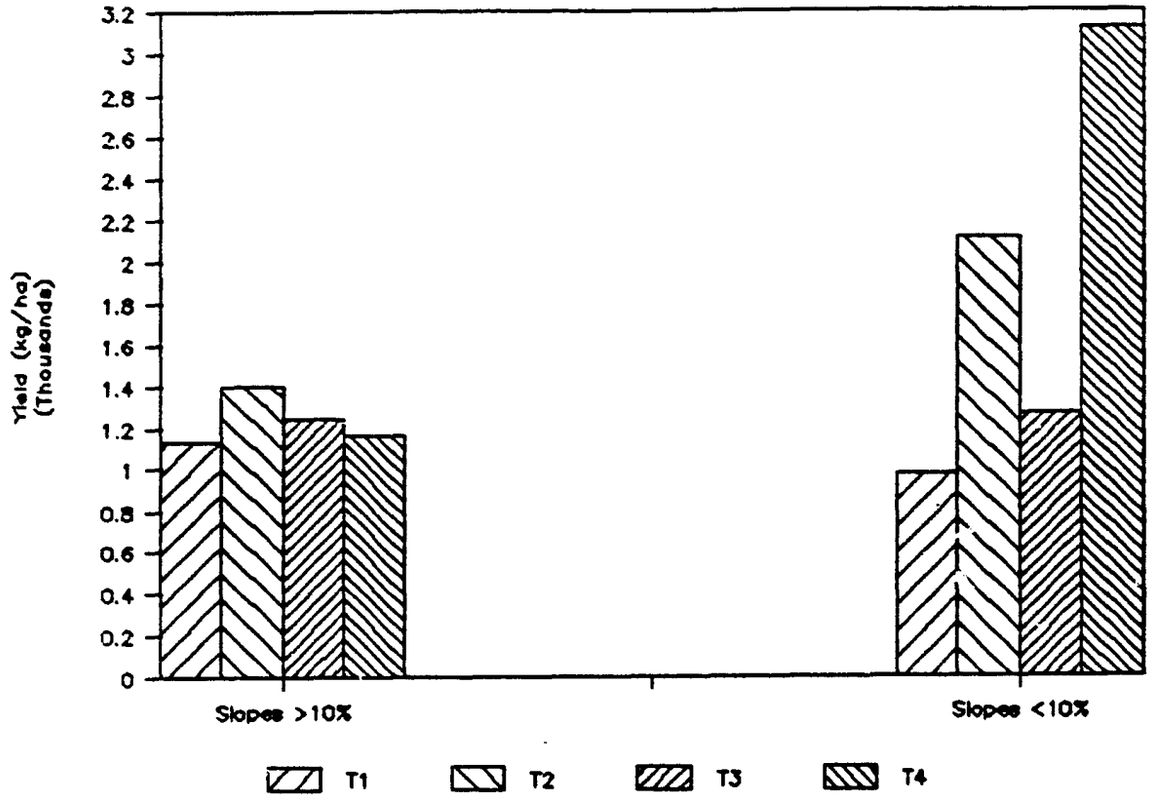
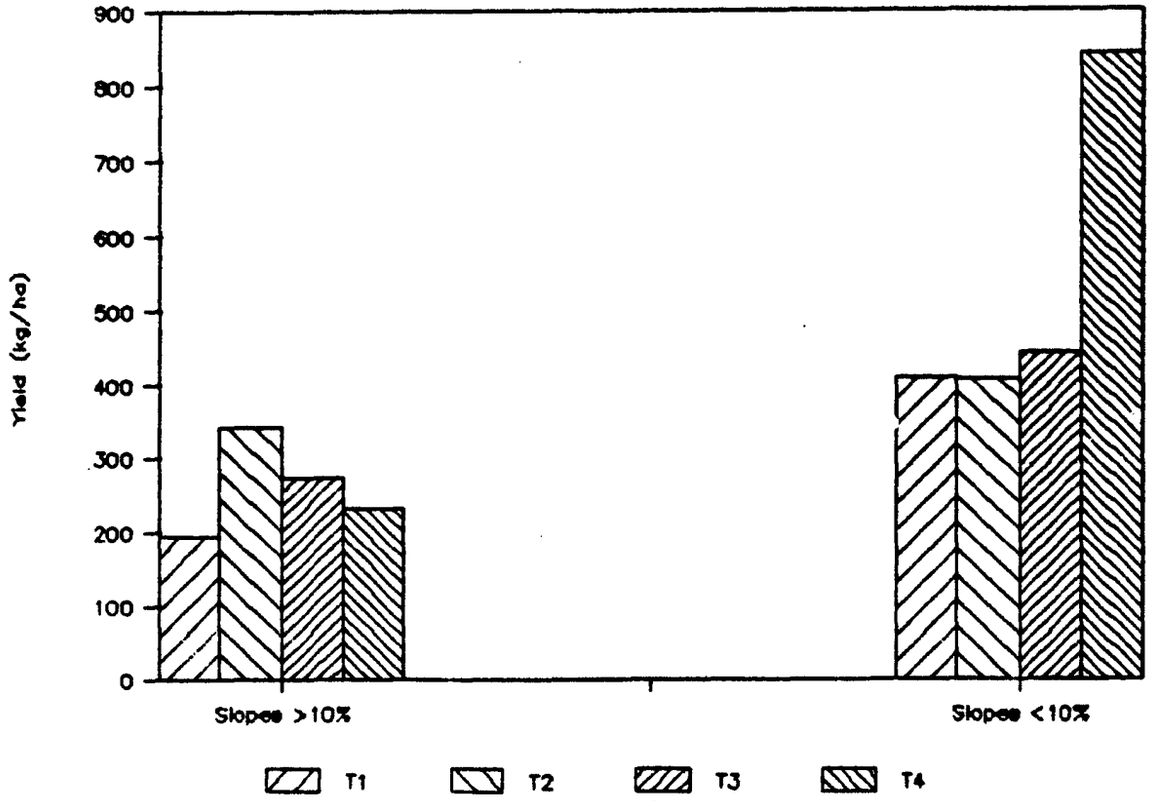


Fig. 5. Interaction of Amounts of Fertilizers x slopes concerning Common Bean Yields in Kg/Ha.



Since additional fertilizers mean higher cost of production, an economic analysis was performed to examine whether it was profitable for Haut Cap Rouge farmers to apply more fertilizers to their maize/local bean associations. Results are shown in Table 10.

Table 10 - Profit Profile in U. S. $ concerning the Amount of Fertilizers and Slopes in the Associations of Maize + Local Bean in Haut Cap Rouge, Jacmel (August - November 1986).

	Pente>10%		Plateau or Pente< 10%	
	Maize	Bean	Maize	Bean
T1 (control): Average yield in kg/ha	1128	194	975	408
T2: Average yield above control	270	150	1136	-2
Total Net Benefits ($/ha) (7)	207.20 (7)		370.00	
T3: Average yield above control	118	80	292	34
Total Net Benefits ($/ha)	30.88		48.44	
T4: Average yield above control	35	39	2143	435
Total Net Benefits ($/N)	-28.18		1118.78	

(7) Net Benefits = Yield increase x price of corn ($0.36/kg) and beans ($0.98/kg) less cost of fertilizer.

Cost of Fertilizer: T1 = $37.00/ha
T2 = $90.00/ha
T3 = $79.00/ha

The above experiment suggest that Haut Cap Rouge plateau farmers can increase their maize production by applying more fertilizers.

2.2.6 Methods of Fertilizing.

Many farmers scatter fertilizers on the soil at planting time while others apply fertilizers directly at pockets at planting time or two to three days after the maize has sprouted out of the soil. Therefore, questions about method efficiency need to be answered. Comparison trials of fertilizing methods are in process in Haut Cap Rouge and Bas Cap Rouge, Jacmel, but data are not yet available for analyses.

2.2.6 Planting Density.

Usually, Haitian farmers dig their maize pockets at a distance varying from 1m to 1.25m and put in about four seeds. The maize plant populations vary then from 25,000 to 50,000/ha. Alternate methods to increase the maize plant population while reducing competition for nutrient at the root level were considered in Jacmel Bas Cap Rouge and Haut Cap Rouge. Thirty two farmers participated at an experiment in Haut Cap Rouge with two blocks per farmer. Each block was subdivided into four treatment plots. In each farmer's site each treatment was repeated twice and randomly distributed (Fig. 6).

Figure 6 - Comparison Trial of Planting Density in Haut Cap Rouge, Jacmel.

T4	T2	T1	T3
T1	T4	T3	T2

T1: farmer's practice 25,000 - 50,000 plt/ha

T2: pockets 0.50 x 0.50m./2 plants/pock
80,000 plants/ha

T3: pockets 0.50 x 0.50m/1plant/pocket
40,000 plants/ha

T4: pockets 0.40 x 0.40m//1 plant/pocket
62,500 plants/ha

At harvest time, November 1986, samples were collected from 9m2 squares delimited at the center of each treatment plot. Farmer practices were not modified. An ANOVA followed by a Duncan specific test was applied to data returned by 14 farmers. Results are presented in Table 11.

It is evident that when we increased the plant population while reducing competition at root levels, the maize yield increases even though we did not achieve the population density sought. For example, with the treatment T2 we harvested only 44% of the population which should be 80.000 plants/ha, but the yield for T2 was higher than the peasant yield T1. The change in the maize population did not affect the common bean associated with the maize.

Table 11 - Comparison of the Effects of Planting Densities on Local Maize Associated with Local Bean in HCR, Jacmel, (August-November 1986).

Treatment	Average Number of Maize pockets harvested per ha.	Average Number of Maize plants harvested per ha.	Number of Maize plants expected per ha.	% Number of plants realized	Aver.Number of Maize ears harvested per ha.	Aver. Yields of dry Maize grain in kg/ha.	Aver. Number of Kidney Bean plants harvested in Kg/ha.	Aver.Yields of dry kidney bean in Kg/ha.
T1	11131 B	256302 B	40000	64%	25036 B	1569 B	145794	460
T2	19742 A	35595 A	80000	44%	33889 A	2052 A	141230	473
T3	23492 A	23492 B	40000	58%	24683 B	1982 AB	148333	491
T4	23650 A	23651 B	62500	38%	24278 B	1750 AB	139000	505
LSD (0-05)	4409	1664			3552	182	-	
C.V. %	50.89	32.30			29.65	52.41	27.57	60.97
F (0.05)	9.78*	11.75*			9.36*	1.47*	0.32 NS	0.02 NS
Number of Participants	14	14			14	14	14	14

2.3. Land/Soil Recuperation is an Important Issue in Increasing the Maize Production

Any observer with some good knowledge about Haiti's social, economic, and agricultural situation and problems might admit the following statements:

2.3.1. Good lands without Farmers

A minority of relatively rich citizens own in Haiti a lot of good lands which are not efficiently and judiciously used. There should then be appropriate laws obligating these landlords either to plan and implement a productive management of their lands or to pass on these lands to needy farmers who are willing to work hard.

2.3.2. Salty lands.

Hundred of acres are not cultivated in the plain of Cul-de-Sac near Port-au-Prince, the plain of Gonaives, and other plains because of the presence of salts in the soil. The most knowingly identified salts are the sodium chloride NaCl and the sodium sulfate Na_2SO_4. Research to treat these lands should be undertaken.

2.3.3. Non Irrigated Lands

A large part of the plains , valleys and plateaux that can be irrigated is not fully used for agricultural production because of lack of moisture. Research efforts should be planned and implemented in order to promote more irrigated agriculture. There still is a lot of unused river or creek water in the country. Dams can be built for appropriate artificial hillside lakes that can provide more irrigation water.

2.3.4. Eroded watershed lands

Mountain lands are critically eroded in Haiti. Three fourth of the country is mountainous. Then, slope soil protective structures, slope land, agroforestry and related community education programs should constantly be planned, implemented and evaluated.

2.3.5. Improper Agriculture Practices

A large part of the plains is covered by sugarcane which needs much less hoeing than maize, beans, and vegetables. Repeated hoeing practices generate and increase slope land erosion. There should then be a switch in the sense that more sugarcane, coffee, fruit trees and animal forage be produced on mountain slopes in order to let more room in the plains and the plateaux for the more demanding hoed crops such as maize, beans, tubercules and vegetables.

2.3.6. Defective land tenure

Irregular land tenure situations in the rural areas constitute also a great impediment to agricultural production improvement programs. Peasants who do not own the land they are farming are reluctant to try and adopt better land improvement methods and technics. Successional heritage has also continued to reduce small farms size. this situations should be put under control.

2.3.7. Little Done so far

Less than 40% of the irrigable lands has actually been irrigated in Haiti's total area of about 11,000 square miles. Aside of some efforts in slope soil conservation and some irrigation in plains, little has been done to recuperate the unused agricultural lands and to protect the soil of the country.

3. SUMMARY AND CONCLUSION

Cultivated as either food crop or cash crop, the importance of maize can never be overemphasized in Haiti. Produced in monoculture or in associations with many other cultivated plant species, under a wide range of soil, climatic and altitude conditions maize is one of the most popular subsistence crops. Relatively cheap with regard to other food commodities, maize has undoubtedly contributed in sustaining the lives of thousands of human beings starving in the evergrowing slums of Port-au-Prince and other regional towns or rural villages. Responding to a wide rande of recipes, the rich use it as well. Maize is used in soil improvement structure and nutrient, animal feedstuff, and artwork.

The relatively great importance of this cereal fully justifies the efforts that have been made to increase its production. In this present paper, two main possible ways to increase a given plant species production were considered: Improving the methods and technologies related to that plant cultivation and/or enlarging and improving the area under production.

In order to increase the maize production by improving the related methods and technologies, many agriculture professionals have attempted to introduce new varieties in rural areas where most peasants are farming only one or two acres of land. These attempts have failed because poor farmers can hardly produce and conserve seeds from a cross pollinating plant species. But, since experience has also shown that, the local heterogeneous maize population tends in many cases to have equal potentialities as the so called improved or new varieties, it may then be judged reasonable to try other production increasing means in order to better adapt them to specific local situations. Some of these means are cropping alleys, soil

conservation practices, methods of fertilizing, appropriate amounts of fertilizers, proper date of planting, seed selection and proper plant population density.

In addition to problems related to appropriate maize production methods and technologies, there are in Haiti a relatively large amount of lands without farmers while there are many thousands of landless farmers. Therefore, the author of this present paper believes that appropriate legislation and technologies should be developed in order to put more lands under cultivation. The author does also believe that contrywide development program planning should go in the same sense as specific community program planning in order to avoid or minimize eventual conflicts among individual, family, community and nation development objective levels. A few Haiti today's nativea are desperates. But there still are many people in Haiti and abroad who are rightfully convinced that there should always be hope where human resources are willing to fight on different fronts.

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