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PROBLEMS FACING PEASANTS IN THE GROWING OF BEANS IN HAITI

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SUMMARY

A one year study of the production systems of 15 agricultural units in a mountain village, has made obvious the importance of beans in the farming system and the major problems posed by the cost of seeds in the total costs of production of this species.

Poor means of production, lack of finances, problems of preserving, and high prices of beans at sowing-time, encourage farmers to avoid these obstacles by sowing three-times a year. Very few of them will achieve complete self-supply, and most of them will have to resort to partial and costly purchases, sometimes at the expense of the means of production.

The analysis of planning inside the production unit adds to the information given by the Salagnac Research-Development system (1976-1982): observation of techniques, experiments, steady observation of land occupation, agrarian system. This analysis underlines the necessity of continuing the research on species in order to complete the range of big-seed varieties already available, with cheaper smaller seed varieties.

METHODOLOGY

In the southern peninsular in Haiti, a group of adjacent-dwelling places representing 15 family farms, was studied, by the agronomer and co-writer, Nicolas Dauphin, during a whole agricultural campaign (Aug. 80 to Aug. 81). In order to get first-hand information, the latter stayed with the families day and night that is about 80% of the year.

The different elements of production systems were carefully listed. Thus each plot and all the cultivated gardens were measured. The yield was calculated from a series of samples taken at harvest-time. Investigations by weekly questionnaires to farmers households helped to determine the working-time spent in each field.

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LOCATION

On the southern slope of the Rochelois Plateau, the area studied is situated at an altitude of 500-600 metres, half-way between the "Fonds-des-Negres" basin (alt. 300 m), and the Salagnac heights (alt. 900 m).

Farmers settled early, in this region, as early as the 2nd half of the 18th century (marrons) because of the water supply from springs for human consumption; the climate, with an annual rainfall of 1.8 to 2 metres (average temp. 25° C), the fertile soil, and hilly topography. This region, at present, is one of the most densely-populated mountain regions in the country.

MEANS OF PRODUCTION
(See tables 1 to 4)

112 plots are cultivated in these 15 farms, totalling 24.12 hectares, 2/3 of which are privately owned. Only 4 farms, that is about 1/4 of the total, utilize more than half of the cultivated land. All the others are inferior to 1.5 hectares in size. On the average, 3.6 persons (age not taken into consideration) live from each hectare; a farm labourer works on 6,000 sq. meters.

A great number of farmers resort to non-agricultural activities (10% of the time); as to the worst off, they have to sell their labour services outside to units which are better off.

Each family has the following tools to work the land: a hoe, a cutlass, a pruning-knife and/or a "soko" and pliers representing a capital of about 100 gourdes (that is $20).

Livestock, which can be seen everywhere, serves as savings, as a provider of labour within the family, as a consumer of farming by-products and of grass found on fallow land.

For every cultivated hectare there is 0.8 horned cattle, 0.8 pig and 1.1 goats.

1. THE IMPORTANCE OF BEANS IN THE FARMING SYSTEM

Farming system

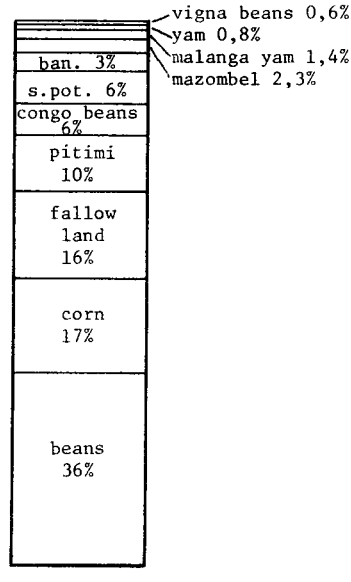
The farming systems adopted are highly dependent upon the types of terrain. All the surfaces cultivated are divided into 16 categories. A large part of these, over 50%, is composed of melanised calcic soils on layers of marly limestone and basalt.

The second largest group is composed of land showing characteristics of rendzine (see chart 5).

The grouping of crops on the same plots is the most frequent in this region. Thus, out of the 112 plots examined, a total of 36 groupings were listed (see chart no. 6); beans are found in 28 of them, and are part of 3/4 of the groupings.

There are four planting seasons a year. If we regroup seasons, terrains and the major cultivated species, we can determine seven main planting systems (see chart 7). The three most important systems, February, July and October, constitute almost 90 per cent of all the planting shifts for the major groupings (see chart 8).

The 80/81 planting shifts of each species (see chart 9) for all the farms show a net dominance of beans over the other species. Together with corn, beans represent more than 50% of the cumulated planting shifts.



80/81 - Planting shifts per species
(percentage of the planted areas)
for 15 farms.

The Importance of the Bean

The main planting shift for almost all the farms in this region is composed of the February Corn associated with congo beans; one will always try to take advantage of the land prepared in such a way to sow beans. Indeed, because of their short cycle (2 to 2 and a half months), beans do not interfere with the development of corn and guarantee an income from the most fertile lands at this time. Thus 2/3 of the area sowed with beans is planted at this time of the year. The other third is planted in July and October and can be classified as follows for all the plots of the 15 fields sowed with beans.

	sowed area (hectare)	number of plots	seeds (number of pots)
80 October Bean	3.45	23	77.5
81 February Bean	11.6	65	174
81 July Bean	1.9	12	46.4
Annual Total Beans:	16.95	100	297.9

These three planting seasons, October, February and July, allow the transmission of seeds among other things. First of all let's say, briefly, that the October planting is used, above all, to keep and multiply the seeds for February; that of July is not very important compared with the other periods, accounting for only 11% of the total area planted with beans during the year. The July sowing depends on the possibility of having a plot in the hills; as a matter of fact, below an altitude of 500 m the high temperatures favour the development of such diseases as "common mosaic" and "golden mosaic" which make all cultivation impossible.

The Bean, a Cash Crop

Out of the 24.12 hectares of cultivated land, coffee accounts for only 1.5% of the planting shifts whereas the bean, cultivated alone or in a grouping, is sowed over 70% of the land. It constitutes the main cash crop. In three planting seasons allow to have a cash in flow throughout the year. The short vegetative cycle, 2 months that is, reduces to a minimum the time for the capital tie-up. Finally, the high demand from the local market provides, even when yields are low, good evenings for the work done.

Thus, a family can get 6.3 gourds for yields varying from 3 to 6 cwt/ha for the October beans, planted alone. In February, the money received was about the same (5.5 gourds) if the production of corn is included in the calculation of the net profit margin and without taking into account the production of other associated species such as congo beans..., which represents 15 times the wages per hour for paid agricultural labor (0,40 gourds) (see charts 10 and 11).

BEANS OCTOBER 1980				BEANS FEBRUARY 1981 + CORN				
Farms	Bean yield (cwt/ ha)	Net profit Margin/family working hours in gourds		Farms	Bean yield (cwt/ ha)	Corn yield (cwt/ ha)	Net profit Margin/family working hours in gourds	
			yield ≥ 3 cwt/ha $\bar{X}$ = 6,3 gdes 6n = 1,8					$\bar{X}$=5,5 gourds/ working hour 6n = 2,9
4.1.3	5,9	7,6		4.1.2	4,9	10,5	7,7	
4.1.16	5,0	8,7		4.1.3	3,9	12,0	7,8	
4.1.16	4,2	5,9		4.1.8	7,0	15,0	3,5	
4.1.17	3,8	3,3	yield < 3 cwt/ha $\bar{X}$ = 2,2 gourds 6n = 1,9	4.1.10	1,7	5,0	2,8	
4.1.10	3,7	6,2		4.1.15	5,2	12,5	10,5	
4.1.17	2,75	1,8		4.1.17	3,5	5,0	2,2	
4.1.2	2,6	5,4		4.1.19	6,2	15,0	4,2	
4.1.1	1,85	1,3	whatever the yield: $\bar{X}$ = 4,5 gourds 6n = 2,7					
4.1.15	0,8	-0,5						

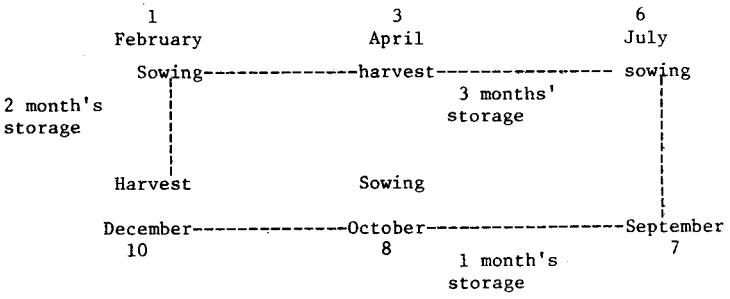
2. SEED SYPPLY: A MAJOR PROBLEM FOR PEASANTS

Seeds, the major expense in bean cultivation

Excluding the price of land, and of family labor from production costs, in order to calculate the sum which would have actually been spent if all the seeds were bought, one can see that the only item "beanseeds" costs twice as much as outside labour. On average, it represents for the farm 3/4 of the production costs (family labour not included) 77% for the October bean, 75% for the February crops.

The prohibitive cost of seedlings for farms which have very limited resources explains largely the necessity for them to look for self-supply.

As a rule, the three planting seasons allow farmers to reach this goal. Thus, sowing at regular intervals (in February, July and October) considerably reduces the time between the harvest and the next seed-planting to a maximum of three months. Keeping seeds for more than three months decreases their power of germination while insects begin to destroy them: sowing twice a year obliges farmers to keep seeds for 5, 6 or 7 months depending on the planting seasons. Growth deficiencies are then too high and the farmer, in this case, would prefer to buy seeds at a high price from another farmer of the area of from a near by market, assuring himself of the origin of the seedlings.



But this will only be a last resort. Therefore the farmer will try, whenever possible, to sow three times a year, if only to be sure of his own self-supply in seeds.

On the whole, for the 15 farms put together, the production of seeds is always more than the seed requirements for the following period.

	OCTOBER BEAN					FEBRUARY BEAN + ASSOCIATED CROPS				
Farms	Area in square meters	Cost of seeds (gourds)	Prod.°cost (gourds) seeds + outside lab. inc. exp.	Bean seed costs/ product° cost		Farms	Area in square meters	Cost of seeds (gourds)	Prod.°cost (gourds) seeds + outside lab. inc. exp.	% bean seeds prod. cost (gourds seed + out.labour + inc.exp.	
1.3	3225	84	124	68		4.1.2	6500	180	338.5	53	
1.16	1450	93.25	110.25	85		4.1.3	9675	240	394	61	
1.16	1260	55.20	55.20	100		4.1.18	900	24	43.5	55	
1.9	300	6.00	26.00	(23)		4.1.10	5000	132	188	70	
1.17	1018	24.00	24.00	100		4.1.15	3225	84	114	74	$\bar{C}_m$ = 75%
1.10	4146	108.0	144.0	75	$\bar{C}$ =	4.1.15	3000	72	135	53	
1.17	1183	48.0	56.0	86	$_m$ 77%	4.1.17	1050	36	52.5	69	
1.2	11183	336.0	502.00	67		4.1.17	1000	24	24	100	6n = 20%
1.1	1612	36	76	47		4.1.17	800	16	35	46	
1.15	1300	43	69	62	6_m= 17%	4.1.20	800	18	18	100	
	26677	833.45	1186.45	70%			34750	892	1411.5	63%	

		July 1980		October 1980		February 1981		July 1981	
		S	H	S	H	S	H	S	H
Σ of the farms	Number of pots	//	113,5	77.5	327	174	889	46,4	//////
	Area in ha	//	///////	3,45	///////	11,6	//////	1,9	// // /

(S: sowing, H: harvest)

	July 1980			October 1980			February 1981			July 1981		
	Seeds		Harvest	Seeds		Harvest	Seeds		Harvest	Seeds		Harvest
	Self-supply	Purch.		Self-supply	Purch.		Self-supply	Purch.		Self-supply	Purch.	
Σ of farms			(113.5)	58,5	19	327	119	55	889	36,4	10	
Σ of actual self-supply				75			68			78		
Σ of actual self-supply if the total of farms is less than 4.1.2.				62			57			72		

Purch. = purchase.

The self-supply in seeds is nevertheless not guaranteed; it only covers for the year, the three seasons together, and for all farms, 12% of the total requirements. If the biggest farm is excluded, this figure falls to 60%.

The July planting

Self-supply accounts for 78% of the July planting: this comparatively high percentage can be explained by the relatively small area cultivated in July as compared with the preceding sowing; the area planted in beans in February is thus, 6 times the size of the area planted in July, and the subsequent production equals twenty times as much as the amount needed for sowing. (See chart 12). We must look for the reasons for external supply, even though small (1/4) elsewhere.

The relatively high production of February represents for the farm, the highest regular annual in flow of cash. This serves, for some, for the repayment of the loans made at the beginning of the planting season (especially seed purchases and labour) and expenses incurred during the year. For others, this sum serves for financing investments which are not immediately productive. The money of the harvest was used for example, by 2 farmers' households, to pay for the emigration of a son, by another to buy land, and by another to buy a horse.

However, only three farms were forced to sell all their February crop, and therefore had to buy seedlings for July.

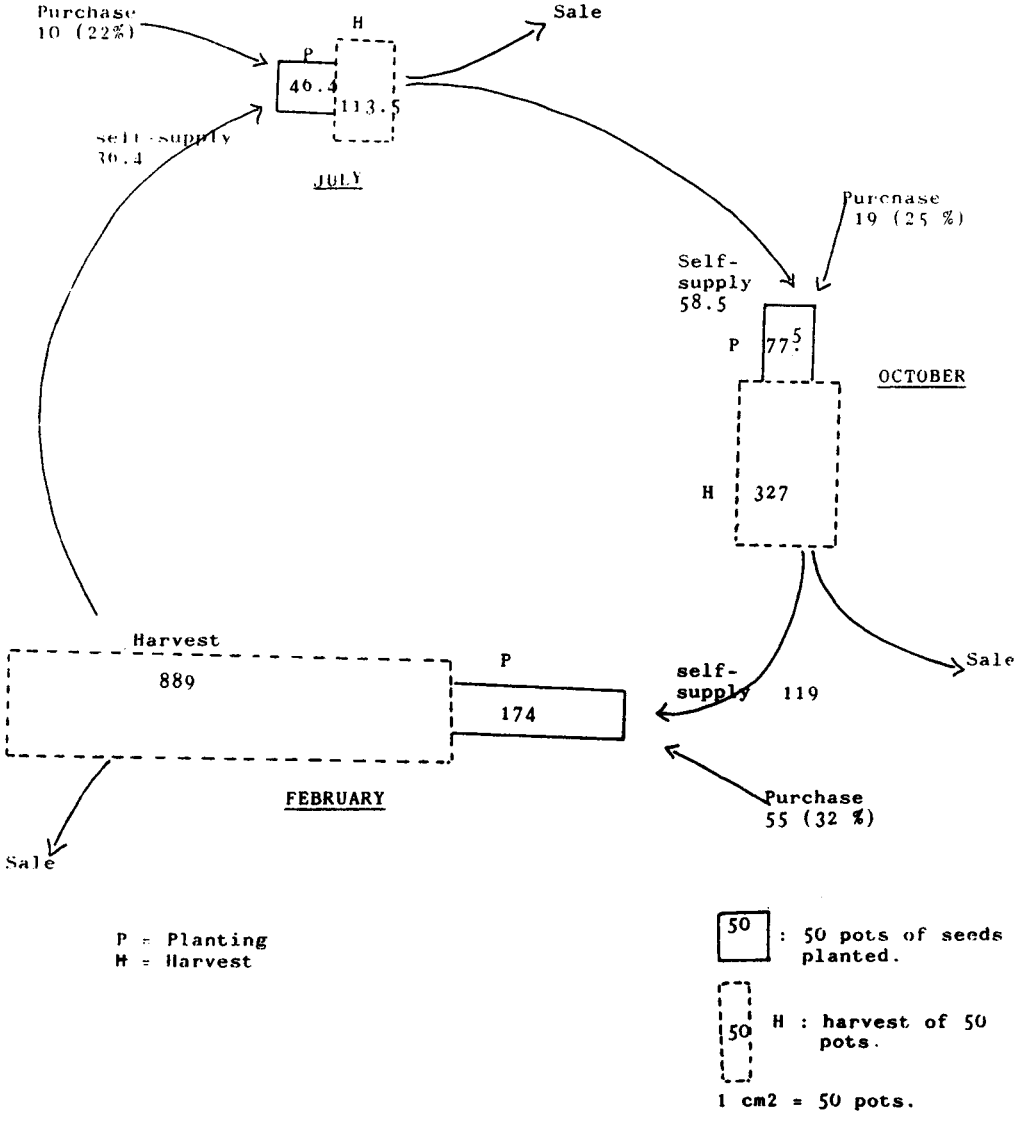
Even though, in some cases, seeds are bought from the outside, the availability of fresh seeds is not the explanation factor for the considerable size of land planted in July. The two determining factors are the availability of labour and "July land". The July bean constitutes a heavy labour investment and a high risk speculation. Thus, 80% of the area planted in bean in July 1980 is the fact of the two largest farms: respectively 3 and 5,5 ha of cultivated surface.

So, unlike February, when the bean is just one species among others; labour investment having been made for all the different crops, to the advantage of the bean, in July, the bean is the main crop, and sweet potatoes are sometimes planted with it. Labour is 50% more than what is necessary for the October bean.

Compared with the October period, three more procedures are added for the July season: the shaking, the scraping, and the making of hillocks. The amount of labour as well as the time of sowing, makes it necessary to hire external labour. Preparation of the land takes place in June, at the time of corn-"scraping" and of sorghum sowing on the "hot" lands situated lower, whether on privately owned farm or by paid labour.

SUPPLY IN SEEDS AND CULTIVATION CALENDAR OF THE BEAN

(13 farms)



As the hazards of weather, which are more frequent at this time of the year, increase the risks, the level of investments is unbearable for some.

The October planting

The October bean is more common. It is also, an almost compulsation way of getting good quality seeds cheaply for the main sowing season, which is in February, (2/3 of the area planted with beans) and for the assurance of a high sale unit-price on harvesting, which correspond to the sowing on irrigated plains in the whole country. The soil used for that, is the rendzines on steep slopes, that cannot be used for any other crop. It has the advantage of being well-drained; the yields never reach the peak of February nor that of July: mediocre soil, as well as heavy rains, poor insolation, and low temperatures, only forecast poor yields: rarrely more than 5 cwt/ha, and the average for October of the year under study, was 3,4 cwt/ha. The habit of particularly close sowing, limiting the growth of weeds and thus avoiding weeding, contributes to the poor yield, at the time when bean planted alone.

The cultivation of the October bean doesn't require much work; there is no need for maintenance. Weeding, which is 40% of the total work done, is the most expensive. The slow growth of weeds and the rocky soil allow a quick cleaning with the "soko". The lower wages given to "women teams" but also the relative availability at that time of year account for the net margin of 4,5 gourds for each hour of family work.

So, each plants 1 or 2 plots with the "October bean". Hurricane "Allen" of August 1980 caused heavy losses in the preceding season, upsetting the farmers' forecasts; half of the farmers had to buy seeds in order to make up for the 25% seed deficit. Let us point out, however, that those farmers who bought seeds in October 1980 were also who didn't sow in July or did so on a small scale.

The February planting

In July and October, the soil is prepared for the growing of beans and therefore, the size of the area prepared depends on the quantity of seeds available.

In February, problems are different. A large variety of species can grow on this soil which is weeded in order to be planted chiefly in corn. The farmers thus have to take advantage of seeds is the major expense incurred in this planting. The farmers have, at any rate, to collect the quantity of seeds necessary for planting, otherwise they will lose a lot at this time when it is possible to make the highest

profits. Because of the large size of the planted area, the necessary quantities cover 60% of the total seed requirement for all 3 periods. Few farms can be totally self-sufficient, 2/3 of them have to buy part of their seed supply. What farmers can get from their neighbours is hardly ever sufficient and many farmers, to cope with this, have to sell small animals such as goats and poultry, but also young growing pigs. 32% of the February seeds are bought from external sources. The large supply of seeds from the October harvest is not enough to make up the deficit of the February planting which is 65% of the total annual deficit.

Thus, out of the 15 farms under study (see charts 12 and 13) only 4 of them, that is to say less than 1/3, had enough seeds for their own use. They all planted during the three seasons of the year.

Except for one of them, these are the biggest farms, respectively 2,3 and 5,5 ha of the planted area, and access to outside hired labour.

Plots were planted with beans during the October and February seasons on all the farms; and among these, 3 could not sow in July (about 1/5): those 3 were forced to buy the greatest amount: 10 to 18% of seeds bought for the year.

Note here that in order to reach this objective, 1/3 of the farmers had to plant on the same plot in October and in February.

CONCLUSION

Adequate experimental apparatus have shown that the techniques used for the culture of beans were justified: taking into account the means of production available to farmers, these proved to be the most efficient.

Thus the heavy planting observed (more than 400,000 seedlings/ha) can be accounted for by the small foliar growth due to the low fertility of the soil; less heavy planting, since it underutilizes the space (soil-air) would yield less.

The time chosen for sowing proves sensible, those who don't comply with this risk a drop in yield.

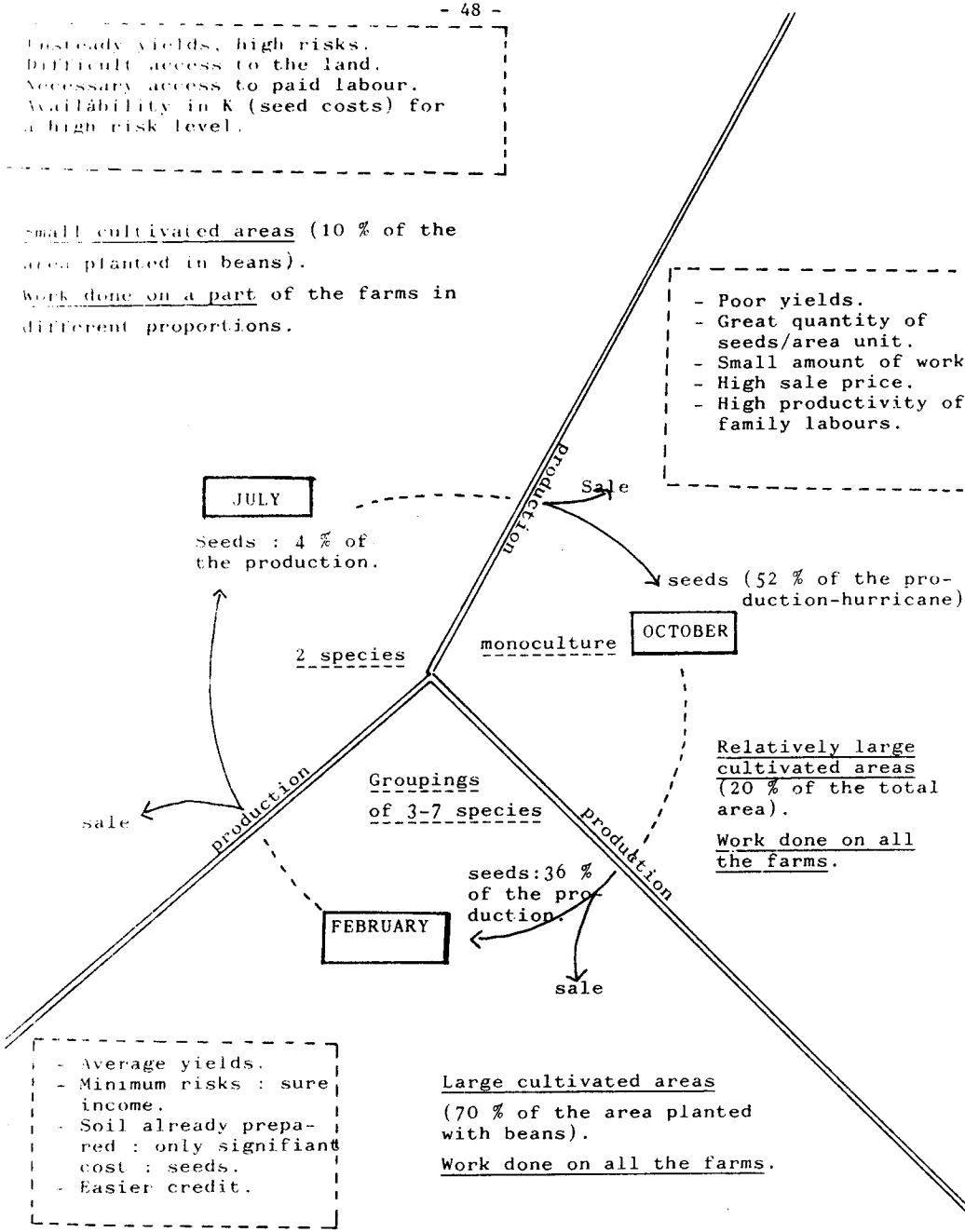
Finally, sowing different species never yields less than sowing just one species.

Always at the same level of the plot, the experiments carried out from 1976 to 1981 at Salagnac, an area next to the locality under study (which has similar problems for the July and October sowings) have made obvious the real limitations. The low fertility of the soil is the prime explanatory factor for low yields. For, simply by adding ashes (4 tons/ha) the yield is doubled, and the addition of manure (30 tons/ha) triples it. The production goes from 5 to 10, then to 15 cwt/ha with the same cultivation methods and the same local species.

Unsteady yields, high risks.
Difficult access to the land.
Necessary access to paid labour.
Availability in K (seed costs) for a high risk level.

small cultivated areas (10 % of the area planted in beans).
Work done on a part of the farms in different proportions.

- Poor yields.
- Great quantity of seeds/area unit.
- Small amount of work
- High sale price.
- High productivity of family labours.



Relatively large cultivated areas (20 % of the total area).
Work done on all the farms.

- Average yields.
- Minimum risks : sure income.
- Soil already prepared : only signifiant cost : seeds.
- Easier credit.

Large cultivated areas
(70 % of the area planted with beans).
Work done on all the farms.

DIAGRAMMED SUMMARY OF THE PROBLEMS IN BEAN CULTIVATION WITHIN THE FARM

A more in-depth analysis, showed that the agrarian system planned by the farmers revolved around, the low fertility of the soil which is the main limiting factor.

An agreement to a follow-up survey of the utilization of the soil for several (hundred) plots over 4 years (1979-1982) shows the good yields of beans in fields B, which peaks of 15-18 cwt/ha. Thus the improvement of bean cultivation firstly requires the renewal of the level of organic content. It also depends on a larger programme for the improvement of fallow lands, taking into account the difficulty for small farms to get fertilizers at present (Bellande et al. 1980, Turenne et al, 1981).

The second factor which explains some low yields (above all those of October and July) is: foliar diseases, principally mildew, rust, and anthracnose. Roughly speaking, these diseases destroy 30% of the production.

The large variety of bean germplasm in Haiti made it possible to isolate mildew-resistant species, 7 species ranging from the most resistant to the least resistant have been chosen after a mass selection in the fields and artificial inoculation tests in greenhouses (Messiaen-Jacqua, Inra Guadeloupe). Two of them, "Salagnac 86" (hardy, quite resistant to mildew) and "Salagnac 92" (fairly resistant) were tested in the fields, multiplied and distributed to farmers. The yields are always superior to the samples by at least 20%.

The analysis of the set of problems encountered within the production unit shows that the supply-seeds is a major constraint. Yield improvements would allow a better multiplication rate and therefore a larger quantity of seeds would be available that at present.

	October	February	July
Number of seed harvested/number of seeds sowed	4-5	8-10	0-10

At the same time as restoring the fertility of the land, which takes a long time, it will be easier to improve the variety of species and the size of seeds. For, with the crossing of species, the size of the seeds varies from 1 to 3.

140 gr/1000 seeds for the "ti pemet" type,
420 gr/1000 seeds for the "Camp Perrin" and "Gross Moget" type

The problems of survival related to the structural difficulties encountered by small family farms, largely account for the tendency of mixed sowing of the "black bean" type (200 gr/1000 seeds) which makes it possible to double the planted area for the same volume (as compared to the "big

red bean"). Thus, the research on species, by simply taking samples from the fields, or by successive cross-breeding using local genotypes (Messiaen et al, 1981) must be continued in order to make smaller seeds as hardy and as highly productive as the ones in "Salagnac 86", available to farmers.

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1. LAND

FARM NUMBER		1	2	3	7	8	9	10	11	13	15	16	17	18	19	20	TOTAL OF 15 FARMS
AREA (ha) OF FARMS	PROPERTY	1,19	5,10	1,89	2,27	0,56	0,4725	0,536	0,84	1,3325	0,875	0,785	0,97	0,215	0,5815	1,66	19,2775
	TAKEN IN POTEK		0,36	1,06	0	0	0,46	0,6	0	0,16	0,3225	0,32	0,02	0	0,13	0,32	3,7525
	TAKEN IN SHARE-CROPING						0,14	0,89					0,3075	0,3525	0,32	0,4825	2,4925
	CULTIVATED MINE		2,9											(0,16)	(0,65)		3,71
TOTAL AREA (in ha)		1,19	8,36	2,95	2,27	0,56	0,0725	2,026	0,84	1,4925	1,1975	1,105	1,2975	0,7275	1,6815	2,4625	29,2325
CULTIVATED MINE AND USED FOR PASTURING		*	*	0,97													
TOTAL AREA (ha) (SHARE-CROPING AND/OR FARMING)		0	2,9	0	0,76	0,10		0	0,16	0	0	0,35	(0,16)	0,16	0,65	0	5,08
TOTAL CULTIVATED SURFACE		1,19	5,46	2,95	1,51	0,46	1,07	2,02	0,68	1,49	1,19	0,76	1,29	0,56	1,03	2,46	24,1
NUMBER OF CULTIVATED PLOTS		7	10	7	5	5	6	8	4	7	6	12	13	6	7	9	112

- Potèk : farming over several years.
- Socié : share-croping.
- Minè : individed land joint possession.

means of production

2.1 - WORK

Farm number	1	2	3	7	8	9	10	11	13	15	16	17	18	19	20	TOTAL 15 FARMS
Number of mouths to feed total popul*	6	6	6	4	6	1	7	3	6	7	3	10	6	6	9	86
Potentially active working labour in MP units*	3.6	3.0	2.8	3.6	3.2	1	3.6	3	3	3.4	1.4	3.5	3	2.4	4.8	45.9 unit MP
External labour			0.75	-	0.75	0.25				0.75		0.75	0.75	-	1.5	5.5 unit MP
Labour working on the farms	3.6	3.6	2.05	3.6	2.45	0.75	3.6	3	3	2.65	1.4	2.75	2.25	2.4	3.3	40.4 unit MP
Area cultivated in ha	1.19	5.46	2.95	1.51	0.46	1.07	2.02	0.68	1.49	1.19	0.76	1.29	0.56	1.03	2.46	24.12 ha
Number of mouths to feed in ha	5.0	1.1	2.0	2.6	13.0	0.9	3.5	4.4	4.0	5.9	3.9	7.7	10.7	5.8	3.7	3.6
Labour on the farms/ha	3.0	0.7	0.7	2.4	2.4	0.7	1.8	4.4	2.0	2.2	1.8	2.1	4.0	2.3	1.3	1.7
Planted area (in ha) work unit	0.3	1.4	1.4	0.4	0.4	1.4	0.6	0.2	0.5	0.5	0.6	0.5	0.25	0.4	0.8	0.6

* calculation of potentially active labour : 1 adult = 1 man power unit.
1 child not attending school = 0.8 M.P.U
1 child attending school = 0.4 M.P.U

** to calculate the labour working outside, see next [illegible]

2.2 - WORK

Labour working outside the farms + capital

Farm number	1	2	3	7	8	9	10	11	13	15	16	17	18	19	20	TOTAL
Occupations other than commerce (trade)			carpenter									carp mason			job salv* army	
Number of persons			1									1			1	3
Time (in man power units)			0,25									0,75			1	2
Capital			1									1			0	·
TRADE : Nb. of persons		1	1		1					1			1		1	6
Time (in man man power unit)		0,25	0,75		0,75					0,75			0,75		0,25	3,5
Capital		1	3		1					3			2		1	
Markets involved		1	1		1					3			2		home	
TOTAL OF ALL ASSESSED OCCUPAT° Nber of persons		1	1		1	1				1		1	1		2	9
Time (in man power units)		0,25	0,75		0,75	0,25				0,75		0,75	0,75		1,25	5,5

Time unit 0,25
0,50
0,75
1 : full time working adult.

Capital classification : 1 = 10 à 50 gourdes
2 = 50 à 200 "
3 = more than 200 g.

(5 gourdes = 1 US $).

Involved markets : 1 = local markets.
2 = regional markets.
3 = Port-au-Prince.

3 - TOOLS

new tools p.p. / Farm number	1	2	3	7	8	9	10	11	13	15	16	17	18	19	20	TOTAL
Hoe (25 gdes)	2	1	1	1	1	1	1	1	2			1	1	1	2	16
Cutlass (20 g)	1	1	1	1	2	1	1	1	1		2	1	1	1	1	16
Pruning knife (25 gourdes)	2	1		1	2		1				1	2		1		11
"soko" (4 gdes)	2	3	1					[illegible]			1		1	1	1	13
"pine" (10 g)		1		1		1	1	1	1		1		1		1	9
"pikoua" (50g)		1		1	1	1			1				1	1		7
TOTAL (present price of new tools in gourdes)	125	142	49	130	105	105	90	59	135	0	79	95	100	124	84	1457

4 - LIVESTOCK

Inventory up to February 1981

Species / Farm number		1	2	3	7	8	9	10	11	13	15	16	17	18	19	20	TOTAL	Total number fed on the farms	Total number of animals fed by the farms / ha planted area
		S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N	S N		
HORNED CATTLE	owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	16	[illegible]
	not owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
HORSES	owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	
	not owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
PIGS	owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20	[illegible]
	not owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
GOATS	owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26	[illegible]
	not owned	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

S : fed on the farms

N : not fed on the farms

cropping pattern

SPECIES/TYPE OF SOIL* — **Chart 5**

TYPE OF SOIL / SPECIES	[illegible] SOIL				RENDZINAL OF LIMESTONE HILLS			TYPES OF SOIL ON MARLY LIMESTONE						TYPES OF SOIL ON BASALT		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Deep 50 cm	Slightly deep 30-50 cm	Cavities in lapiaz	Slightly deep	Red rendzine	Dark rendzine	Rendzine in cavities	Rendzine	Calcic mollic hydromorphic soils [illegible]	Calcic [illegible]	[illegible] with clay	Calcic [illegible] deep alluvial	[illegible]	Eutrophic [illegible] soils	[illegible]	[illegible] soils
Beans		•	•	•	•	•		•	•	•		•	•	•	•	•
Corn	•		•			•		•	•	•	•	•	•	•	•	•
Congo beans	•		•			•		•	•	•	•	•	•	•	•	•
Sweet potato		•	•	•	•			•	•	•		•	•	•	•	•
Cassava			•						•	•			•	•	•	•
Malanga yam									•				•	•		•
Yam									•				•	•		•
Plantain						•			•				•			•
Sorghum	•	•	•						•	•	•		•	•	•	•
Known beans	•								•							
Dasheen	•								•		•					

• present

* - Maps made by [illegible], INRA-GUADELOUPE.

36 GROUPINGS OF SPECIES AT VIEL — **Chart 6**

I - Beans*
II - Beans x sweet potato.
III - Beans x sorghum*
IV - Corn x beans x congo beans.
IVA - Corn x beans x congo beans x cassava.
V - Corn x beans x congo beans x yam.
V.A - Corn x beans x congo beans x yam x plantin.
VI - Corn x beans x congo beans x yam x malanga.
VII - Dasheen.
VIII - Corn x beans.
IX - Corn x beans x congo beans x sweet potato x sorghum x cassava.
IX.A - Corn x beans x congo beans x sweet potato x cassava
X - Corn x beans x congo beans x sweet potato
X.A - Corn x beans x congo beans x sweet potato x yam
X.B - Corn x beans x congo beans x sweet potato x malanga yam
XI - Corn x beans x congo beans x sorghum
XII - Corn x beans x malanga yam x sorghum.
XIII - Corn x beans x sweet potato x congo beans x sorghum
XIV - Corn x congo beans x sorghum.
XV
XVI - Malanga yam x fallow land.
XVII - Corn x beans x sweet potato x congo beans x plantin.
XVII.A - Corn x beans x congo beans x plantin.
XVIII - Corn x congo beans x kno-wed beans x sorghum.
XIX - Corn x beans x congo beans x sweet potato x yam x plantin x malanga yam x wood.
XIX.A - Corn x beans x congo beans x sweet potato x yam x plantin x malanga yam x cassava x wood.
XIX.B - Corn x beans x sweet potato x yam x plantin x malanga yam x cassava x wood.
XX - Sweet potato.
XXI - Corn x beans x congo beans x yam x malanga yam x plantin x wood.
XXI.A - Corn x beans x yam x malanga x plantin x wood.
XXI.B - Corn x beans x congo beans x malanga yam x plantin x wood.
XXII - Corn x congo beans x sorghum x cassava x yam.
XXIII - Corn x beans x congo beans x sorghum x cassava x yam
XXIV - Corn x congo beans x sweet potato.
XXV - Beans x sweet potato x yam x malanga yam x wood.
XXV.A - Beans x sweet potato x yam x malanga yam x wood.
XXVI - Sorghum.

* = beans (Phaseolus vulgaris)
** = sorghum (Sorghum vulgare).

CALENDAR OF CULTIVATION — **Chart 7**

1. October system
   - 1.1. Beans.
   - 1.2. Beans x sweet potato.
2. February system :
   - 2.1. Corn x beans.
   - 2.2. Corn x beans x sweet potato.
   - 2.3. Corn x beans x sweet potato x congo beans.
   - 2.4. Corn x beans x congo beans x sorghum.
   - 2.5. Corn x beans x congo beans x sorghum x cassava.
   - 2.7. Corn x sweet potato x congo beans.
   - 2.8. Corn x sweet potato x congo beans x sorghum.
   - 2.9. Corn x sweet potato x congo beans x sorghum x cassava.
   - 2.10. Beans x malanga yam.
3. April-May system Sorghum :
   - 3.1. Corn x sorghum.
   - 3.2. Sorghum
4. July system :
   - 4.1. Beans x sweet potato.
   - 4.2. Beans x sorghum.
5. System Dasheen :
   - 5.1. Dasheen.
6. October and February system
7. Sweet potato system (April)

repartition by crops

SUMMARY : CULTIVATION SYSTEMS **Chart 8**

Rotation crops in 80/81 for each major grouping

farms	JULY 80 (4)	OCTOBER 80 (1)	FEBRUARY 81 (2)	APRIL 81 (5) dasheen	APRIL-MAY 81 (3) sorghum	APRIL-MAY 81 (7) sweet-potato	OCTOBER 80 + FEBR. 81 (8)	TOTAL AREA CULTIVATED EN 80-81 (m2)
4.1.1 m2 %	1 600 11 %	3 200 28.5 %	6 200 55.5 %			200 2 %		11 200
4.1.2	12 000 26 %	14 200 31 %	19 000 41 %	500 2 %				46 000
4.1.3	3 000 14 %	4 800 22 %	12 900 61 %	600 3 %				21 100
4.1.7			2 700 21 %	1 600 12 %	7 000 55 %		1 400 11 %	11 300
4.1.8			2 800 70				1 200 30 %	4 000
4.1.9		1 400 24.5 %	4 300 75.5 %					5 700
4.1.10		[illegible]	[illegible]	1 [illegible] 7 %			3 000 17 %	14 860 + (3000)
4.1.11		900 19 %	2 500 53		1 300 28 %			4 700
4.1.12	1 600 11 %	450	12 275 86					14 325
4.1.15		2 200 21 %	[illegible]	500 5 %		50 0.5 %		10 475
4.1.16		2 400 40 %	3 650 60 %					6 050
4.1.17	600 5 %	1 [illegible] 11 %	4 [illegible] 16 %	200 2 %	4 475 19 %		700 + 800 6%	10 675(+700)
4.1.18		[illegible]	4 700 [illegible]	625 11 %				5 625
4.1.19		[illegible]	4 900 51.5 %	400 4 %	3 000 31 %			9 690
4.1.20		500 4.5 %	10 800 90 %	75 0.5 %			400 3 %	11 675 (+400)
Total	18 600 10 %	16 050 15.2 %	100 250 50.5 %	6 050 [illegible]	15 775 8.2 %	250 0.1 %	6 700 3.5 %	187 375 (+5500)

ROTATION OF CROPS 1980/1981 **% OF THE PLANTED AREA** **Chart 9**

farms	bean	corn	congo bean	sweet potato	cassava	malanga yam	yam	plantain	sorghum	fallow lands	dasheen	TOTAL AREA (m2)
4.1.1	40	12	5	27	3.5	0.3	0.7	0.7	11	-	-	11 179
4.1.2	50	11	5.7	7.2	0.24	1.0	0.8	3.3	8	11	1.5	54 802
4.1.3	35	17	5	2.4	-	1.2	0.8	2.6	10	23	2.3	26 130
4.1.7	20	21	7		-	2.4	0.6	2.3	8	28	8.3	15 540
4.1.8	19	22	4		2.7	5	0.4	1.6	6.9	16.3	-	7 324
4.1.9	27	4	4	2.5	1.2	4	0.7	0.7	2.2	43	-	10 923
4.1.10	43	17	4	6	1.8	1	0.1	2.1	10	7	6	22 228
4.1.12	33	19	12	1.4	-	3	0.8	18	12	-	-	6 919
4.1.13	31	24	7.5	6.1	1.5	2.1	0.7	4.7	11	11	-	14 895
4.1.15	35	14	7	10	0.9	0.6	0.1	0.5	8	16	2.5	11 957
4.1.16	55	25	5	9	1.6	0.2	0.2	1	2	--	-	7 642
4.1.17	14	21	6	6	0.8	0.5	0.2	2.3	23		1.5	13 870
4.1.18	23	29	[illegible]	2.4	0.7	0.7	2.7	0.8	23	bean 4	11	5 519
4.1.19	42	20	15	2.5		1.5	1.1	3.5	19	-	4.6	8 644
4.1.20	11	13	6.5	3.2	0.07	0.6	0.01	3.4	10.3	45	0.1	23 817
TOTAL AREA (m2)	[illegible]	41713	15151	14074	[illegible]	[illegible]	[illegible]	7124	24523	38346	5550	241 289
	36	17	6	6	0.8	1.4	[illegible]	3	10	16	2.3	99.1

fallow land : land not planted during the concerned year.

THE ADOPTED METHOD TO CALCULATE THE ROTATION OF CROF

S = area of a plot.

P = species N = species.

d = density.

d_p = species density = density observed in the plots.

d_{pe} = maximum density of species in pure cultivation : density observed in the region and determined by experiments

S_p = Area occupied by species "P"

S_n = Area occupied by species "N"

We think that

S_p - S_N will always equal

We can right $S_p = \frac{d_p \times S}{d_{pu}}$ (d_p measured on the plot)

S- S

The bean : amount of work and seed supply

AMOUNT OF WORK (hours) — **OCTOBER BEAN** — **Chart 10**

Farm number	area (m2)	Weeding int.	Weeding ex.	Collection int.	Collection ex.	Making hillocks int.	Making hillocks ex.	Sowing int.	Sowing ex.	Harvest int.	Harvest ex.	Total int.	Total ex.	Total total	Total/ha int.	Total/ha ex.	Total/ha total
4.1.3	[illegible]	44	16	24	-			12	[illegible]	12	5	[illegible]	72	164	[illegible]	[illegible]	508
4.1.[illegible]	1450	10	58	8	-			4	24	4	[illegible]	24	[illegible]	116	166	[illegible]	[illegible]
4.1.[illegible]	1200	7	55	12	-			[illegible]	16	5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	421	738
4.1.9	1612	5	16	5	-			[illegible]	20	[illegible]		41	[illegible]	[illegible]	[illegible]	221	477
4.1.[illegible]	[illegible]	8	17	3	-			[illegible]	25	[illegible]	-	44	55	[illegible]	[illegible]	[illegible]	853
4.1.10	[illegible]	24	24	14	-			21	[illegible]	24	10	[illegible]	124	[illegible]	200	[illegible]	[illegible]
4.1.2	[illegible]	24	[illegible]	-	-			[illegible]	114	[illegible]	[illegible]	[illegible]	[illegible]	502	122	[illegible]	449
4.1.1	[illegible]	[illegible]	52	-	-	101	[illegible]	[illegible]	24	[illegible]	-	44	56	[illegible]	271	345	620
4.1.[illegible]	1100	5	24	-	-	241	24[illegible]	[illegible]	22	12	-	55	[illegible]	70	[illegible]	354	540
TOTAL	[illegible]	116	424	67	-			62	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL HA	1ha	55	200	25	-			30	135	[illegible]	11	[illegible]	[illegible]	[illegible]			
															x̄ 242, σn-1 84	x̄ 372, σn-1 127	x̄ 621, σn-1 183

int : interior.
ex. : exterior.

AMOUNT OF WORK (HOURS) — **FEBRUARY BEAN** — **Chart 11**

FARM NUMBER	AREA (m2)	Weeding i	Weeding e	Collection & ramps i	Collection & ramps e	Digging & covering hillocks i	Digging & covering hillocks e	[illegible] bean i	[illegible] bean e	Mowing bean i	Mowing bean e	Scraping i	Scraping e	Bean harvest i	Bean harvest e	Scraping i	Scraping e	Sowing sorghum i	Sowing sorghum e	Corn harvest i	Corn harvest e	Total sorghum excluded i	Total sorghum excluded e	Total sorghum excluded tot	Total/ha sorghum excluded i	Total/ha sorghum excluded e	Total/ha sorghum excluded tot
4.1.2	6 500	72	80	22	-			45	25	24	48		66	24	104		72	32		21		221	428	649	340	658	998
4.1.3	6 675	63	132	66	24			16	205	6	30		142	26	25	6	72	-	-	20		257	706	963	269	730	995
4.1.5	[illegible]	12	9					12	24			11	[illegible]	25	-	12				20		113	40	153	[illegible]	[illegible]	[illegible]
4.1.10	5 000	27	75	5	-	12	22	30	41			20	16	30	5	12	16	15	-	24	-	170	179	349	340	[illegible]	698
4.1.11	[illegible]	25	20	22				19	11			64	-	16	16							158	67	225	[illegible]	[illegible]	701
4.1.15	[illegible]	21	61	5				15	45			14	30	14	25		16			12		69	200	[illegible]	[illegible]	[illegible]	[illegible]
4.1.16	700	13	-	10				16				12		12		15				4		85	-	85	[illegible]	-	[illegible]
4.1.[illegible]	[illegible]	15						20	5					10		12				12	3	75	11	86	714	105	819
4.1.17	[illegible]	21								10		23		22								93	-	93	930	-	930
4.1.18	[illegible]	36		7						[illegible]				6								69	-	69	767	-	767
4.1.19	[illegible]	[illegible]	16					22	3			15		12						16	3	77	42	119	[illegible]	[illegible]	[illegible]
4.1.20	[illegible]	17						25	14					9								53	14	68	[illegible]	[illegible]	550
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	47	-	[illegible]	6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

i : interior man-power
e : exterior man-power
tot : total

σn - 193

RELATIVE SIZE OF THE AREA PLANTED IN BEANS — **Chart 12**

FOR EACH SEASON AND SEED-SUPPLY

	AREA PLANTED IN BEANS (m2) July 1980	October 1980	Febr. 1981	July 1981	Oct. [illegible] July [illegible]	Febr. [illegible] Oct. [illegible]	July [illegible] Feb. [illegible]
4.1.1	1600	3600	6200	1612	2,25-	1,7-	[illegible]
4.1.2	12000	11200	16000	4000	0,9-	1,7-	[illegible]
4.1.3	3000	4800	12900	(?)	1,6-	[illegible]	-
4.1.7		1200	2600	-	-	[illegible]	[illegible]
4.1.8		500	2100	500	-	[illegible]	[illegible]
4.1.9		1000	4325	-	-	[illegible]	[illegible]
4.1.10		7000	13500	4000	-	1,9-	[illegible]
4.1.11		500	3200	-	-	[illegible]	[illegible]
4.1.13	1650	450	12225	3225	[illegible]	[illegible]	[illegible]
4.1.15		2500	[illegible]	-		[illegible]	[illegible]
4.1.16		2500	3450	1000	-	[illegible]	[illegible]
4.1.17	600	2600	6000	160	[illegible]	[illegible]	[illegible]
4.1.18		300	4200	506	-	[illegible]	[illegible]
4.1.19		1600	4855	1612	-	[illegible]	[illegible]
4.1.20		1000	[illegible]	1612	-	[illegible]	[illegible]
TOTAL	[illegible]	[illegible]	[illegible]	[illegible]			

SEED SUPPLY FOR EACH FARM — **Chart 13**

Farm number	Planted area (in ha)	Labourers working on farms /ha	SEEDS (measured in pots) OCTOBER 80 self-supply	OCTOBER 80 purchase	FEBRUARY 80 self-supply	FEBRUARY 80 purchase	JULY 80 self-supply	JULY 80 purchase	ANNUAL TOTAL self-supply	ANNUAL TOTAL purchase	Percentage of seeds bought for a year	Percentage of seeds according to season/year Oct. %	Feb %	July %	[illegible]	Sowing [illegible]
4.1.1	1.10	5.0	8	0	5	9	-	4	13	13	50 %	31	54	15		
4.1.2	5.46	0.7	28	-	46	-	10	-	84	-	0	33	55	12		
4.1.3	2,05	0.7	(10)	-	(36)	-	(10)	-	(56)	-	0	18	64	18		
4.1.7	1.51	4.0	-	2	2	5	-	-	2	7	78	22	78	0	x	x
4.1.8	1.46	6.6	-	2	11	-	2	-	13	2	13	13	74	13		x
4.1.9	1.07	1.2	-	4	3	3	-	-	3	7	70	40	60	0	x	
4.1.10	2.02	3.0	10	-	15	-	10	-	35	-	0	29	42	29		x
4.1.11	0.63	7.4	1.5	-	-	4	-	-	1.5	4	73	27	73	0	x	
4.1.13	1.19	[illegible]	1	-	6	12	5	-	15	[illegible]	44	[illegible]	[illegible]	[illegible]		
4.1.16	0.76	[illegible]	-	[illegible]	[illegible]	1	[illegible]	-	9	9	50	44	33	[illegible]		
4.1.17	1.20	[illegible]	5	-	10	-	[illegible]	-	15.4	-	[illegible]	[illegible]	65	[illegible]		
4.1.19	1.01	[illegible]	-	[illegible]	3	10	-	4	1	16	[illegible]	11	65	21		x
4.1.[illegible]	0.56	[illegible]	[illegible]		4	[illegible]	-	[illegible]	6	10	[illegible]	12.5	[illegible]	[illegible]		
4.1.20	[illegible]	[illegible]	[illegible]	1	[illegible]	[illegible]	4	[illegible]	14	4	[illegible]	[illegible]	[illegible]	[illegible]		x
TOTAL FOR [illegible] FARMS			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]						

Detail, for each farm, of the seeds Bean origin and destination.