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AGRICULTURAL DEVELOPMENT SUPPORT II
HAITI

University of Arkansas,
Fayetteville

PN-ABC-207

AGRICULTURAL RESEARCH AND EXTENSION LINKAGES IN HAITI: A PRAGMATIC FSR/E APPROACH

Report #23

ADS-II
Agricultural Development Support II Project

AGRICULTURAL RESEARCH AND EXTENSION LINKAGES IN HAITI
A PRAGMATIC FSR/E APPROACH

USAID CONTRACT # 521-0092

between

The University of Arkansas/Winrock International

and

The Ministry of Agriculture, Haiti

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Report # 23
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ADS-II APPLIED RESEARCH PROGRAM IN LES CAYES AND JACMEL, HAITI

1. PROGRAM LOCATION
   A. HAITI
   B. TWO DEPARTMENTS: SUD AND SUD-EST
   C. MOUNTAIN AND PLAIN SITES IN EACH DEPARTMENT

2. ENVIRONMENT
   A. 18 - 19 Latitude, 72 - 74 Longitude
   B. Jacmel Plain: 20-100 meters; Mountain: 100 - 600 meters
      Cayes Plain: 30-100 meters; Mountain: 100- 350 meters
   C. Temperature: Rarely exceeds a 10 degree change for any one day
      Daily min-max. = 24.4 - 37 C
   D. Precipitation: bimodal
      Jacmel Plain: 1200 mm.; Mountain: 2200 mm
      Irregularity of rainfall in Jacmel plain is a major constraint
      Les Cayes Plain: 1985 mm.; Mountain: 1200 mm.
      Evapotranspiration: 98-118mm evapotranp.during Dec.-March, higher than rainfall received
      Irrigation: Les Cayes plains: some 20,000 ha. potential; Jacmel plains: limited

   E. Soils:
      Jacmel Mountain: HAUT CAP ROUGE: Excellent conductibility, pH=8, generally high fertility
      Red and grey soil more fertile than black ones,
      Plateau region with 30-45 degree slopes
      Jacmel Plain: BAS CAP ROUGE: Soils with good conductibility, pH= 8, low potassium and phosphorus
      Soils considered fairly fertile
      Les Cayes Mountain: MANICHE/CAVAILLON WATERSHED: eroded slopes at 30-45 degrees, low fertility
      Les Cayes Plain: BERAULT: Soils considered fairly fertile, PH=8, good conductibility

3. Socio-economic Indicators
   A. Jacmel Plain mean size farm = 2.01 ha.
      Jacmel Mountain mean size farm = 1.39 ha.
      Les Cayes Berault Plain mean size farm = 1.49 ha.
      Les Cayes Maniche Mountain mean size farm = 1.53 ha.
   B. Land Tenure:
      Jacmel Mountain: % of land owned=59%; % sharecropped=5%; % rented=13; % undivided family=23%
      Jacmel Plain: % of land owned=56%; % sharecropped=24%; % rented=15%; undivided family=5%
      Cayes Mountain: % of land owned=52%; % sharecropped=30%; % rented=7%; % undivided family=11%
      Cayes Berault Plain: % of land owned=54%; % sharecropped=26%; % rented=5%; % undivided family=13%
   C. Languages: Creole, French
   D. Fertilizers available in intensive plain and mountain zones
   E. Formal agricultural credit extremely limited (18%-20%), informal credit costs 200%-350%/year

4. Nature of Cropping System (Mountain, Plain)
   A. Largely subsistance farming; approximately 30% of produce sold in market
   B. Men most active in agriculture, women in commercialization of products
      Many households hire occasional labor during field preparation periods
   C. All labor done manually, animal traction rare (plots generally too small)
   D. Market Price of Corn = $.36/kg; Beans = $.90/kg; Yams = $.38/kg;
      Fertilizer costs: 20-10-20 = $.24/kg; 0-0-60 = $.28/kg; 11-53-00 = $.40/kg; urea = $.36/kg

Project Activities

A. Project works with corn, sorghum, rice, sweet potatoes, yams, manioc, red and black beans, pidgon pea, cowpeas, taro, coffee, leucaena, sesbania and other legume plants, napier and Guatamala grass, grafted citrus, assorted trees.
   Livestock worked with include swine, goats, rabbits

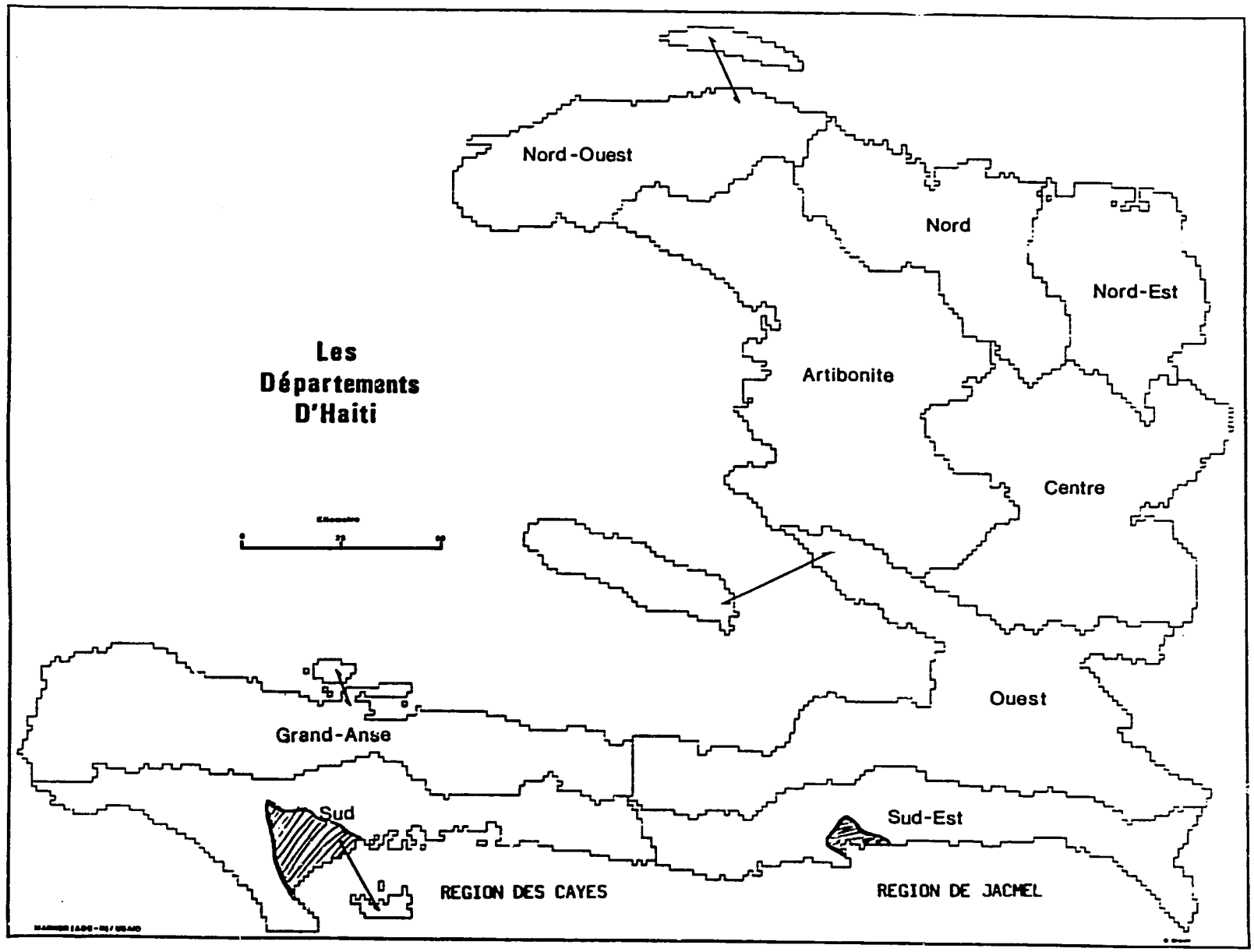
B. Two agricultural periods; most important = Feb-July; second August-January

C. Researcher Managed Triais (5-10 sites with two blocks and 3-5 treatments)
   Farmer Managed Trials (20-30 sites with one block and 2-3 treatments)

D. Researcher managed trials are on a portion of farmer's field and is fairly small.
   Farmer managed trial generally covers an entire farmer parcelle and is fairly large.
   Two - three yield plots (3 meters X 3 meters) per large treatment, less when small.

E. Level of farmer involvement (see present case study); it is a continuum.

F. Most of above program executed in context of a watershed management system, including agro-forestry and soil conservation (rock terraces, vegetative barriers, etc.).


Les
Départements
D'Haiti
Nord-Ouest
Nord
Nord-Est
Artibonite
Centre
Ouest
Grand-Anse
Sud
Sud-Est
REGION DES CAYES
REGION DE JACMEL

AGRICULTURAL RESEARCH AND EXTENSION LINKAGES IN HAITI: A PRAGMATIC FSR/E APPROACH

0.0 Introduction

Farming systems applied research programs have often been inserted into already existing programs of agricultural research in developing countries. This has been permitted by the countries concerned presumably because they have perceived, or been persuaded by funding agencies, that a new emphasis is needed in agricultural research, extension and development; that old approaches have not led to increased productivity and/or better living conditions for a nation's subsistance level farmers who usually represent the great majority of the population.

The complementary systems approach towards interdisciplinary, on-farm study and experimention of the constraints, resources, goals, and increased production potential of different groups of farm units which characterizes a FSR approach is often only taught and practiced by an extremely limited number of individuals in actual field research conditions. Their influence for change on the more top-down institutionalized and entrenched agricultural research approach within a particular country may only be successful after long years of efforts at a number of levels within the research/extension establishment. Fortunately, research orientations of these national agricultural programs can change over time in response to changing national/regional objectives, the nature of the experience of trained technicians, financial support, etc.

Although research processes and institutional linkages of the Agricultural Development Support II (ADS-II) project (*1) did not function in the classical "bottom-up" FSR manner, this paper illustrates how a pragmatic FSR orientation may serve to tie disparate organizations together and deliver improved technologies to small farmer clients in the short term, while helping to re-orient existing institutions in the long term. (See Appendix A for description of institutional setting of the ADS-II program.)

After three years in Haiti, the ADS-II project has only just begun to make some progress in imparting a FSR/E-type orientation to some individuals within the agricultural research/extension establishment. We have been supported by the increasingly applied rural research focus coming from the University of Haiti's Faculty of Agronomy (FAMV), an institution which provides all the country's agronomic technicians. The interest in (1) applying experimental station results to real life situations for practical results and in (2) orientating research itself to real, field-identified agricultural constraints of farmers, characterized by the FAMV and ADS-II programs, may be seen as a needed revitilization of the research/extension continuium.

The ADS-program has been able to demonstrate that success in

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* 1. ADS-II project # 521-0092, USAID funded bilateral project between the University of Arkansas, Fayetteville (subcontractor, Winrock International) and the government of Haiti.

this revitalization effort, ultimately benefiting the small farmer, depends on long term linkages of many usually separate institutions - international centers, in-country experimental stations and agronomist training programs, FSR type on-farm testing, demonstration and extension, and national agricultural information gathering services. As an example of how these linkages function in Haiti, this paper follows the evolution of one important research process through various stages to the adoption of the research results by Haitian farmers. The focus of the study will be one variety of the common bean (Phaseolus vulgaris) called Tamazulapa.

1.0 Grain Legumes in the Southern Department of Haiti

When the ADS-II program began in early 1984, reliable quantitative data did not exist for the regions in which we were to be involved. Though the farming systems group did conduct rapid reconnaissance and formal exploritory surveys in the sub-zones of concern, the overall pattern of the farming systems in the regions was not clear. It was not until a year and a half latter that the statistics component of the project was able to deliver the first macro-level agricultural data at a Departmental level. Had such data been available from the beginning, the farming systems program could have focused its program more rapidly. The discussion below benefits from this new data base (* 2).

(* 2) MARNDR/ADS-II Agricultural Survey, Report #15, p.4, 1985, and Report #24, p. 7, 1986. Reliable data based on a probabililty sample have never been available for estimating crop area and production on a national or regional level in Haiti, though various organizations have frequently attempted to arrive at their own subjective estimates without statistically valid field survey research. For the first time, Haiti can expect to possess such data at a national level through the ADS-II program by mid 1987.

In a pilot phase of this program, field data were obtained for the Department of the South which give some perspective on the relative importance of various cultivars in one of the more important agricultural zones of the country (10% of land area, 12% of rural population).

Six major agricultural strata were identified, defined by intensity of agriculture as determined from close inspection of 1978 aerial photography enlarged to 1:20,000 scale. Some 76% of the agricultural households of this Department are located in the mountain zones, while 53% of total cultivated area is located on mountain slopes, many between 40-50 degrees. The agricultural statistics for the Southern Department reported here were obtained between July '85 and January '86 for the second agricultural season, 1985 in 55 area frame sampled segments comprising some 2,750 households, or approximately 2.5% of the population of the department (cf. IHSI, 1982). During the first agricultural season of 1986, between March and July, ag. statistics came from 40 segments comprising 1750 ag. households.

The relative importance of legume cultivars in the Department du Sud of Haiti vis-a-vis other major cultivars is given in Table 1 below for the second agricultural season of 1985 and first season of 1986. Sorghum, called "petit mil" in Haiti, is the dominent cereal cultivated during this season, followed by corn. The major explanation for this is that the second season is generally dryer and sorghum does better under limited moisture conditions. Where moisture availability permits (eg. irrigated plains, lower parts of some watersheds) corn cultivation will take precedence even during this season. Some farmers will place a small parcel of corn on their best land to be sure of a fresh source of seed for the primary corn season, beginning February/March. Legumes are generally associated with these two dominent cereal crops.

TABLE 1: Relative Importance of Principal Cultivars
Department du Sud, 1985 - 1986

Cultivar	Hectares Cultivated 2nd.Season	Hectares Cultivated 1st Season	% in Association	% Found in all Association
Corn	14,900	47,300	85% (*3)	27% (*4)
Sorghum	58,900	-	47%	32%
Rice	5,900	5,100	38% (*5)	7%
Bitter Manioc	10,500	-	95%	26%
Sweet Potatoes	18,800	13,500	85%	37%
Yams	10,600	-	97%	28%
Plantain	8,800	-	91%	20%
Pidgeon Pea	20,400	-	98%	38%
Black Beans	9,300	4,700	64%	17%
Red Beans	2,800	2,000	99%	12%
Cowpeas	300	3,800	92%	2%
Peanuts	500	5,000	96%	8%
White (lima) Beans	100	100	100%	1%
Pois Sinistre (*6)	100	100	100%	2%

In terms of area, black beans are one of the most important grain legumes cultivated in this department. Data from the second agricultural season of 1986 (not shown) indicated 9,800 hectares

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(* 3) Interpret this as: 85% of all parcels surveyed containing corn as a cultivar were found to be in association with one or more other cultivars.

(* 4) Interpret this as: 27% of all parcels surveyed in the Department found to include more than one cultivar had corn as one of these cultivars. One of every four parcels in association contain corn.

(* 5) The "associated crop" referred to here is taro (mazumbel), grown as a border crop in about 38% of all rice plots.

(* 6) This bean (literally "disaster bean") represents an assortment of varieties originating from food grain relief aid following various hurricains over the past few decades. Some of this was planted and gave origin to new cultivars.

under black beans, very close to the 1985 estimate for this season (cf.ADS-II Report # 24). While pidgeon pea may cover more area than black beans, planting density is much lower, resulting in low yields (eg. about 150 kg./ha.).

1.1 At least 10% of all farmers grow black beans during the second agricultural season each year on 9% of all parcels, representing approximately 5% of total cultivated area (cf.Table 2). These figures however mask considerable variation between agricultural zones. Most (79%) of the Department's estimated 9,316 (1985) hectares of black beans are found in the mountain zones. Tables 2 and 3 demonstrate differences between agricultural strata and in monocrop/crop association situations.

TABLE 2: Black Bean Data Variability by Agricultural Zone
Department du Sud, Second Season, 1985 (*7)

Variables:
(1) % of Households Cultivating Black Beans
(2) % of all Parcels with this Cultivar
(3) % of all Parcels with Associated Crops with Black Bea as one of the associated cultivars
(4) % of Parcels in which Fertilizer Application was said to be intended for Black Beans
(5) % of Parcels in which Pesticide Application was said to be intended for Black Beans

Strata	Variables: (1)	(2)	(3)	(4)	(
Intensive Plain	5%	7%	16%	81%	2
Extensive Plain	2%	2%	3%	0	
Intensive Mountain	7%	8%	11%	46%	4
Extensive Mountain	30%	19%	22%	0	
Rural Village Zone	4%	5%	17%	14%	1
Department Mean	10%	9%	16%	39%	2

It is interesting to note the perceived importance and use of fertilizers and pesticides for black beans. The data indicate such use is located in intensive agricultural zones where imputs are more likely to be available. In contrast, farmers in the intensive plain strata cited maize as the crop for fertilizer and pesticide application in only 10% and 26% of the parcels, respectively.

(* 7) MARNDR/ADS-II Agricultural Survey, Report #22, 1986. Similar data for all major cultivars found in the Department du Sud can be obtained from this report.

TABLE 3: Relative Importance of Black Beans by Agricultural Zone (*8)

Strata	Hectares in: Monocrop	%	Association	%	Survey Total	%
Intensive Plain	1,157	34%	694	12%	1,851	20%
Extensive Plain	0	0	15	.3%	15	.2%
Intensive Mountain	2,109	63%	1,673	28%	3,782	41%
Extensive Mountain	18	.5%	3,524	59%	3,541	38%
Rural Village Zone	85	2.5%	42	.7%	127	1.3%
TOTAL:	3,469		5,947		9,316	

1.2 The complexity of Haitian small farmer cropping systems is illustrated by the fact that more than 440 unique crop associations were identified by the survey. Of these, 70 included black beans. Of 70 unique black bean associations, only 2 represented over 1% of the total number of associations:

black beans + sweet potatoes	2.0%
black beans + corn	1.14%

Black beans were found as a sole crop and in association with one to six other cultivars (* 9). Despite the large number of unique associations, black beans are found most frequently (89% of all associations with black beans) with one or other of the following cultivars: corn or sorghum, bitter manioc, sweet potatoes, or yams. A complete list of these associations can be found in Appendix B. The average size fields in which beans and other major crops might be found in the Southern Department is given in Table 4 below (*10).

Table 4: Average Field Sizes in Southern Department by Agricultural Zone

Strata	Mean Area per Parcelle: Hectares	Acres	Carreaux
Intensive Plain	.41	1.28	.32
Extensive Plain	.32	1.02	.25
Intensive Mountain	.30	0.96	.23
Extensive Mountain	.50	1.59	.39
Rural Village Zone	.73	2.33	.57
Department Mean	.52	1.66	.40

Any one household might be expected to have about 3 such parcelles, at least one of which would include black beans.

(* 8) MARNDR/ADS-II Agricultural Survey, Report #15, pp.3-4, 1986.
(* 9) We limited ourselves to identifying associations of up to a maximum of 6 cultivars.
(* 10) MARNDR/ADS-II Technical Report # 22, p.9, 1986.

2.0 Tamazulapa Black Beans

In its program of on-farm applied research and extension in the Les Cayes and Jacmel regions of Haiti, variety selection and testing has been one means of attempting to increase sustainable agricultural production among small farmers. Edible legumes, as we shall illustrate below, are not only an important source of protein for Haiti's 6 million population, but they also "contribute to soil fertility through atmospheric nitrogen fixation" (* 11). A leading legume candidate for future extension to certain groups of small farmers has turned out to be Tamazulapa black beans. How have we as an applied research program come to this conculsion? Where does Tamazulapa come from?

2.1 Role of International Centers and Expermental Stations

Tamazulapa was among some 1,370 bean cultivars, originating from CIAT, IITA, ICTA, and Haiti itself (*12), evaluated through numerous carefully monitored trials on the Haitian Ministry of Agriculture, FAMV/ Damian research station near Port-au-Prince. This experimental research was conducted as part of the research component of the USAID funded Integrated Agricultural Development Project (PDAI). The intensive screening program lasting some three years resulted in the isolation of a number of promising red and black bean varieties, among which was Tamazulapa. FAMV program technicians concluded that "Tamazulapa black bean was superior to local Haitian varieties and that the variety should be multiplied and distributed to farmers in all bean growing regions of Haiti" (*13). Charateristics of this variety are given below (* 14).

TAMAZULAPA BLACK BEANS

Variety	:Tamazulapa (*Phaseolus vulgaris*)
Origin	:ICTA Guatamala
Architecture	:Indeterminate
Plant Population	:100,000 to 200,000 plants/ha.
Seeding spacing	:8 - 10 cm. X 75 cm.
Soil preparation	:Plow 20 cm. deep bed on land contour
Flowering 50%	:42 days after seeding
Physiological maturity	:64 days after seeding
Irrigation	:Every 7 - 10 days if no rain
Weeding	:15 days after emergence, then 2 to 4 weeks
Fertilizer	:No fertilizer applied
Diseases	:Tolerant to viruses
Insects	:No major problems
Yield of dry grain	:2,000 kg/ha
Seed multiplied 1983	:600 kg.

(* 11) Texas A&M PDAI annual report, p. 38, 1985.
(* 12) International Research Centers: CIAT = Centro Internacional de Agricultura Tropica, based in Cali, Columbia; IITA = International Institute of Tropical Agriculture based in Ibadan, Nigeria; ICTA = Institute of Agricultural Science and Technology, based in Guatemala.
(* 13) IBID, p. 16.
(* 14) Texas A&M PDAI annual report, p.36, 1983.

As one of the more promising varieties coming from the PDAI legume research program, ADS-II included Tamazulapa in its on-farm testing and pre-extension program beginning during the last half of 1984 in Jacmel and Les Cayes, in both mountain and plain sites.

3.0 Farming Systems Applied on-farm Research

During the first months of the ADS-II project in early 1984, reconnaissance and formal exploritory surveys indicated that local bean varieties figured among the four most important cultivars in terms of food and cash crops for small farmers in several project subzones (*15). A number of recommendation domains could also be identified. These might be summarized as follows.

Physical/Climatic Characteristics

(1) Mountain slopes vs. plain (plateau, valley bottom) sites
(2) First agricultural season (wetter) vs. second agricultural season (dryer)
(3) Naturally Fertile vs. Badly Eroded, Infertile Soils (Mountains)

Agricultural System Characteristics

(4) Monocrop vs. Association
(5) Presence of Irrigation vs. no- Irrigation (plains)
(6) Accessability and Use of Fertilizer vs. No - Fertilizer
(7) Bean Color Preferences (Black vs. Red)

Other major factors effecting farmer's responses to exploiting their resources could be mentioned (eg. elevation, red or black soils, north vs. south facing slopes, access to credit). Given different project locations, a number of these factors could be studied with respect to Tamazulapa. Of concern to us was the relative importance of an introduced legume to farmers, whether or not it could compete with local varieties under local agro-climatic conditons, in the marketplace, and as a food. From cooperating farmers we had learned that local bean varieties suffered significant yield loss from Mosaique virus.

While Tamazulapa was described by FAMV experimental station scientists as not needing fertilizers and yielding 2,000 kg/ha., we have seen that farmers do use fertilizers on their own varieties (cf.Table 2). We also know that conditions on the plain differ from those on mountain slopes. Monocrop beans do not give the same yields as associated ones, and the presence or lack of irrigation presents new conditions. On-farm bean research therefore became a priority for the program to determine the potential of not only increasing productivity of local cultivars, but in determining the circumstances under which an improved cultivar might be superior to local cultivars.

(* 15) MARNDR/ADS-II technical reports # 3 & 6, 1984. "Small farmer" here defined as households with total land resources of less than 1.29 ha., representing some 68% of agricultural households.

The applied research program therefore initiated both short and long term socio-economic surveys combined with an on-farm trial program. The latter included researcher and farmer managed trials with varying levels of technical and/or farmer control, followed by a limited extension program.

3.1 Researcher Managed Trials

Researcher managed trials were conducted on a portion of a farmer's field with the farmer's active participation. Research technicians would lay out trial boundaries and sub-divisions (blocks, treatments) and supervise farmer activity on this plot following a trial protocol. Such trials focused on two major types of trial designs. Examples of each are reported below.

3.1.1 Variety Screening Trial (in association)

We found that red beans were the dominent local variety of *Phaseolus vulgaris* cultivated in Haut Cap Rouge, Jacmel region, and that it was almost always found in association with maize (first agric.season) or sorghum (second agric. season). Four varieties were recommended by ag. experimental station scientists (PDAI program with the FAMV) for testing with the local variety. Thirteen farmers participated with the following treatments (*16):

Table 5: Jacmel Mountain, Researcher Managed Trial: Comparison between 5 Bean Varieties in Association with Local Corn

Treatment 1: Local Corn with Local Red Beans (Manzejout)
Treatment 2: Local Corn with Salagnac 86 (red beans)
Treatment 3: Local Corn with Tamazulapa (black beans)
Treatment 4: Local Corn with Damien 450 (red beans)
Treatment 5: Local Corn with Damien 544 (red beans)

Treatment results (kg/ha.):		Corn	Beans
	T 1:	1,751	488 B
	T 2:	1,751	602 A
	T 3:	1,544	614 A
	T 4:	1,711	485 B
	T 5:	1,862	458 B
	LSD	298	80
	CV%	31	27
Treatment variability	(F)	1.48	4.17 ***
Interactions var.	(F)	0.76	1.58
Site var.	(F)	12.32 ****	9.48 ****

Trials with significant treatment results, such as these, were submitted to a simple economic analysis such as that given below for T1, T2, and T3 of the above experiment.

Table 6. Economic Analysis of Tamazulapa, Salagnac 86, and Local Bean Varieties in Association with Corn, Jacmel

	TREATMENTS					
	LOCAL CORN	LOCAL BEANS	LOC. CORN	SALAGNAC 86	LOC. CORN	TAMAZULAPA
Yield (kg/ha)	1751	488	1751	602	1544	614
Yield above control plot			0	114	-207	126
Total Net Benefits ($/ha)*			$112		$31	
% of farmers who benefited**			80%		75%	

* Net Benefits = Yield increase X price of corn (1.8 gourdes/kg) and beans (red beans = 4.9 gourdes/kg; black beans = 4.2 gourdes/kg), less cost of fertilizer (at $ 43.60/ha) when used.

** Benefiting farmers = all farmers receiving a net benefit in the test plot greater than that of the control plot for the association.

With both agronomic and subsequent economic analysis, Tamazulapa and Salagnac 86 proved in this trial to be significantly better than the local variety and the other introduced varieties. Cooperating farmers were enthusiastic about results.

3.1.2 Improved vs. Local Management Trial (in monoculture)

Recommended management for Tamazulapa was different from local practice. We also wanted to test the effect of fertilizer application in a monocrop situation, and under conditions of irrigation. Black bean cultivars are the local preference on the Les Cayes plain and they are frequently found as a sole crop (cf Table 3). A researcher managed trial was set out on 7 farmer fields on the Les Cayes plain near Berault (with irrigation possibilities) and 6 farmer fields on the Maniche (Cavaillon

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(* 16) MARNDR/ADS-II Technical Document # 7, pp. 47-51, 1984 for more details on this trial and others conducted in Jacmel and Les Cayes during 1984. **, ***, **** indicate a level of significance of 0.05, 0.01, or 0.001 respectively for differences as determined by either a T-Test for paired observations or F-Test (Anova or Factorial analysis).

watershed) plain (no irrigation) with these treatments (*17):

Table 7: Les Cayes Plains Monocrop Black Bean Research Managed Trial

Treatment 1: Local Black Bean with Farmer Management (no fertilizer, farmer planting density)
Treatment 2: Local Black Bean with Improved Management (fertilizer and recommended density of T4 below)
Treatment 3: Tamazulapa with Farmer Management
Treatment 4: Tamazulapa with Improved Management (fertilizer with recommended density)

Treatment results (kg./ha.):		Berault	Maniche
	T1:	887 AB	650 B
	T2:	802 B	607 B
	T3:	1,035 A	843 A
	T4:	1,052 A	705 B
	LSD	161	108
	CV	22.39	13.67
Treatment variability	(F)	4.55 ***	4.25 ***
Economic Analysis:			
X̄ Yield Above Control	(T1,T3)	148	193
Total Net Benefits ($/Ha.)		$133 (*18)	$174
% of Farmers Benefiting		50%	80%

Tamazulapa in this trial was shown to significantly outyield the local variety under the farmer's own management techniques. Yields were also higher in Berault where irrigation was available when needed. Improved management (fertilizer application, lower planting density) was not significantly better than Tamazulapa under farmer management (no fertilizer, higher density). The key difference here was probably plant density. The farmer's practice of planting two rows of beans (2 seeds per hill X 10 cm) along the mounded rows is believed to be superior to Tamazulapa's

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(* 17) MARNDR/ADS-II Technical Report # 14, p.155, 1985
(* 18) Per capita GDP for the rural sector of Haiti was estimated by World Bank as US $125 (Haiti Agricultural Sector Study, June, 1985). A cash income of this amount from increased yield in black beans would have a positive effect on farmer household economies.

'recommended' practice of only one row (2 seeds per hill X 10 cm). Distance between rows (75 cm) were about the same between both practices. Other on-farm experimentation would deal with this issue.

3.2 Farmer Managed Trials: Pre-Extension

Farmer managed trials are more simple in design and much larger than researcher managed trials, sometimes including an entire field divided into approximately equal portions. Actual farmer management can vary from some supervision by a technician to complete farmer control, where the technician only records dates of actual activities (after performance) and collects yield estimates and farmer observations. These trials are less costly in terms of scarce technical resources and more of them can be planned. This is important because such trials test treatment performance across many different field situations (soils are different, planting times can vary, rainfall will differ, different farmers will manage plots differently, etc.). To obtain significant statistical results with such site variability, a large number of sites is necessary; 20-30 sites per trial have proven adequate. We have recommended not more than two treatments for such trials.

Trials under the management of the farmer have also developed into two major designs, demonstration and adoption trials.

3.2.1 Demonstration Trials

When on-farm research technicians have believed a particular variety or technique (or group of techniques) to be demonstratably superior to a local variety or technique, and farmers have responded favorably to earlier trials, we seek to demonstrate this on a greater number of farmer fields under more direct control of the farmer's themselves. Many such trials have been placed with farmers in both Cayes and Jacmel, in 1984, 1985, and 1986. One such trial, with 14 cooperating farmers in Berault and 15 in Maniche (all on plain or valley floor) in 1984 had the following treatments. There were no irrigated fields.

Table 8: Les Cayes Plain Pre-Extension Trial: Tamazulapa and Local Black Beans Compared (T-Test)

Treatment 1: Local Black Bean under Farmer Management
Treatment 2: Tamazulapa with Improved Management (in latter trials, this has changed to Farmer Management with some fertilizer)

Treatment results (kg/ha.):		BERAULT	MANICHE
	T1:	446	530
	T2:	608 ***	706 **
	CV	47%	45%
$\bar{X}$ Yield Above Control:		162	176
Total Net Benefits ($/ha): (*19)		$146	$159
% of Farmers Benefiting:		91%	94%

In these trials, the Tamazulapa variety itself was the determining factor in the increased yields.

3.2.2 Farmer Adoption Trials

Many farmers in Jacmel and Les Cayes have begun to cultivate Tamazulapa in preference to the local variety they used to use. In some zones it actually is replacing the local variety. When farmers, on their own volition, cultivate an introduced variety, research technicians take yield samples from such parcelles. Data were obtained from a group of farmers in Les Cayes in 1985 who cultivated Tamazulapa on a portion of their plots next to their local black bean variety (*20).

(* 19) Same cost estimates used for this and subsequent trials as was used in Table 6.
(*20) MARNDR/ADS-II Technical Report #14, pp. 190-192, 1985.

Table 9: Les Cayes Plain Pre-Extension Adoption Trial (monocrop) (T-Test)

Treatment 1: Tamazulapa under Farmer Management
Treatment 2: Local Black Beans under Farmer Management

(farmer management= no fertilizer, farmer density, farmer planting and weeding methods)

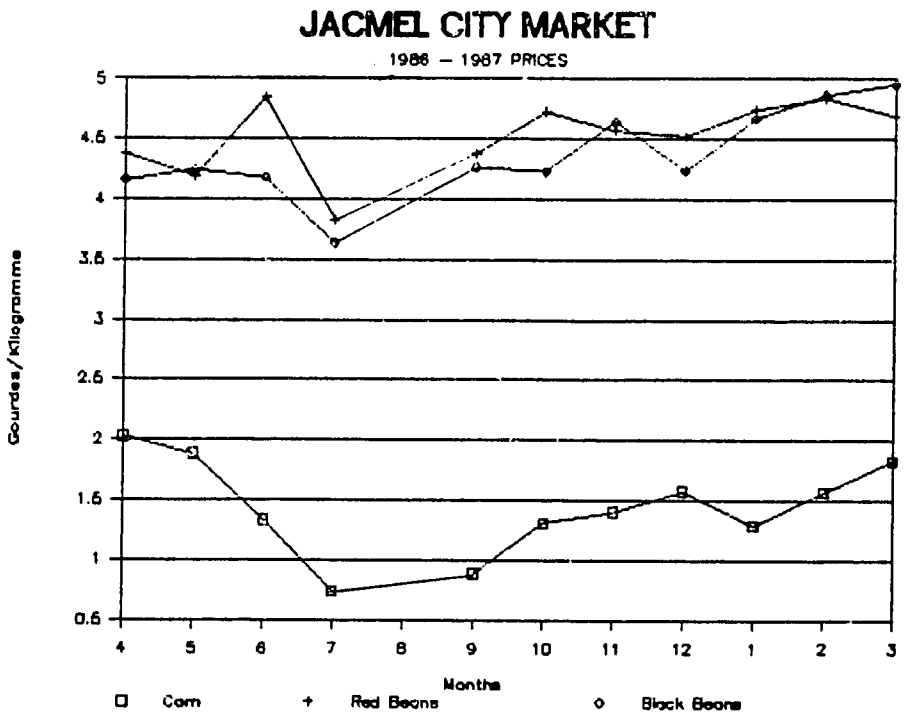
Treatment results (kg/ha.)	BERAULT	MANICHE
T1:	526 *	798 ***
T2:	421	596
$\bar{X}$ Yield Above Control:	105	202
Total Net Benefits ($/ha):	$ 95	$ 182
% of Farmers Benefiting:	91%	79%

Here again, as we learned from other similar trials in Jacmel and Les Cayes, Tamazulapa was a significantly better variety than the local one in our plain sites. Results in our eroded, dryer mountain sites were much less positive.

4.0 Marketing and Extension

Most of each season's harvest is sold on a local market soon after the harvest resulting in peak and low pricing, as shown in the graph below in Jacmel for Jan.-March and July-August respectively. As seen here, the price for 1 kg. of corn is about half that of beans. Furthermore, prices between major bean varieties are close. To the extent that it has begun to appear on the local markets, particularily in Les Cayes, Tamazulapa has sold near the price of local black beans.

Much of the bean seed used for planting comes from the local market. Harvest season in some mountain regions of the country coincides with planting seasons in the plains, resulting in a back and forth movement of seed material. Because of the high cost of money (250-300% interest) farmers have an economic incentive to sell their grain stocks at harvest, in spite of lower prices, rather than store grain.



No functioning national level agricultural extension program yet exists in Haiti, though serious steps are being made to correct this situation. What extension does exist takes place through various region-specific private and public sector projects of limited duration. The ADS-II program, to give an example, through its pre-extension program of Tamazulapa, has in effect, extended this black bean in a limited number of areas in the country. The program currently seeks to assume wider extension responsibility by assisting the newly formed Ministry of Agriculture extension centers near project sites and the Ministry's Watershed programs. Cooperating farmers within project zones are becoming an important source of seed for continuing extension efforts. For example, such farmers in Les Cayes during the first agricultural season of 1986 cultivated over 20 hectares of monocrop Tamazulapa, yielding some 16,000 kgs. of seed, part of which was purchased by the project for distribution to other sites. A similar amount of seed is being prduced by cooperating farmers for seed multiplication purposes in Les Cayes in 1987.

On-farm applied research has demonstrated that Tamazulapa should indeed be extended to Haitian small farmers. Nowhere did it do worse than local varieties (whether red or black). Yield expectations from the different recommendation zones (cf.p.7) will vary as summarized in Table 10 below. Almost everywhere, Tamazulapa outyielded the local variety by about 200 kgs/ha. Highest yields can be expected where irrigation is possible (eg. Les Cayes), followed by areas with naturally fertile soils (eg. Haut Cap Rouge in Jacmel). Lowest yields will come from eroded, infertile, and over-cultivated mountain slopes, though even here Tamazulapa sometimes outyields the local variety (eg. Fond-des-Frères, Cayes mountains). The mean yields promised by the agricultural research station (2000 kgs/ha., cf.p.6) were rarely reached.

What we know about this variety's performance under different conditions, across three years, might be partially summarized in Table 10 below.

TABLE 10: PERFORMANCE OF TAMAZULAPA BLACK BEANS IN DEPARTMENTS OF SUD AND SUD-EST
JACMEL AND LES CAYES (T-test of significance of paired observations)
1984-1986

		LOCAL BLACK OR RED BEANS * (kgs./ha.)				TAMAZULAPA BLACK BEANS				Positive Difference	
	# of Cases	Minimum	Maximum	Stand.Dev.	Mean	Minimum	Maximum	Stand.Dev.	Mean	kg/ha	$/ha.
Non-trial Farmer Yields	256	33	2666	454	603						
Mountain Slopes in Association (Jacmel, Fertile)	214	28	6250	727	839	44	5800	987	1016 ***	177	$159
Mountain Slopes in Assoc.(Cayes, Eroded, no fert.)	50	83	738	128	312	71	840	166	386 ***	74	$67
Plain Association (Les Cayes, Rainfed)	19	220	1444	322	809	310	1670	317	837 ns	28	$25
Plain Association (Les Cayes, Irrigated)	10	556	1111	168	849	556	2222	555	1239 **	390	$351
Plain Monocrop (Les Cayes, Rainfed, no fert.)	123	112	1500	294	582	152	1630	344	782 ****	200	$180
Plain Monocrop (Les Cayes, Irrigated, some fert.)	42	200	3832	806	1326	300	4106	850	1415 ns	89	$80
With Fertilization (Les Cayes, Mountains)	9	225	437	59	298	137	462	95	313 ns	26	$23
Without Fertilization (Les Cayes, Mountains)	9	0	450	-	315	200	500	-	349 ns	34	$30

* Local beans = Red in Jacmel, Black in Les Cayes

5.0 Conclusions

In both the Jacmel and Les Cayes regions:

(1) Tamazulapa, under the same management as local black beans, gives a significantly better yield. It does no worse than local varieties under conditions of very low fertilitly, eroded slopes, and low irregular rainfall.

(2) Tamazulapa showed greater tolerance to moisture stress and to mosaique virus than the local variety.

(3) Without fertilizer, Tamazulapa performed better under irrigated conditions than under rainfed conditions. Fertilization did not seem to have a yield effect on either local or Tamazulapa beans.

(4) Tamazulapa, even though it matures some two weeks later than the local variety, is very much appreciated by farmers for both its vegetative growth and the food quality of its grain.

(5) Significantly higher yields can be expected when irrigation is used.

(6) The market value of the yield increases which can be expected from cultivating Tamazulapa (without fertilizer) on the land most small farmers already use for their local beans can contribute in important new source of revenue for these farmers. If, for example, only <u>half</u> the land presently cultivated in black beans by farmers in the <u>intensive plain and mountain zones</u> of the Southern Department should, through extension efforts, shift to Tamazulapa, one might expect at least 1,152 additional metric tons of beans to be produced, representing a market value of about $ 1 million a year (*21).

Applied field research has confronted project research technicians with new issues for future research, both in the field and at the research station. We are still looking for better ways of helping more farmers realize the production potential possible with Tamazulapa for example. It seems likely that Tamazulapa will not prove of interest to farmers on extensively eroded slopes or very poor soils. We are concerned about how farmers can be assured a continuing source of quality seed, because over time it will become mixed with local varieties of the same color. Researchers have come to realize that local varieties themselves hold outstanding potential, particularily if selection of desirable characteristics is undertaken and field management conditions improve.

Increased production of one cultivar in the farming system, however important, is only a first step in improving the overall productivity of this system. ADS-II expects to demonstrate productivity increases for other cultivars through improved soil and ground moisture management on slopes (eg. vegetative barriers and/or rock terraces, mulching) as well as on the plains (irrigation, hilling). Such techniques for example might render

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(* 21) Table 3. Calculation assumes a 200 kg/ha. yield increase with two plantings of beans a year.

Tamazulapa significantly better than local varieties in just those areas (eg. eroded slopes, low moisture) where it does not seem to outperform local varieties at present. The future availability of national agricultural statistics should provide initial indications where specific cultivars like Tamazulapa might be successfully extended and adopted. We continue to look to the international centers and other research programs for new genetic material as well as ideas/methods to improve the applied on-farm research program. We believe we are training a new generation of rural orientated Haitian field technicians (agronomists, rural sociologists and economists) who will provide new leadership in the country's technical training schools and experimental stations - leadership based on a first hand experience dealing with the problems of rural agricultural development. Agricultural research and extension require a dynamic long term exchange between the farmer client and the technician if lasting positive change is to occur.

Appendix A: Organizational Framework of ADS-II project

The ADS-II project was placed, by agreement between the Haitian Ministry of Agriculture and the United States Agency for International Development (USAID), in the Center for Agricultural Research and Documentation (CRDA) of the Faculty of Agriculture and Veterinery Medicine (FAMV), perhaps the best functioning division of the State University of Haiti system. The FAMV's long term program for research and training is coordinated by the Ministry of Agriculture, Natural Resources, and Rural Development (MARNDR). MARNDR itself is made up of five major program divisions:

(1) Administration
(2) Natural Resources (Hydrology,Fisheries,Forestry,Watershed Dev.
(3) Rural Development (Extension)
(4) Livestock
(5) Agriculture

ADS-II, like the FAMV and Rural Credit Bank, enjoys a semi-autonomous place, under the direct control of the Minister and his cabinent, permitting us to support the various divisions without ourselves being a part of them. We are housed in the Ministry of Agriculture headquarters in Damien, just outside Port-au-Prince, and less than 100 meters away from the FAMV campus.

The ADS-II project includes two major components:

(1) Farming Systems Research/Extension Division (with micro-economic orientation)
(2) National Agricultural Statistics Division (with macro-economic orientation)

The FSR/E Division conducts its activities in two major regions of the country: Jacmel and Les Cayes. In each of these regions three plain sub-zones and three mountain sub-zones were selected for the on-farm program of trials and surveys. The program includes providing short term practical field training for FAMV second and third year students, as well as a year's assignment for 12 graduates/year to fulfill their graduation residency requirements. Over time we hope these graduates will take a FSR/E perspectives to other parts of the country.

The National Agricultural Statistics Division has two major sub-divisions:

(a) A nation-wide area frame agricultural statistics recurrent survey (twice a year and into future) to provide basic statistics on crop area and production, livestock, land tenure, and other socio-economic variables.
(b) Setting up within the Ministry a digitized data base of national and regional level data based on the Comprehensive Resource Inventory and Evaluation System (CRIES). The geographical information systems section of this division has already digitized 9 natural resource variables at

the national level as well as data concerning some 10 watershed systems of major priority to developing agricultural programs. A cartographic section is creating a land use map for digitization based on current Landsat 5 imagery.

An agenda was handed "top down" to us at the beginning. A previous USAID project had done intensive experimental station research to collect and test all the major crop cultivars grown in Haiti and had already "recommended extension" of many promising varieties (without field testing). Another program had done similar work on grafted fruit and other tree varieties. We were asked by the Ministry for national agricultural statistics.

The project has emphasized developing new agricultural technology, building an agricultural information system, and training agricultural technicians based upon farmer participation and extensive use of the detailed information about Haitian farming systems that the project itself has acquired in the field. As planned in the original project technical proposal (*), experience with agricultural information gathering and analysis, done to support the farming systems activities (formal and informal socio-economic surveys) would serve as the basis for the design of a national level information gathering and analysis system.

The phases in the design and implementation of the national agricultural information system included chronological steps that began by serving the needs of specific geographic regions (eg. farming systems program), expanding later to serve other regions (agricultural statistics surveys) and finally the country. Rather than only identifying at the top what types of data should be obtained at the national level, we began "at the bottom" to learn what could be known and how to ask for such data. This was the basic project philosophy integrating the diverse elements of the program.

The breadth of the ADS-II program has permitted us to bring together in a complementary fashion a wide range of factors effecting agricultural production in Haiti. We believe the program has proven a challenging and professionally rewarding experience for all members of the team, both expatriate and Haitian.

(*) A Technical Proposal, Submitted to USAID, Port-au-Prince, Haiti for Technical Assistance in Support of the Agricultural Development Support II Project No. 521-0092, by the University of Arkansas, Fayetteville and Winrock International, April 1983.

Appendix B: Associations Found within the Department du Sud Which Include Black Beans (Second Agricultural Season, 1985)(ADS-II Technical Report # 22, 1986)

Associations	Percentage of All Associations Recorded
Black Beans, Sweet Potatoes	2.00
Black Beans, Corn	1.14
Black Beans, Sweet Potatoes, Bitter Manioc	0.80
Black Beans, Sorghum	0.61
Black Beans, Plantain	0.52
Black Beans, Bitter Manioc	0.42
Black Beans, Corn, Sweet Potatoes	0.34
Black Beans, Corn, Plantain	0.23
Black Beans, Coffee, Plantain	0.19
Black Beans, Taro, Malanga	0.15
Black Beans, Sweet Potatoes, Yams	0.13
Black Beans, Bitter Manioc, Plantain	0.13
Black Beans, Bitter Manioc, Yams	0.13
Black Beans, Yams	0.11
Black Beans, Pidgeon Pea, Sweet Potato, Yams	0.11
Black Beans, Sweet Potato, Plantain	0.11
Black Beans, Sweet Potato, Malanga	0.10
Black Beans, Pidgeon Pea, Sweet Potato	0.09
Black Beans, Bitter Manioc, Yams, Coffee	0.09
Black Beans, Sweet Potato, Banana	0.07
Black Beans, Rice	0.06
Black Beans, Yams, Malanga	0.06
Black Beans, Red Beans	0.06
Black Beans, Pidgeon Pea	0.05
Black Beans, Sweet Potato, Yams, Plantain, Breadfruit	0.05
Black Beans, Corn, Sweet Potato, Plantain	0.05
Black Beans, Yams, Plantain	0.05
Black Beans, Bitter Manioc, Coffee	0.05
Black Beans, Pidgeon Pea, Sweet Potato, Plantain	0.05
Black Beans, Corn, Bitter Manioc	0.05
Black Beans, Plantain, Banana	0.05
Black Beans, Sorghum, Pidgeon Pea	0.04
Black Beans, Corn, Sorghum, Sweet Potato	0.04
Black Beans, White (Lima) Bean	0.03
Black Beans, Sorghum, White (Lima) Bean	0.03
Black Beans, Bitter Manioc, Sugar Cane	0.03
Black Beans, Sweet Potato, Coffee	0.03
Black Beans, Pidgeon Pea, Sweet Potato, Malanga	0.03
Black Beans, Yams, Sweet Potato, Squash, Banana	0.03
Black Beans, Sweet Potato, Squash	0.03
Black Beans, Bitter Manioc, Sweet Potato, Rice	0.03
Black Beans, Corn, Bitter Manioc, Yams	0.03
Black Beans, Corn, Squash	0.03
Black Beans, Corn, Sweet Potato, Bitter Manioc,Rice	0.03

Bla k Beans, Corn, Sorghum	0.03
Black Beans, Sorghum, Sweet Potato, Bitter Manioc, Pidgeon Pea, Coffee	0.03
Black Beans, Yams, Coffee	0.03
Black Beans, Yams, Squash, Banana	0.03
Black Beans, Bitter Manioc, Pidgeon Pea	0.03
Black Beans, Pois Inconnu, Yams	0.03
Black Beans, Corn, Yams	0.03
Black Beans, Malanga, Plantain, Banana	0.03
Black Beans, Sweet Potato, Bitter Manioc, Pidgeon Pea	0.03
Black Beans, Sorghum, Rice	0.03
Black Beans, Corn, Sorghum, Yam, Pois Inconnu, Malanga	0.03
Black Beans, Corn, Pidgeon Pea	0.02
Black Beans, Corn, Sorghum, Pidgeon Pea, Malanga,Taro	0.02
Black Beans, Sweet Potato, Taro, Mazumbel	0.02
Black Beans, Sweet Potato, Squash, Mazumbel	0.02
Black Beans, Corn, Sorghum, Red Beans	0.02
Black Beans, Corn, Sweet Potato, Taro	0.02
Black Beans, Sorghum, Pidgeon Pea, Sweet Potato, Taro	0.01
Black Beans, Sorghum, Pidgeon Pea, Bitter Manioc, Sweet Potato	0.01
Black Beans, Corn, Pidgeon Pea, Yams	0.01
Black Beans, Bitter Manioc, Yams, Banana	0.01
Black Beans, Corn, Plantain, Coffee	0.01
Black Beans, Corn, Sweet Potato, Sugar Cane	0.01
Black Beans, Corn, Mazumbel	0.01
Black Beans, Coffee	0.01
Black Beans, Corn, Sugar Cane	0.01
Black Beans, Yams, Plantain	0.01

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