BEAN PRODUCTION IN KENYA'S CENTRAL AND EASTERN PROVINCES:

Survey of the Situation, Analysis of Problems, Recommendations for Extension and Infrastructural Support

coordinated by

Siegfried Schönherr and Erastus S. Mbugua

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This paper is the report of a joint survey carried out by the Institute for Development Studies of the University of Nairobi and the Kenya Ministry of Agriculture's Thika Grain Legume Project. Any views expressed in this paper are those of the authors, and should not be interpreted as reflecting the views of the Institute for Development Studies, the University of Nairobi or the Ministry of Agriculture.

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ABSTRACT

This is a report on a survey of bean production in Kenya's Central and Eastern Provinces, carried out in June and July, 1975 by staff members from the Institute for Development Studies and the Thika Grain Legume Research Project. The survey was based on eight districts where beans are widely grown, and 242 farmers were interviewed, 72 bean sellers in local markets and officers of the Ministry of Agriculture and the Maize and Produce Board.

First the present situation is reviewed, including the seed types used, crop husbandry practises, yield levels, storage, marketing and pricing, and extension services for beans. Then the economics of bean production are discussed, as well as the basic constraints on the intensification and expansion of bean production, both in high-rainfall small-farm areas and in dryer areas where farms are larger and land is not such a limiting factor. Specific problems are discussed relating to seeds, land preparation, planting systems and plant density, the application of fertiliser and manure, weed control, pests and diseases, storage, and marketing and pricing.

Finally an extension project is proposed and described in some detail which would promote the production of beans in Kenya. The infrastructural support which would be needed for expanded bean production is also described, particularly wider availability of inputs and a viable marketing and pricing system.

BEAN PRODUCTION IN KENYA'S CENTRAL AND EASTERN PROVINCES

CONTENTS

PREFACE

Next to maize, grain legumes (beans, pigeon peas, cow peas, green and black grams, field peas, etc.) constitute the most important group of food crops in Kenya. Food legumes are all the more important in that they provide a major source of protein for the majority of the population. It is estimated that the total area devoted to food legume production is about 480,000 hectares annually, most of which is in Central and Eastern Provinces.

Food beans (Phaseolus vulgaris) constitute the largest portion of grain legume production. The area under this crop is estimated at some 320,000 hectares, most of it in the medium-potential areas of Central and Eastern Provinces having an annual bimodal rainfall pattern of 700 to 900 mm.

Since 1963, it has been the declared Government policy to intensify bean production for the country's self-sufficiency and export. However, despite mentions of intentions in the last three Development Plans (1966/70, 1970/74 and 1974/78), no production plans have been developed or budgetary support provided. Owing to the absence of a concerted effort to maintain or increase production, it is now estimated that the volume of production is actually declining.

This trend is dangerous. In a country such as Kenya where animal protein (meat, milk, eggs and fish) is in short supply and therefore expensive for the lower-income groups, beans and other pulses which contain considerable amounts of protein of high nutritional quality assume an eminent role as a potential source of low-cost, readily obtainable protein. Yet because of shortages in supply, beans have become unavailable and expensive, selling in excess of shs 4.00 per kg in some parts of the country. It is now estimated that based on the present production level and population, and assuming equal availability to all sectors of the population, the daily intake from pulses amounts to 10 grams of vegetable protein per person. The nutritionally adequate daily intake ranges from 20 grams for a 6-months-old child to 53 grams for an adult male, and averages 41 grams per person assuming 70 per cent utilisability. The protein intake from pulses is therefore inadequate. The Report of the Committee on Nutrition Training of the Ministry of Health (May 1976) reports that 40 per cent of children aged 6 months to 3 years present moderate forms of protein-calorie malnutrition and 2 to 5 per cent exhibit severe forms. The need for increased production and availability of pulses cannot therefore be over-emphasised.

The only direct resource allocation for bean improvement has been the

implementation in November 1971 of the Dry Bean Project with finances from the Government of Kenya and the Netherlands. The Project was to contribute to the development of the production of "dry beans in general and the development of the white haricot beans (for export) for canning purposes in particular". This policy has now been revised to lay emphasis on food beans, with particular attention to the selection of acceptable cultivars, investigations into the correct ways of growing the crop, and the promotion of improved cultivation techniques.

No research programme can, however, make any substantial contribution to improved production and productivity without a clear understanding of problems at farm level. This is especially so for a crop such as beans which is wholly a monopoly of the smallholder farm sector. It was with this in mind that the Scientific Research Division made resources available to the Kenyan staff of the Bean Research Project to carry out a survey to determine what particular aspects constituted constraints in bean production for incorporation into the research programme.

Availability of biological solutions and recommendations for improved technology are only part of the food production process. Increased output for the country's self sufficiency will depend on available technology and its acceptance by the farmer, resources available to the farmer, pricing policies, incentives, production programmes, extension service organisation, supply and demand, etc. The analysis of the available data and rational treatment of each aspect is beyond the capability of biological scientists in the Bean Research Project, hence our soliciting the support of the socio-economic capability available at the Institute for Development Studies.

Thanks are due to the Acting Director of I.D.S. for his Institute's participation in the project. Thanks are also due to the Bean Research Project staff for on-farm surveys, data collection and compilation of the agronomic report. Special thanks to Dr. Schönherr and Mr. Mbugua of I.D.S. for participation in the development of survey strategy, the data collection, the research coordination and for their tireless effort in writing the report.

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June, 1976.

INTRODUCTION

This survey of bean production was carried out by staff members from the University of Nairobi's Institute for Development Studies and from the Ministry of Agriculture's Thika Grain Legume Research Team. The field survey was carried out in five weeks from early June to mid-July 1975, and the findings given in this report reflect the situation at that time unless otherwise indicated.

Selection of the Survey Sites

The Central and Eastern Provinces of Kenya were selected as sites for a survey of bean production because in these two provinces the cultivation of beans is a relatively important agricultural activity, as shown by available data on the number of hectares devoted to bean crops.

Table 1. Area under beans in 1969/70 by province ('000 hectares).

Province	'000 Hectares
Rift Valley	9.3
Central	113.7
Nyanza	40.0
Western	20.4
Coast	8.3
Eastern	130.9

Source: (6), p. 3.

In each province, the districts were chosen in which bean cultivation is most widespread. In Central Province, this includes all districts except Nyandarua, where bean cultivation is relatively unimportant, and in Eastern Province this includes Embu, Meru, Kitui and Machakos Districts.

Table 2. Area under beans in the districts of Central and Eastern Provinces in 1969/70 ('000 hectares).

	District	'000 hectares
Central Province	Nyeri	13.4
	Murang'a	48.4
	Nyandarua	0.2
	Kiambu	17.7
	Kirinyaga	34.0
Eastern Province	Embu	9.4
	Meru	27.0
	Kitui	33.1
	Machakos	61.4

Source: (6), p. 3.

Three divisions were selected in each of these nine districts. From among the divisions where beans are grown, one was chosen with relatively high rainfall, one with medium and one with low rainfall. These classifications were made with the assistance of the District Agricultural Officers. An exception was made in Kitui District where only two divisions were identified in which beans are widely grown, so only these two divisions were included in the survey. Another exception was made in Meru, where four divisions were included. The survey team wanted a broader sample to increase the reliability of its findings in this district, where apparently the most serious bean production problems have arisen. The three maps included in this report show the provinces, districts and divisions selected as sites for the survey.

In the course of the survey, it was possible to determine the average number of hectares under bean cultivation per household in each of the eight districts. This includes bean cultivation during both the long and short rains in one year. These figures are given in Table 3.

Table 3. Average number of hectares under beans per household in one year.

Districts	Hectares per Household
Kirinyaga	2.8
Kitui	2.0
Meru	1.7
Machakos	1.6
Kiambu	1.5
Embu	1.4
Nyeri	1.2
Murang'a	0.9

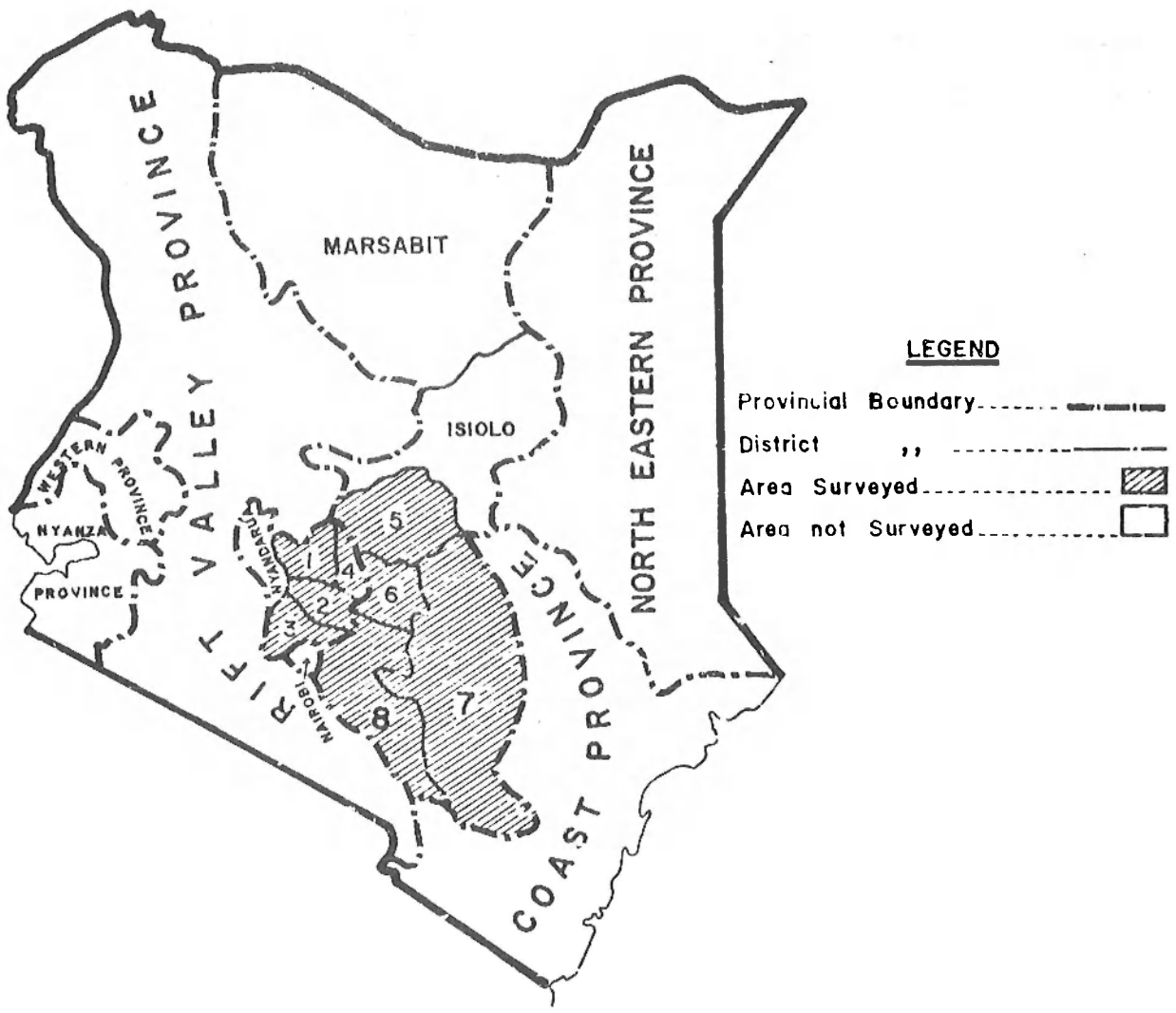
Source: I.D.S./Thika Grain Legume Research Team survey, 1975.

Selection of Informants

The District Agricultural Officer or his deputy was interviewed, using a questionnaire, in each of the eight districts. Also the Maize and Produce Board Branch Manager or another officer was interviewed in each district, and the Maize and Produce Board files were studied. Three bean sellers were interviewed in one of the bigger local markets in each division. This came to 72 bean sellers who were selected at random and interviewed with a questionnaire. A note was also made of their bean stocks. No officially licensed dealers or shops were included in this sample. Finally, 242 farmers

who grow beans were selected at random and interviewed with a questionnaire. The interviewers selected approximately ten farmers from each division, the actual number ranging from nine to twelve. This was done by taking the longest possible line through the bean-growing area of each division, taking into account accessibility by car. Farmers were then selected who were distributed evenly along this line. This selection procedure was carried out exclusively by the interviewers: no extension staff or other government officials participated.

Figure 1. Provinces and districts surveyed.



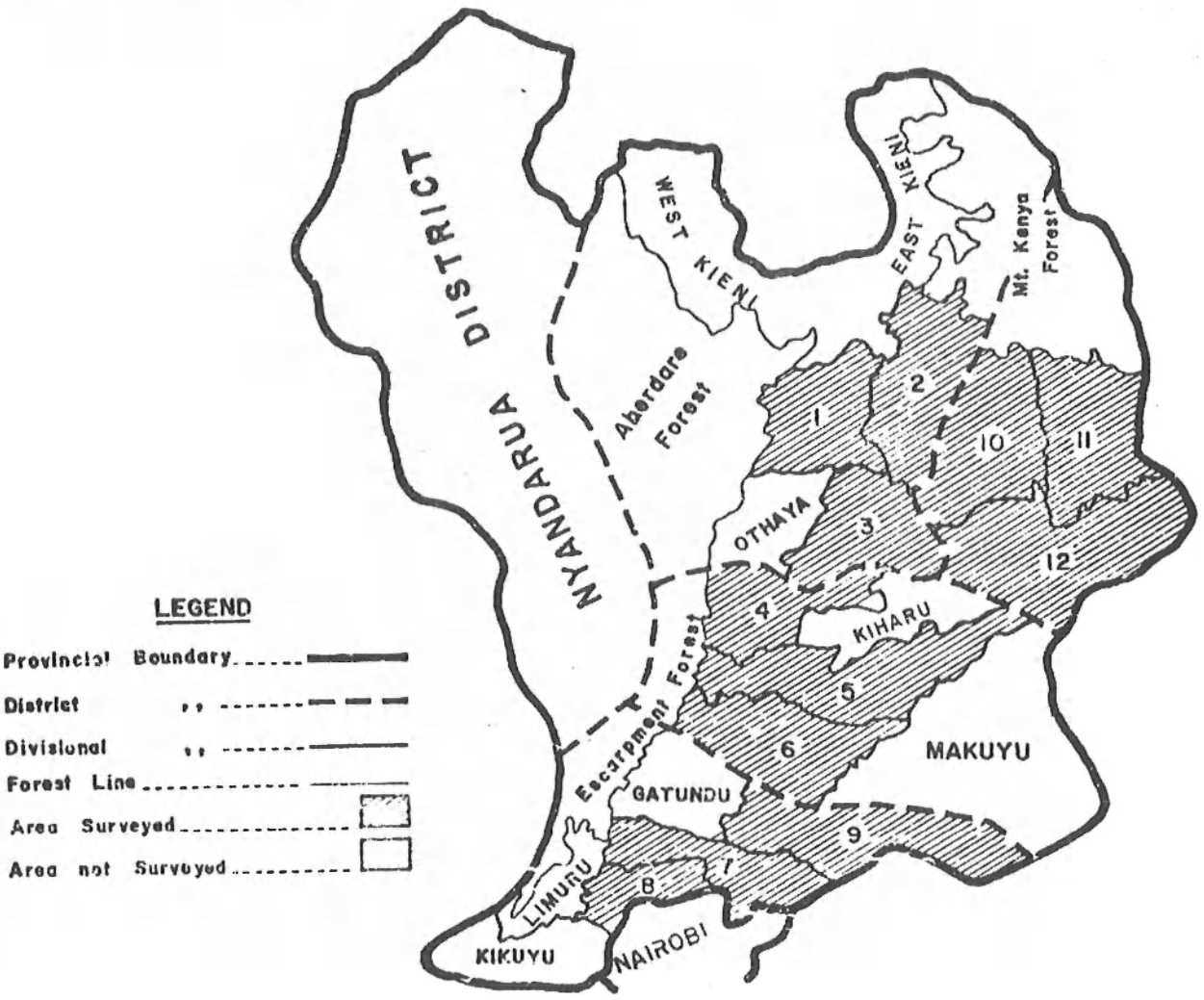
Central Province

1. Nyeri District
2. Murang'a District
3. Kiambu District
4. Kirinyaga District

Eastern Province

5. Meru District
6. Embu District
7. Kitui District
8. Machakos District

Figure 2. Divisions surveyed in Central Province.



Nyeri District

1. Tetu
2. Mathira
3. Mukurueini

Kiambu District

7. Githunguri
8. Kiambaa
9. Thika

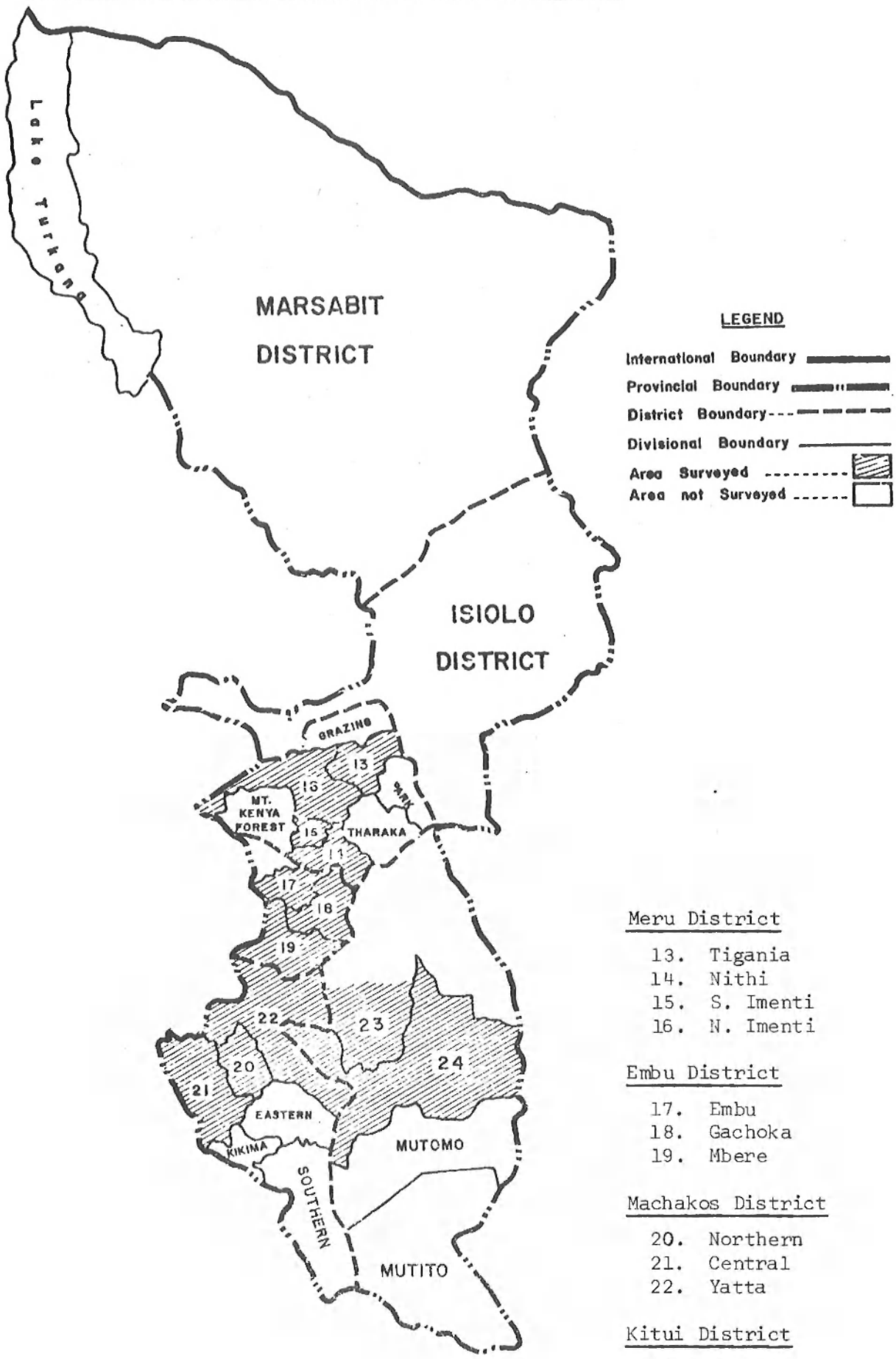
Murang'a District

4. Kangema
5. Kigumo
6. Kandara

Kirinyaga District

10. Ndia
11. Gichugu
12. Mwea

Figure 3. Divisions surveyed in Eastern Province.



Meru District

13. Tigania
14. Nithi
15. S. Imenti
16. N. Imenti

Embu District

17. Embu
18. Gachoka
19. Mbere

Machakos District

20. Northern
21. Central
22. Yatta

Kitui District

23. Mwingi
24. Central

PART I: THE PRESENT SITUATION

THE SEED TYPES UNDER CULTIVATION

The different strains of beans grown in Central and Eastern Province are referred to as 'seed types' because in fact they are large groups of intermixed 'land races' rather than pure varieties. These seed types are described by D.M. Mukunyu and S.O. Keya with particular reference to Kenya. (2, pp. 7-13) The only pure strain grown in the area is the Mexican 142 cultivar. The level of production of the different seed types was assessed in three different ways: according to the acreage under cultivation, the frequency of sales in the local markets, and the sale of 90 kg bags to the Maize and Produce Board.

Using the first measure, it was found that 33 per cent of the total acreage under beans was devoted to the Rose Coco seed type, 20 per cent to Mwezi Moja, 19 per cent to Canadian Wonder, and 11 per cent to Mexican 142. Twelve other types were grown in small areas, making up 16 per cent of the total acreage. This distribution is suggested also by the pattern of sales in local markets, except that Mexican 142 was offered less frequently. Mexican 142 was practically the only type sold to the Maize and Produce Board.

Within this overall pattern of bean production there was considerable variation among the provinces and districts. Rose Coco was commonly grown and traded in both provinces and in most districts, but there was a high concentration of Mwezi Moja cultivation in Machakos and Kitui, and it was also frequently traded in Kiambu and Kirinyaga. Canadian Wonder was grown and traded predominantly in Central Province, but not in Nyeri. The cultivation of Mexican 142 was concentrated in Meru, Embu and Kitui. This type was traded mainly through the Maize and Produce Board, but it also ranked sixth among the types most frequently traded in the local markets. Red Haricot is grown extensively in parts of Nyanza, but was not found to be grown widely in Central or Eastern Province. It was traded in the local markets in Kiambu. The other seed types were only sold to any extent in the local markets in Meru.

BEAN CULTIVATION

This section does not deal with all facets of bean cultivation, but only with those aspects which appeared particularly important in the areas which were surveyed.

Table 4. Average acreage of seed types cultivated by a household in one year (short rains 1974 plus long rains 1975).[1]

a. By Province

	Acres per Household			Total Area Surveyed	
	Eastern P.	Central P.	Average	Acres	%
Rose Coco	1.5	1.2	1.4	323	33
Mwezi Moja	1.1	0.5	0.8	196	20
Canadian Wonder	0.2	1.3	0.8	182	19
Mexican 142	0.8	0.1	0.5	110	11
Others (12 types)	0.5	0.9	0.7	159	16
Average Total Acreage Under Beans	4.1	4.0	4.1	970	100

b. By District

	Acres per Household							
	Nyeri	Murang'a	Kiambu	Kirinyaga	Meru	Embu	Kitui	Machakos
Rose Coco	1.7	0.4	0.7	2.0	1.8	1.2	1.1	1.5
Mwezi Moja	0.1	0.3	0.5	1.3	0.2	0.6	2.0	2.2
Canadian Wonder	0.4	1.6	0.8	2.2	0.3	0.1	0.5	0.2
Mexican 142	0.1	-	-	0.3	1.3	0.9	0.9	0.1
Others	0.7	0.1	1.6	1.0	0.7	0.6	0.5	0.1
Average Total Acreage Under Beans	3.1	2.3	3.7	6.9	4.3	3.4	5.0	4.0

Note: N = 242 households.

1. Throughout the survey acres are used as the unit of measurement rather than hectares for two reasons. The interviews could only be carried out in terms of acres because that was the measure with which the respondents were familiar. Further, acres are a more sensitive measure of the small landholdings in the densely populated areas. For example, 0.1 acre can be visualised more easily than 0.04 hectares.

Table 5. Rank order of seed types according to presence in local markets (by district).

	Rank Order		
Central Province	First	Second	Third
Nyeri	Rose Coco	Other Types[2]	Mwezi Moja Small Pink Rose Coco
Murang'a	Rose Coco Canadian Wonder	Mwezi Moja	Red Haricot
Kiambu	Red Haricot Mwezi Moja Canadian Wonder	Small Pink Rose Coco	Rose Coco
Kirinyaga	Rose Coco Mwezi Moja Canadian Wonder	Mexican 142	Small Pink Rose Coco
Eastern Province			
Meru	Rose Coco Other Types	Canadian Wonder	Mexican 142
Embu	Rose Coco	Mwezi Moja	Mexican 142
Kitui	Rose Coco	Mwezi Moja	Mexican 142
Machakos	Mwezi Moja	Rose Coco Other Types	Canadian Wonder

Note: N = 72 traders.

Table 6. Rank order of seed types according to presence in all local markets.

Rank	Seed Type	Number of Times Present
1	Rose Coco	66
2	Mwezi Moja	48
3	Canadian Wonder	42
4	Other Types	35
5	Small Pink Rose Coco	19
6	Mexican 142	16
7	Red Haricot	10

Note: N = 72 traders.

2. Each of these types was found being sold in the markets fewer than ten times.

Table 7. Seed types sold to Maize and Produce Board in 1974 (90 kg bags).

Central Province	Mexican 142	All Others
Nyeri	341	none
Murang'a	1,813	none
Kiambu	11	none
Kirinyaga	2,920	162
Eastern Province		
Meru	81,541	314
Embu	30,295	8
Machakos	10	3
Kitui	468	3

Table 8. Percentage of total bean acreage under minor seed types.

Types	Percentage
Red Haricot	4
Small Pink Rose Coco	3
Tanzania	2
White Haricot	2
Zebra	1
Large Rose Coco	1
Nyakamangu	below 1
Katurututu	below 1
Kirigiti	below 1
Kabithari	below 1
Black Bean	below 1
Nyagaitho	below 1
Total	16%

Seeds

Of the farmers interviewed, 47 per cent planted seeds saved from the previous harvest and 44 per cent purchased seeds in local markets. Only Mexican 142 certified seeds were available: no system of certified seed distribution could be identified for any other bean seed type. In fact, 83 per cent of the farmers questioned had no knowledge of certified bean seeds at all. This was the case throughout the area surveyed: there were no obvious differences among the districts or provinces.

Table 9. Sources of seeds used by farmers interviewed.

Source	Percentage of Responses
Own harvest	47
Purchase from local markets	44
Neighbours	7
Other sources	1
Total	100

Notes: N = 242 households.
53 farmers mentioned two sources; in these cases both responses are counted.

Land Preparation

In the higher rainfall areas of Nyeri, Murang'a, Kiambu and Meru, land was prepared almost exclusively by hand using a fork and hoe (jembe). In Kirinyaga, Kitui and Machakos, ox ploughing was the most common form of land preparation, particularly in Machakos. In Eastern Province as a whole, tractor ploughing accounted for about one fourth of all land preparation, but in Central Province tractor ploughing was uncommon.

Table 10. Methods of preparing land for bean cultivation.

	Percentage of Farms Surveyed			
Central Province	Tractor	Ox Plough	Fork/Jembe	Total
Nyeri	0	3	97	100
Murang'a	0	3	97	100
Kiambu	11	3	86	100
Kirinyaga	6	58	36	100
Eastern Province				
Meru	29	13	58	100
Embu	28	24	48	100
Kitui	29	58	13	100
Machakos	20	70	10	100

Note: N = 242 farms.

Planting Systems and Plant Densities

In most cases beans were found interplanted with another crop, but to a significant extent (31 per cent) they were also grown in pure stand. In Eastern Province, a much larger proportion (44 per cent) of the households surveyed grew beans in pure stand than in Central Province (17 per cent). Beans were most frequently planted at random, but a significant minority of the households surveyed planted in lines. Where beans were interplanted with another crop, they were planted at random on about two-thirds of the farms in both Central and Eastern Province. Beans in pure stand were planted in rows on just over half the farms in both provinces.

The plant density varied for interplanted and pure stand crops, as one would expect. Most interplanted crops (56 per cent) were planted at a density of 100 to 200 thousand plants per hectare, while about half (50 per cent) of the beans in pure stand were planted at 150 to 250 thousand plants per hectare. Nearly another fourth (21 per cent) of the beans in pure stand were planted at a density of around 400 thousand plants per hectare.

Table 11. Percentage of bean crops in pure stand and interplanted during the long rains of 1975.

	Pure Stand	Interplanted	Total
Central Province	17	83	100%
Eastern Province	44	56	100%
Average for Both Provinces	31	69	100%

Notes: Figures for the districts can be taken from Table 14.
N = 242 households.

Table 12. Percentages of random and line planting in pure and interplanted stands, long rains of 1975.

	Random		Line		Total	
	Pure Stand	Inter-planted	Pure Stand	Inter-planted	Pure Stand	Inter-planted
Central Province	45	67	55	33	100%	100%
Eastern Province	47	66	53	34	100%	100%
Average for Both Provinces	46	67	54	33	100%	100%

Note: N = 242.

Figure 4. Plant density of beans in Central and Eastern Provinces in pure and mixed stands. (long rains 1975)

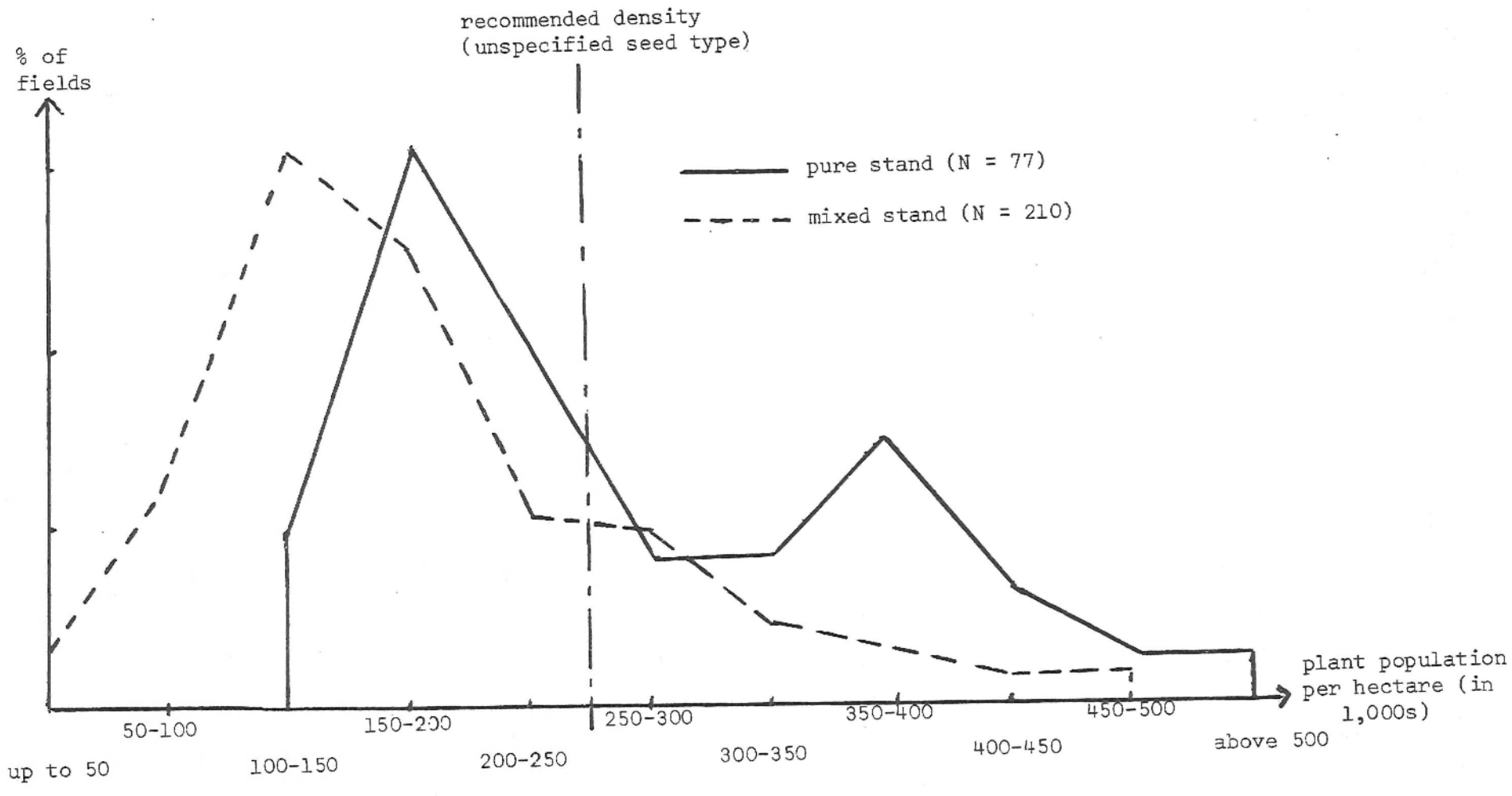


Table 13. Plant density of pure and interplanted bean stands, 1975 long rains (average for Central and Eastern Province).

Number of Plants per Hectare	Percentage of Fields	
	Pure Stand	Interplanted
up to 50,000	-	3
50,000 to 100,000	-	12
100,000 to 150,000	10	31
150,000 to 200,000	31	25
200,000 to 250,000	19	10
250,000 to 300,000	8	9
300,000 to 350,000	8	5
350,000 to 400,000	15	2
400,000 to 450,000	6	1
450,000 to 500,000	2	1
over 500,000	2	-
Total	100%	100%

Notes: The plant populations were measured by members of the survey team. For beans planted in pure stand, a standardised frame was used which was thrown into an area of the field where the population appeared to be average. Where beans were interplanted, a larger area was measured from a part of the field which appeared average and the plants were counted.

The columns may not add up exactly to 100 due to rounding.
N = 287 fields on 242 farms.

According to knowledgeable informants, random planting is usually carried out by making holes with a machete (panga) and planting one to three seeds in each hole. In Kirinyaga and Machakos, seeds are frequently broadcast and then covered with soil using ox-drawn equipment. For row planting, a thread is often stretched between two sticks and a furrow made, but apparently other methods are also used.

As shown in Table 12, slightly more than half of the beans in pure stand were planted in lines. However, when beans were interplanted they were more often planted at random. In this case, the main crop, which was usually maize, was planted in rows either at the recommended spacing or a little wider apart, and the beans were planted at random between the rows.

It was also reported that farmers tend to interplant beans with other crops during the long rains, but are more likely to plant in pure stands during the short rains, which were not considered in this survey. Farmers who do

intercrop during the short rains tend to space rows of maize very widely and plant more beans: then this trend is reversed during the long rains.

Application of Fertiliser and Manure

Synthetic fertiliser was being used on nearly one fourth of the fields surveyed. It was used more widely in Central than in Eastern Province, but within the provinces there was great variation among districts. In Central Province, synthetic fertilisers were most widely used in Kiambu - on 75 per cent of the fields planted in pure stand and 45 per cent of the fields where beans were interplanted. By contrast, in Nyeri only 13 per cent of the fields in pure stand and 9 per cent of the interplanted fields had been treated with synthetic fertilisers. In Eastern Province, fertilisers were much more widely used in Meru and Embu than in Kitui and Machakos, where they were used on less than 10 per cent of all fields. In Central Province, synthetic fertilisers were more likely to be used on fields planted in pure stand than on interplanted fields, but in Eastern Province the opposite was true.

Manure was used slightly less often than synthetic fertilisers in general, but it was used more widely in Eastern than in Central Province. The highest use of manure was in Machakos where it was applied on 63 per cent of the fields in pure stand and 50 per cent of those interplanted. In general, manure was used to about the same extent on interplanted and pure stands.

Neither synthetic fertilisers nor manure was used on half the fields in Central Province or 60 per cent of the fields in Eastern Province.

Weed Control

Two thirds of the farmers interviewed reported that they weed twice during the growing season. In Nyeri, Murang'a, Meru and Machakos about one fourth of the farmers weed three times. This tends to be more common in the high-rainfall areas except in Machakos, which is a dry area, where some farmers report that they weed three times to improve the preservation of moisture in the soil. In other cases in Machakos, one weeding is done before planting as part of the seedbed preparation, so in fact the crop is only weeded twice. This may be necessary in dry areas because the fields are often ploughed at the end of the previous rainy season, long before the crop is planted, so that considerable weed growth may take place before the planting season. In Murang'a, Kirinyaga, Meru, Machakos, and particularly in Embu, a significant proportion of the farmers weed only once.

Table 14. Use of fertiliser and manure on pure and interplanted stands.

	Pure Stand			Interplanted		
	% using fertiliser	% using manure	% using nothing	% using fertiliser	% using manure	% using nothing
Nyeri	13	25	62	9	30	61
Murang'a	67	0	33	33	22	44
Kiambu	75	13	13	55	14	31
Kirinyaga	33	0	67	23	10	67
Average for Central Province	45	14	41	31	18	50
Meru	12	4	85	32	14	54
Embu	33	0	67	14	0	86
Kitui	8	25	67	8	25	67
Machakos	11	63	26	8	50	42
Average for Eastern Province	14	24	62	18	22	60
Average for Both Provinces	22	22	57	25	20	55

Note: N = 242.

Two thirds of the farmers begin weeding two weeks after planting. About one third of the farmers in Murang'a, Kirinyaga and Embu begin weeding after the third week. Almost all farmers weed with pangas (66 per cent), jembes (14 per cent) or both (19 per cent). Only two farmers, both in Kitui, reported weeding with ox-drawn ploughs, and no interrow weeders or herbicides were reported.

Pests and Diseases

Pests and diseases were identified with great care by scientists from the Thika Grain Legume Research Team and the Embu Research Station during the period from early June to mid-July 1975. Pests and diseases which could not be identified in the field were taken to the laboratory for exact identification. In most areas the bean crops were just nearing maturity at this time.

It was found that bean pests and diseases were very widespread. Of all the fields surveyed, 63 per cent were seriously infested by some pest or disease with at least half the plant population affected and an

Table 15. Number of weedings, time of first weeding and tools used.

	% of farmers weeding 1, 2 and 3 times				% of farmers weeding after 1, 2 and 3 weeks				% of farmers using tools for weeding				
	1	2	3	Total	1	2	3	Total	Panga	Jembe	Both	Plough	Total
Central Province													
Nyeri	10	64	26	100	10	74	13	100	77	6	16	-	100
Murang'a	21	54	25	100	22	48	30	100	83	3	14	-	100
Kiambu	3	87	10	100	4	75	21	100	69	30	10	-	100
Kirinyaga	19	74	7	100	8	56	36	100	57	-	3	-	100
Eastern Province													
Meru	26	56	18	100	18	72	10	100	69	18	13	-	100
Embu	48	52	-	100	14	48	39	100	76	7	17	-	100
Kitui	10	86	5	100	10	76	14	100	-	35	55	10	100
Machakos	17	53	30	100	7	77	17	100	33	22	44	-	100
Average for Both Provinces	19	66	15	100	12	66	22	100	66	14	19	1	100

Note: N = 242 households.

expected loss in yield of at least one third. Virtually none of the fields were altogether free of pests or diseases. At the time of the investigation, the most widespread pests were aphids, cutworms, American bollworms, bean flies and flower beetles. The most common diseases were halo blight (Pseudo Domonas Phaseolicola), root rot (Nematode), common blight (Xantho-monasphaseoli), anthracnose (Colletot richum Lindemuthianum), angular leaf spot (Pharei-sariapsis griseola) and virus (mosaic).

The incidence and seriousness of pests and diseases varied widely among districts, with Meru and Murang'a the most seriously affected (100 per cent and 73 per cent seriously infested) and Kiambu and Kitui the least (both 43 per cent seriously infested). In a number of cases, one particular pest or disease was present in over half the fields surveyed in one district and was rare or completely absent in another district.

Harvesting

Bean crops in the areas surveyed mature in two to five months, with 69 per cent maturing in three months. The growing period depends on a number of factors such as seed types and climatic and soil conditions. For example, Mexican 142 is generally classified as an early maturing variety and Canadian Wonder as late maturing, but this was not confirmed in the survey area. Mexican 142 matured on average at between 11 and 16 weeks, and Canadian Wonder showed a wide variation, between 8 and 18 weeks, with many cases of early maturity.

Variations in the time of planting and the growing period result in wide variations in the time of harvesting. According to agricultural officers, a large part of the harvest is often ruined in high rainfall areas because it is difficult to dry the crop if it matures before the rains have stopped. The most widespread method of harvesting beans is to uproot the plants, dry them on the field or near the home, spread them on a hardened floor or mat and thresh the plants by beating them with sticks. A more detailed description of harvesting methods is given by Mukunyu and Keya, (2), pp. 22-24.

Yield Levels

This survey did not include the measurement of yields, but a number of estimates of yield levels are available from other sources. The Kenya Ministry of Agriculture in guidelines for 1972/73 estimates yields for pure and interplanted bean crops at three production levels: at the low level the yield is estimated at 180 kg per hectare, at the average level 540 kg per hectare, and at the high level 1,350 kg per hectare. Mukunyu and Keya give an average yield of 500 kg per hectare, but they claim that the potential yield is

Table 16. Percentage of fields infested and seriously infested with most common bean pests.

	Cutworms		Aphids		American Bollworm		Flower Beetle		Bean Fly	
	% infested	% seriously infested	% infested	% seriously infested	% infested	% seriously infested	% infested	% seriously infested	% infested	% seriously infested
Central Province										
Nyeri	3	3	77	35	26	-	3	-	26	6
Murang'a	3	3	93	57	13	-	3	-	17	10
Kiambu	57	-	83	3	70	7	13	-	23	7
Kirinyaga	6	3	55	13	-	-	-	-	13	3
Eastern Province										
Meru	90	56	79	46	72	46	31	29	46	26
Embu	48	21	24	-	76	34	14	7	31	21
Kitui	52	14	33	5	76	10	5	5	62	24
Machakos	60	10	47	10	70	10	10	3	77	7
Average for Both Provinces	41	16	63	23	50	15	11	5	36	10

Note: N = 242.

Table 17. Percentage of bean fields infested and seriously infested with most common diseases.

	Anthracnose		Halo Blight		Common Blight		Root Rot (fusarium)		Angular Leaf Spot		Virus		Others	
	I	S	I	S	I	S	I	S	I	S	I	S	I	S
Central Province														
Nyeri	13	6	39	19	19	-	52	16	23	-	42	3	16	-
Murang'a	47	13	37	7	29	-	37	-	48	-	20	-	30	-
Kiambu	40	13	40	7	39	-	53	7	23	3	33	-	43	-
Kirinyaga	10	3	42	13	19	3	39	10	52	6	58	32	3	-
Eastern Province														
Meru	41	21	87	41	87	59	69	33	59	38	38	10	67	28
Embu	38	34	17	-	55	3	52	-	-	-	-	-	14	-
Kitui	5	-	43	14	76	19	76	24	-	-	14	-	19	10
Machakos	20	10	20	10	87	3	80	13	-	-	20	-	27	13
Average for Both Provinces	24	10	42	15	52	12	57	13	28	7	29	6	29	7

Notes: I = per cent infested; S = per cent seriously infested.
N = 242.

Table 18. Percentage of bean fields infested and seriously infested with any pest or disease.

	Not Infested	Infested but not Seriously	Seriously Infested	Total
Central Province				
Nyeri	-	52	48	100
Murang'a	3	23	73	100
Kiambu	-	57	43	100
Kirinyaga	-	42	58	100
Eastern Province				
Meru	-	-	100	100
Embu	3	34	62	100
Kitui	-	57	43	100
Machakos	-	43	57	100
Average for Both Provinces	1	37	63	100

Note: N = 242.

Table 19. Districts in rank order according to percentage of bean fields with serious pest or disease infestation.

District	Seriously Infested
1. Meru	100%
2. Murang'a	73%
3. Embu	62%
4. Kirinyaga	58%
5. Machakos	57%
6. Nyeri	48%
7. Kiambu	43%
8. Kitui	43%

Table 20. Districts in rank order according to percentage of fields seriously infested with specific bean pests.

Cutworms	Aphids	American Bollworm
1. Meru 56%	1. Murang'a 57%	1. Meru 46%
2. Embu 21%	2. Meru 46%	2. Embu 34%
3. Kitui 14%	3. Nyeri 35%	Others 10% or less
Others 10% or less	4. Kirinyaga 13%	
	Others 10% or less	

Flower Beetles	Bean Fly
1. Meru 29%	1. Meru 26%
Others 7% or less	2. Kitui 24%
	3. Embu 21%
	Others 10% or less

Table 21. Districts in rank order according to percentage of fields seriously infested with specific bean diseases.

Anthracnose	Halo Blight	Common Blight
1. Embu 34%	1. Meru 41%	1. Meru 59%
2. Meru 21%	2. Nyeri 19%	2. Kitui 19%
3. Murang'a 13%	3. Kitui 14%	Others 3% or less
4. Kiambu 13%	4. Kirinyaga 13%	
Others 10% or less	Others 10% or less	

Root Rot	Angular Leaf Spot	Virus
1. Meru 33%	1. Meru 38%	1. Kirinyaga 32%
2. Kitui 24%	Others 6% or less	Others 10% or less
3. Nyeri 16%		
4. Machakos 13%		
Others 10% or less		

Others
1. Meru 28%
2. Machakos 13%
Others 10% or less

Note: Further information on bean pests and diseases can be found in Mukunya and Keya, (2), pp. 27-47; and van Rijnatten, Muna and Hesselmark, (6), pp. 59ff.

Table 22. Period in which bean crops mature in Central and Eastern Province.

	Percentage of fields maturing in:				
	2 months	3 months	4 months	5 months	Total
Central Province	3	75	18	3	100
Eastern Province	18	62	19	1	100
Average for both Provinces	11	69	19	2	100

Note: N = 242.

Table 23. Weeks to maturity for the most important seed types in rank order.

		Average Weeks to Maturity	Range of Weeks to Maturity
1.	Mwezi Moja (N = 18)	10.7	8 - 16
2.	Rose Coco (N = 42)	11.5	8 - 16
3.	Canadian Wonder (N = 32)	12.2	8 - 18
4.	Mexican 142 (N = 8)	14.2	11 - 16

Notes: Out of the 242 households interviewed, only 100 were able to specify the maturation period of individual seed types. The figures for Mexican 142 are not conclusive since the number of cases is too small.

about 1,500 kg per hectare. (2, p. 24)

Van Eijnatten gives rather high estimates of yields in three zones of Kirinyaga, based on farmers' reports of 33 fields:-

	Range in kg/hectare
Upper Zone	720 - 1,800
Middle Zone	720 - 1,620
Lower Zone	720 - 2,250

He does not specify whether the sample included interplanted fields, but his high estimates suggest that only pure stands were considered. (5, p. 28) Yields of Canadian Wonder and Mexican 142 grown under experimental conditions have been

recorded as high as 3,000 kg per hectare (2, p. 24), and the highest yield of Mexican 142 which van Eijnatten observed in Kirinyaga was 2,700 kg per hectare.

The observations of the Survey Team would indicate that the Ministry of Agriculture's estimates most closely reflect the yields actually obtained in Central and Eastern Province. Nearly two thirds of all the fields surveyed would be classified at the low or average production level, and in some districts the severe infestation of pests and diseases may reduce the yields even below the Ministry's estimates.

Wage Employment in Bean Production

On more than half of the farms surveyed, additional labour had to be employed in connection with bean production. More outside labour was hired in Eastern than in Central Province. Wages varied from less than shs 3 to more than shs 8 per day, with more than two thirds of the farms paying between shs 5 and shs 7. In Eastern Province the daily wage was more often shs 5, and in Central Province shs 7.

Table 24. Percentage of households employing additional labour and wages paid.

	Percentage of all Households Employing Additional Labour	Percentages of Employing Households Paying:						
		3/ or less	4/	5/	6/	7/	8/ or more	Total
Central Province	44	2	9	17	15	43	15	100
Eastern Province	79	2	8	37	21	20	12	100
Average for both Provinces	58	2	9	29	19	29	13	100

Notes: If a meal was part of the payment, it was valued at shs 2.
N = 242.

STORAGE OF BEANS

More than 95 per cent of the farmers surveyed stored beans on their homesteads. In Kiambu, Meru and Embu most farmers stored beans for less than two months. In Machakos over 60 per cent of the farmers stored beans for at least six months, and in other districts the majority of farmers stored beans from two to six months. More than half of the farmers reported that bean crops were severely damaged during storage. In Eastern Province nearly three fourths of the farmers reported severe damage, and in Meru 82 per cent. This damage

Table 25. Length of time beans are stored and damage occuring during storage.

	Months Beans Are Stored						Damage During Storage			
	less than 2 %	2 - 4 %	4 - 5 %	6 or more %	not stored %	total %	none %	minor %	severe %	total %
Nyeri	14	14	59	9	5	100	23	47	30	100
Murang'a	7	17	62	3	11	100	26	56	19	100
Kiambu	55	10	21	-	14	100	4	20	76	100
Kirinyaga	21	10	62	3	3	100	3	43	53	100
Central Province	25	13	50	4	8	100	14	42	44	100
Meru	69	18	5	8	-	100	3	15	82	100
Embu	60	16	4	20	-	100	7	30	63	100
Kitui	20	25	35	20	-	100	10	25	65	100
Machakos	4	22	11	63	-	100	3	21	75	100
Eastern Province	42	20	12	26	-	100	5	22	73	100
Average for Both Provinces	34	16	31	15	4	100	10	32	58	100

Note: N = 242.

Table 26. Methods used by farmers to protect beans in storage, by province.

	Chemicals	Ashes	Dust/Unidentified	Nothing	Total
Central Province	8	-	71	20	100
Eastern Province	48	6	23	23	100
Average for Both Provinces	28	3	47	22	100

Note: N = 242.

Table 27. Specific chemicals and other methods used to protect beans in storage, by district.

	Blue Cross	Red Triangle	DDT	Mala-thion	Dust/ un-identified	Ashes	Nothing	Total
	%	%	%	%	%	%	%	%
Central Province								
Nyeri	7	-	3	10	55	-	24	100
Murang'a	3	-	3	3	68	-	23	100
Kiambu	-	-	-	-	67	-	33	100
Kirinyaga	-	-	6	-	94	-	-	100
Eastern Province								
Meru	8	5	3	5	49	-	31	100
Embu	3	-	30	3	23	7	33	100
Kitui	33	19	24	-	5	14	5	100
Machakos	33	30	7	3	3	7	17	100
Average for All Districts	10	6	9	3	47	3	22	100

Note: N = 242.

occurred in spite of the factthat 47 per cent of the farmers used 'dusts' or other unidentified treatment to protect their beans in storage. Another 28 per cent treated their beans with chemicals, and of these 9 per cent used DDT to protect food beans, which is not safe. In Embu as many as 30 per cent used DDT, and in Kitui 24 per cent.

MARKETING AND PRICES OF BEANS

Bean prices in local markets varied widely among the districts surveyed. Prices were highest in Nyeri and Murang'a, averaging shs 370 and shs 360 per 90 kg bag, and lowest in Kitui and Embu, averaging shs 185 and shs 220 per bag. In the other districts included in the survey the average price was around shs 290 per 90 kg bag. Though these were the average prices, more than half the farmers reported selling beans at a wide range of prices to relatives, friends and in the local markets.

Beans are a 'scheduled crop' which means that legally they can only be traded across district borders through the Maize and Produce Board at prices set by the Board. In fact, in the two provinces covered in this survey the Maize and Produce Board had no significant marketing role because virtually no beans were sold to the Board except for Mexican 142. Prices set by the Maize and Produce Board had little or no impact on the prices in the local markets, again with the exception of Mexican 142. Local market prices were on average more than 100 per cent higher than the prices offered by the Board.

EXISTING EXTENSION SERVICES FOR BEANS

A number of bean extension projects were said to be underway in the survey area -- at least two in each district. However, in Kitui, Meru and Kirinyaga only between 30 and 57 per cent of the farmers could remember ever receiving extension advice on beans, and in the other five districts surveyed only around 10 per cent of the farmers reported ever receiving advice on beans. It seems that most of the advice which was given concerned Mexican 142.

The Ministry of Agriculture offices in the districts reported very few or no extension recommendations which were being made for beans. This leads to the conclusion that most of the bean projects must have been limited to making some seeds available to farmers.

Table 28. Prices of beans in local markets in June/July 1975.

	Seed Type	Price per 90 kg bag	Average Bean Price
Central Province			
Nyeri	Rose Coco	420	
	Canadian Wonder	390	
	Mwezi Moja	360	
	all others	240 - 420	370
Murang'a	Rose Coco	240 - 420	
	Mwezi Moja	150 - 420	
	Canadian Wonder	290 - 360	
	all others	360 - 420	360
Kirinyaga	Canadian Wonder	400	
	Rose Coco	330	
	Mwezi Moja	330	
	all others	210 - 360	295
Kiambu	Rose Coco	360	
	Canadian Wonder	310 - 360	
	Mwezi Moja	250	
	all others	210 - 360	285
Eastern Province			
Meru	Rose Coco	270 - 335	
	Canadian Wonder	245 - 280	
	Mwezi Moja	215	
	all others	220 - 360	290
Machakos	Rose Coco	330	
	Mwezi Moja	290 - 310	
	Canadian Wonder	270	
	all others	270 - 300	285
Embu	Mwezi Moja	190 - 240	
	Rose Coco	190 - 220	
	Canadian Wonder	180 - 210	
	all others	150 - 270	220
Kitui	Mwezi Moja	210 - 240	
	Rose Coco	190 - 220	
	Canadian Wonder	150	
	all others	150 - 240	185

Note: N = 72.

Table 29. Farm door/basic prices offered by Maize and Produce Board per 90 kg bag.

Seed Type	April-July 1975	Since August 1975
Rose Coco	120/-	150/-
Rose Coco undergrade	80/-	100/-
Mwezi Moja	80/-	150/-
Canadian Wonder	120/-	150/-
Canadian Wonder undergrade	80/-	100/-
Mexican 142	120/-	120/-
Mexican 142 undergrade	80/-	80/-
Others	80/- to 120/-	100/- to 150/-

Notes: For the number of bags sold to the Maize and Produce Board in 1974, see Table 7.

In October 1975 the price offered for Mexican 142 was sharply reduced to 85/- for all grades. Shortly before April 1975 the price had been about 160/-.

Table 30. Percentage of farmers who sold beans in 1974 and the prices at which beans were sold.

	Percentage of all farmers who sold beans	Percentage of Farmers who sold Beans selling at various prices per 90 kg bag					
		shs 60-150	shs 151-210	shs 211-270	shs 271-330	shs 331-450	Total
Central Province							
Nyeri	60	6	-	6	35	50	100
Murang'a	72	24	24	19	10	24	100
Kiambu	83	8	8	24	44	12	100
Kirinyaga	50	-	7	14	64	14	100
Eastern Province							
Meru	69	15	26	26	15	19	100
Embu	38	18	27	27	18	9	100
Kitui	29	-	-	67	17	17	100
Machakos	61	12	24	29	29	6	100
Average for All Districts	59	12	16	24	29	19	100

Table 31. Responses of District Agricultural Officers concerning bean projects and recommendations, June/July 1975.

	Recommendations	Existing Projects: French Beans K 74	Rose Coco	Canadian Wonder	Mexican 142	Red Haricot
Central Province						
Nyeri	none		x	x		
Murang'a	none		x	x	x	
Kiambu	from Kabete Information Centre and Embu Res. Station	x	x	x	x	x
Kirinyaga	None		x		x	
Eastern Province						
Meru	none	x	x		x	
Embu	none		x	x	x	
Kitui	little rain for Mwezi Moja and Mexican 142		x	x	x	
Machakos	seeds should be dry planted		x		x	

Table 32. Percentage of farmers who could remember receiving any extension recommendations on bean cultivation from extension staff or other officers.

	Percentage of Farmers Who Received Advice
Central Province	
Nyeri	13
Murang'a	10
Kiambu	10
Kirinyaga	30
Eastern Province	
Meru	37
Embu	10
Kitui	57
Machakos	10

PART 2: PROBLEMS AND RECOMMENDATIONS

Beans have been increasingly in short supply in Kenya over the past few years. Prices for beans in the local markets have shown a tremendous increase, but the volume of bean production has not increased correspondingly. In other words, the price elasticity of bean production has been low. Other factors must be in effect, unrelated to prices, which prevent or limit increases in production.

The basic objective of a bean policy in Kenya would be to increase the production of beans, but not at the expense of other agricultural crops or farm activities. A strategy to increase bean production could be based on the expansion of land under bean cultivation in areas where land is not a limiting factor and on the intensification and improvement of existing bean cultivation. Beans should only be substituted for other crops in cases where they are clearly more profitable to the farmers.

THE ECONOMICS OF BEAN PRODUCTION

In this section we shall give the average size of farms in the survey area and describe cropping patterns and the land and labour factors affecting bean production. Then we shall analyse specific land, capital and labour constraints which may be preventing increases in the production of beans.

Farms can be divided into three categories according to their size: small farms of less than seven acres, and large farms of fifteen acres or more. In Central Province, most of the farms where beans were grown were below seven acres. In Nyeri and Murang'a 85 per cent of all the farms surveyed came under this small farm category. The farms tended to be larger only in the lower potential areas of Kirinyaga. Also in Eastern Province the majority of farms surveyed were under seven acres. Farms tended to be larger only in the lower potential areas of Meru, Kitui and Machakos. For the province as a whole, 24 per cent of the farms were in the middle category of seven to fourteen acres, and only 12 per cent were large farms. These large farms, however, are potentially of great importance to the overall level of bean production.

In both provinces the smaller farms tended to be situated in the high rainfall areas where coffee, tea, hybrid maize and sometimes pyrethrum and grade cattle were the most common cash earning activities. The middle-size farms were found in all agricultural zones, but were most typically located [illegible] dominant crops

Table 33. Size of farms where beans are grown.

	Percentage of Farms in Each Size Category				
	1 - 2 acres	3 - 6 acres	7 - 14 acres	15 acres and over	total
Nyeri		85	11	4	100
Murang'a		85	8	8	100
Kiambu		71	22	7	100
Kirinyaga		50	43	7	100
Central Province	26	46	22	6	100
Meru		41	38	20	100
Embu		82	14	4	100
Kitui		50	25	25	100
Machakos		58	19	24	100
Eastern Province	18	29	26	18	100
Average for Both Provinces	22	42	24	12	100

Note: N = 242.

in these areas. The larger farms were usually found in the medium and lower rainfall areas where there was no uniform cropping pattern except for maize cultivation during the long rains.

The economic factors andconstraints affecting bean production vary in importance according to farm size and the dominant cropping pattern in each rainfall zone. In the high rainfall areas there is a permanent shortage of land due to population pressure, and cash crops such as coffee, tea and pyrethrum must compete for scarce land with subsistence crops such as maize. Because both cash and subsistence crops are cultivated intensively throughout the area, labour may also be in short supply during seasons of peak activity. Interplanting is one widespread response to the problem of land and labour constraints.

In the medium rainfall areas there is great variation in the pattern of farm activities, but generally labour is a more important constraint than land. Mechanised farming is one response to this constraint, for example using oxen for ploughing, and another response is to keep a substantial part of the land as pasture. The crucial constraint on large farms is labour. If

is to take place to any significant extent, some form of mechanisation is necessary.

The labour requirements for bean production are relatively low compared to those of other crops. Capital requirements, using present production methods, are relatively low as well. Some farmers purchase seeds from the previous harvest of their neighbours, but nothing is spent on pest and disease control during the period of cultivation. Synthetic fertilisers were being used on about one fourth of the fields surveyed, but most of the fertilised fields were interplanted, usually with maize, and the farmers generally attributed the cost of fertilisers to the primary crop, rather than to the bean crop.

Table 34. Labour man days per hectare required for bean production and other farm activities, at average production levels.

Labour Operation	Beans 1 season	Hybrid Maize 1 season	Pyrethrum 1 year	Tea 1 year	Coffee 1 year	Cotton 1 year	Grade Dairy Cows 1 yr.
seed bed preparation	35	35	(mature)	(mature)	(mature)	60	-
planting	8	8	(mature)	(mature)	(mature)	40	-
weeding	20	20	65	30	120	30	-
harvesting	20	35	65	375	230	25	-
other tasks	-	-	20	40	130	70	64
total man days	83	108	150	445	480	225	64

Note: It is assumed that the grade dairy cows are kept on one hectare in the Kikuyu/Stargrass zone.

Sources: Compiled from crop economics tables of the Kenya Ministry of Agriculture, Land and Farm Management Division, 1972/3; figures for grade dairy cattle from the Ministry of Agriculture's Kericho District Farm Management Guidelines, 1975, Part C.

The profit margins which can be achieved by bean production compare very closely with those of most other farm activities, even when beans are valued conservatively at shs 200 per 90 kg bag. If one takes into account that in many areas two crops of beans can be grown in a year, the gross profit margin appears higher than that of other commonly grown cash crops. Furthermore, the areas most suitable for bean production are at lower altitudes than the tea and pyrethrum zones, so that beans are often not in competition with these two important cash crops. Thus it is surprising that bean production has [illegible] in Kenya over the past few years. The constraints which have

prevented an expansion of production will be discussed in the following section.

Table 35. Gross profit margins per hectare for beans.

	Production Level		
	Low	Medium	High
yield in 90 kg bags	2	6	15
value at 200/ per bag	400/	1,200/	3,000/
variable costs	60/	70/	130/
gross margin	340/	1,130/	2,870/

Source: Derived from Ministry of Agriculture Guidelines.

Table 36. Gross profit margin of various farm activities compared to beans.

	Production Level		
	Low	Medium	High
Hybrid Maize (1 crop)	higher (than beans)	similar	lower (than beans)
Pyrethrum (1 year)	similar	similar	similar
Tea (1 year)	similar	similar	higher (than beans)
Coffee (1 year)	similar	similar	similar
Cotton (1 crop)	lower (than beans)	very much lower	very much lower
Grade Dairy Cows (1 year)	similar	similar	lower (than beans)

FARM - LEVEL CONSTRAINTS ON THE EXPANSION OF BEAN PRODUCTION AND PROPOSALS FOR IMPROVEMENT

Seeds

In the eight districts of Central and Eastern Province where beans are widely grown, the District Agricultural Officers were asked what they considered the most serious constraint on increased bean production. The most frequent response was the lack of high quality seeds. The seeds available to farmers have degenerated genetically and are often infested with seed borne pests and diseases. Certified seeds are not available anywhere, except for Mexican 142.

A programme to increase the production and i...

make certified seeds widely available immediately because the infrastructure of a production and distribution system must first be developed. At present the Kenya Seed Company claims that there is no market for certified bean seeds in Kenya, but this is because the infrastructure is lacking so that production and distribution costs are very high. As of March 1976, Kirchhoff's Ltd. kept a small stock of certified bean seeds in Nairobi, but most types cost shs 20 per kilogram. On average, about 50 kilograms of seeds are needed to plant one hectare of beans which would cost shs 1,000, putting certified seeds completely beyond the reach of the majority of Kenyan farmers. A better production and distribution system should be initiated right away, so that certified seeds will be available to farmers at reasonable prices in the near future.

It would also be possible to improve the quality of seeds a great deal by introducing seed dressing materials which the farmers could apply to the seeds they are now using and which would protect them against a number of seed borne pests and diseases. The cost of dressing material would come to only one or two shillings per acre and the technique of dressing seeds could easily be learned.

We propose, therefore, that as a short-term policy farmers should be taught the advantages and techniques of seed dressing and the dressing material should be made widely available. The production and distribution of certified seeds should be developed as a medium-term policy to be initiated right away.

Land Preparation

Where land is not a limiting factor, especially in the medium and lower rainfall areas of Kirinyaga, Meru, Kitui and Machakos, a shortage of labour for seedbed preparation is one of the most significant constraints to expansion of the area under cultivation. This constraint can be alleviated by the introduction of mechanisation for seedbed preparation. However, the use of tractors is not likely to expand rapidly in the near future because of the high costs of importing tractors, spare parts and fuel and the negative effects on Kenya's foreign exchange position. At the local level, it is relatively expensive for a farmer to have his land ploughed by tractor, and this might not be a wise investment because crop production is typically being expanded in dryer areas where the risk of failure great.

On the other hand, the area under cultivation might be increased by using ox ploughing for the seedbed preparation. In the medium- and low-rainfall [illegible] is a common practise, but the

In certain places, for example in parts of Kitui, even simple ox-drawn ploughs were not widely available.[3] It seems likely that the area under cultivation could be increased immediately if suitable ox-drawn equipment can be made available to the farmers. As a longer-term measure, the quality of draught animals and of guiding methods should be improved.

The expansion of cultivation in medium rainfall areas by the use of ox-drawn equipment would have at least four advantages:-

1. The cultivation capacity could be increased immediately,
2. Existing local resources (e.g. oxen) could be used more effectively,
3. Local industry and employment would be stimulated by the demand for locally manufactured equipment, and
4. Ploughing with oxen would be more economical for medium- and lower-potential areas than tractor ploughing.

In areas where land is a limiting factor, as well as in other areas, the cultivation of beans could be intensified by improving the quality of seed-bed preparation. Soil erosion - which is often a serious problem in areas where fields are sloping - can be reduced by simple ploughing techniques such as contour ploughing across the slopes, ridging, and leaving strips across the slopes planted with fodder grass or trees. Another common problem is the presence of a so-called 'plough pan' which is a layer of very hard soil below a shallow layer of loose top soil. The 'plough pan' is produced by constant shallow ploughing or digging, and it tends to reduce the fertility of the soil, to encourage erosion of the shallow layer of top soil, and to prevent the roots of plants from penetrating deeply into the soil so that the plants dry up quickly. Deeper ploughing or digging from time to time can prevent the formation of the 'plough pan'.

We propose that in areas where land is available for the expansion of crop production, ox-drawn ploughs and other equipment should be improved and made widely available. In the medium-term, the quality of draught animals and

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3. In 1975, a mission station in Kitui set up a scheme for purchasing ox-drawn ploughs in Nairobi, with farmers paying part of the cost immediately and part on credit. More than 500 farmers in one location purchased ploughs under this scheme, which may indicate the potential for increasing the cultivation capacity in these areas if equipment is made more widely available.

guiding methods should also be improved. In areas where additional land is not available, as well as in other areas, cultivation should be improved and intensified by simple methods of soil conservation and by improving the quality of ploughing and digging to prevent the formation of a 'plough pan'.

Planting Systems and Plant Density

The question of whether beans should be planted in pure stand or interplanted with another crop can only be answered in the context of a farmer's overall production constraints. The majority of farmers surveyed, and in parts of Central Province nearly all the farmers, were faced with a severe shortage of land. They had to grow cash crops, which were usually perennial crops, to provide a sufficient cash income to meet household needs, and they had to grow maize to provide the family's food supply. If these farmers are told not to interplant beans with other crops they will not be able to grow beans at all. Thus, the practise of interplanting beans should not be disputed in these areas.

Fortunately, in high rainfall areas interplanting maize with beans has no adverse effects on maize yields. On the contrary, beans,as legumes, fix nitrogen in the soil which is then available to the maize, and interplanting wit beans also reduces soil erosion and weed growth. The farmer can produce a bean crop in addition to his maize crop with a minimum of additional labour.[4] The development and dissemination of improved methods for interplanting beans would help the farmers and also increase the national supply. Pure stands of beans might be recommended for commercial producers in areas where beans compare favourably with other cash crops and elsewhere during the short rains when maiz has a high risk of failure.

In most cases it seems preferable to plant beans in lines rather than at random because the spacing can be optimised, the plant population can be controlled and weeding is quicker and easier. Further advantages might become relevant with more intensive cultivation - for example, spraying to control

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4. Recent experimentation has been carried out at Agricultural Research Stations at Kakamega, Kisii and Kitale in Western Kenya by N.M.Fisher of the University of Nairobi's Department of Crop Science. These experiments showed that a significantly higher gross profit margin can be achieved if maize is planted at the recommended spacing and beans are interplanted at a density of less that 100,000 plants per hectare. However, these are all high-rainfall areas, and the beans were planted at the same time as the maize. No conclusio can be drawn about gross margins in drier areas or if the beans are planted after the maize at the time of the first weeding.

diseases and pests would be easier and mechanised weeding could be done with an interrow cultivator if beans were planted in lines. However, there are cases where line planting might not be feasible. It was observed during the survey that some farmers in Kirinyaga and Machakos who grow beans on a relatively large scale planted by broadcasting and then covered the seeds with ox-drawn equipment. This method probably helps to relieve the labour constraint at the time of seedbed preparation and planting.[5] However, improved equipment for drawing furrows and planting could probably greatly increase the capacity of farmers who grow beans on a large scale while allowing them to plant in lines.

It is recommended in general that beans in pure stand be planted at a density of 250,000 plants per hectare, but specific recommendations are needed for specific groups of seed types with similar characteristics, and possibly for different rainfall zones. For example, it has been shown in trials that Mexican 142 is much more successful if planted at twice the density of the general recommendation, and it seems that farmers have realised this. There are no recommendations available at present for the density of beans interplanted with maize or other crops, and this is a serious shortcoming given the prevalence of intercropping as revealed by this survey. If mechanised interrow cultivation becomes more widespread, density recommendations will have to be revised. In fact, all recommendations on plant density should be based in part on considerations of weeding, since this is probably the most labour-intensive aspect of bean cultivation. It may be that if plants are spaced more closely the ground will be covered quickly with bean leaves and weed growth will be reduced.

We propose that sound recommendations should be formulated for interplanting beans with maize on small farms, and that pure stands should be recommended during the short rains when maize frequently fails and for large commercial growers. Line planting should be recommended in general except in cases where farmers are already successfully growing beans by broadcasting seeds and covering them with ox-drawn equipment. Ox-drawn or hand-operated planting equipment for medium and large farms should be improved. Planting density recommendations should be formulated for specific groups of bean types, and for beans planted in pure stand and interplanted with hybrid maize or other crops. Specific recommendations for plant densities may be necessary where mechanised interrow cultivation is practised. The control and suppresion of

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5 The much-

weeds should be considered when formulating all recommendations on optimum plant densities. Meanwhile, existing recommendations should be followed for pure stands - lines 40 cm apart and plants 10 cm apart - and for interplanted crops - one row of beans between each row of maize and 15 cm between bean plants.

Application of Synthetic Fertilisers

A number of fertiliser trials have been carried out in Kenya by the Agricultural Research Stations and by such organisations as the F.A.O., but apparently no comprehensive evaluation of these trials has been made. In the literature, it is often stated that phosphorus and potash applications tend to increase yields significantly, but nitrogen applications are not very effective in many areas.[6] (See Mukunyu and Keya, 2, van Eijnatten et al., 6, and U.N.D.P., 4.) For example, an experiment in Kirinyaga is quoted where the application of 40 kg P2 05 per hectare increased bean yields by 22 per cent based on a control yield of 1,374 kg per hectare. The application of 40 kg P2 05 plus 40 kg K_2 0 produced an increase of 38 per cent over the same control level.

However, no recommendations have been given to farmers for fertiliser application in specific areas. We feel that synthetic fertilisers should not be recommended to bean growers for economic reasons except in special cases. In 1976, the Kenya Farmers Association in Nairobi sold double super phosphate at shs 125 for a 50 kg package. It has been the experience of many extensionists that the income derived from a bean crop must be increased by 2.5 times the cost of the fertiliser under experimental conditions if a similar fertiliser application is to be profitable for smallholder farmers. In other words, if one 50 kg package is applied per hectare, the value of the bean crop should increase by at least shs 310 under experimental conditions. The application of two 50 kg packages per hectare, which is recommended by some Research Stations, would only be justified if the additional yield under experimental conditions is valued at shs 620 or more.[7]

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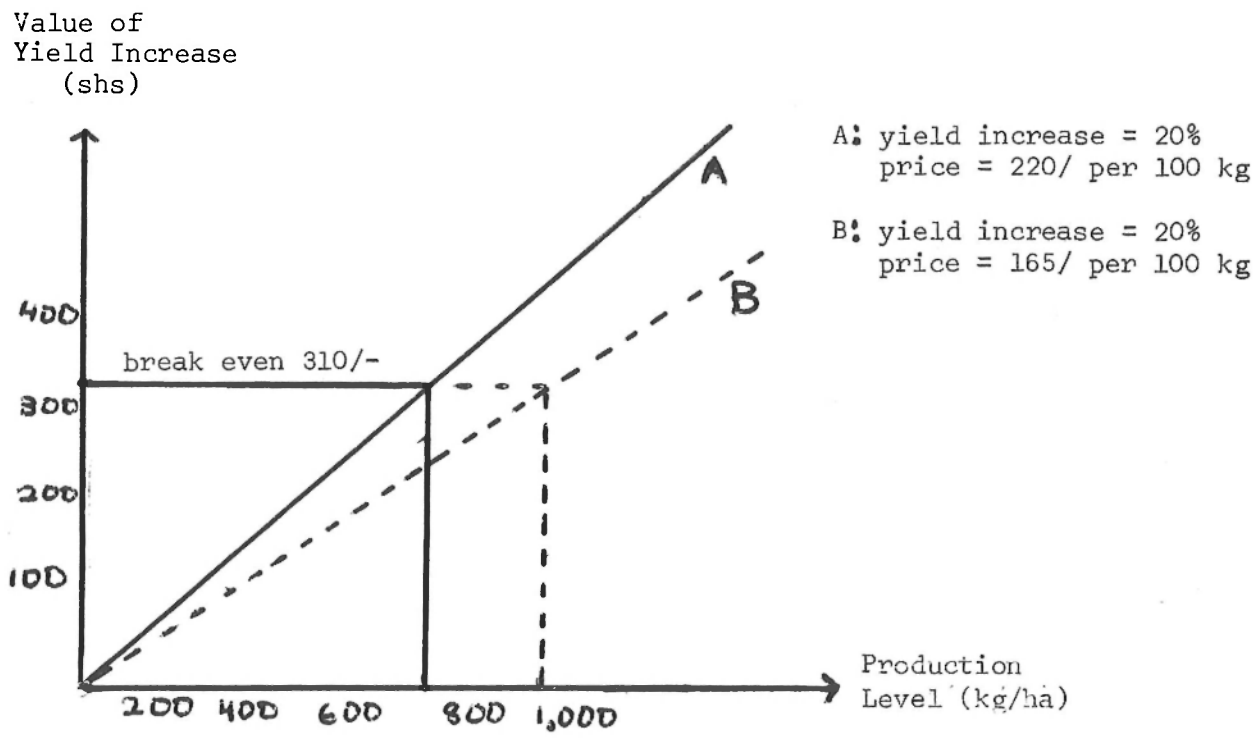
6. One exception was reported from the Embu Research Station where experiments with nitrogen showed significant yield increases. Positive responses generally seem to be most consistent with phosphorus.

7. This cost benefit ratio of 2.5 was not derived scientifically, but rather from the experience of a number of extensionists. It is widely felt that unless a ratio of 2.5 is achieved under experimental conditions, most farmers will not achieve a positive cost/benefit ratio under actual farming conditions. Some organisations call for an even higher ratio (up to 4) before recommending fertiliser to smallholder farmers.

Figure 5 illustrates the production levels necessary to justify the use of fertiliser in economic terms. The figure is based on the assumption that the application of 50 kg of double super phosphate per hectare increases yields by 20 per cent at all production levels. Yields are valued at the lowest reported open market price of shs 220 per 100 kg (or shs 200 per 90 kg bag) and at the Maize and Produce Board price of shs 165 per 100 kg (or shs 150 per 90 kg bag). If beans are sold at the open market price, yields of at least 700 kg (nearly 8 bags) per hectare must be achieved to justify the use of fertiliser; if beans are sold at the lower Maize and Produce Board price, yields of about 950 kg (10.5 bags) per hectare must be achieved.

Figure 5. Production levels necessary for the economic application of synthetic fertiliser.



The general conclusion from these calculations is that fertiliser should only be recommended to bean growers who have already reached a high production level, roughly ten bags per hectare or four bags per acre as an average over several seasons. Only about one third of the farmers surveyed who grow beans in pure stand were achieving this production level. Another consideration is that the response to fertiliser strongly depends on all

control. If general husbandry is poor, then the response to fertiliser will be much lower than that achieved under experimental conditions. This means that where yields are low due to poor husbandry, no significant improvement can be achieved by introducing fertiliser as an isolated innovation.

One final factor which should be considered is that at present synthetic fertilisers are imported in Kenya. They therefore represent a drain on foreign exchange reserves and should only be used where they are economically justified.

Application of Manure and Composting

Where manure is available, it is inexpensive to apply and farmers and agronomists feel that it increases yields significantly. However, the use of manure is limited by two major factors: first, most farmers do not have enough manure to cover the acreage under cultivation, or even under bean cultivation, and second, the farmers who do have enough manure find it very difficult to transport it to their fields.

The first constraint is typical of small farms and could be relieved by introducing composting methods. The survey team did not observe composting anywhere, and most farmers seemed unaware of the possibility of producing organic fertiliser in this way. The second constraint is more typical of middle-size and large farms where a number of cattle are kept. The problem of transporting manure could be solved by introducing simple ox carts or at least wheelbarrows. Inexpensive prototypes have been developed in Kenya, for example at the Rural Industrial Development Centres, but the survey team found no extension efforts to tell farmers about this equipment and how it could be used.

Proposals for the Use of Synthetic and Organic Fertilisers

In general, synthetic fertilisers should not be recommended for beans at present, but phosphorus in particular should be recommended to the small number of commercial bean growers whose husbandry methods and yields have already reached a high level. More research needs to be carried out on the use of synthetic fertilisers, particularly considering specific soil zones.

The use of manure to fertilise bean fields should be encouraged much more widely, and composting methods should be introduced to farmers. An extension effort should also be organised to introduce simple equipment, such as ox carts and wheelbarrows, for transporting manure to the fields.

Weed Control

Agricultural economists in Kenya seem to agree that in middle- and large-farm areas where land is not a constraint, the expansion of the area under cultivation is limited primarily by the lack of sufficient labour for weeding. Weeding has become a more serious constraint in recent years since more land has been ploughed and planted using ox-drawn ploughs and tractors. Local labour is completely absorbed during weeding time, but few migrant workers are attracted because the period is so short. The wages for weeding in some areas rise to shs 12 a day, which means that it is not economic for many farmers to grow beans if they must use hired labour at weeding time.

We have already mentioned that planting beans at a higher density may reduce the amount of weeding required, and planting in lines makes weeding by hand with jembes or pangas easier. The application of chemical weed killers or herbicides would also reduce the labour required for weeding, but a number of problems make this method undesirable. A few innovative farmers use herbicides for maize cultivation, but this makes interplanting difficult because a different herbicide would have to be used for beans since the weed killer used for maize is harmful to beans. Herbicides also leave a residue which could harm crops planted subsequently under a system of crop rotation. Another problem is that chemical herbicides must be imported, thus contributing to balance of payments problems.

However, the best argument against chemical weed killers is that in the middle- and large-farm areas where weeding is the greatest problem, alternatives exist which are cheaper and cause fewer problems. Draught animals are generally available in these areas, and they could be used for weeding with an interrow weeder/cultivator. This piece of equipment is already being produced in Tanzania for about shs 250, and it could easily be manufactured in Kenya. The Rural Industrial Development Centre in Machakos is now experimenting with a prototype. Farmers would probably be willing to accept this innovation in areas where draught animals are already available and are not used at weeding time. However, planting must be done in lines if crops are to be weeded with an ox-drawn cultivator, and the oxen must be guided accurately. Present guiding methods tend to be inadequate for interrow weeding, but the Bukuru Institute of Agriculture and other institutions are experimenting with improved guiding methods and have already achieved good results. These institutions could be used to help teach farmers better guiding methods. One remaining problem is that weeding with an ox-drawn interrow cultivator might

problems.

The weeding capacity, which is probably the most crucial agronomic constraint on the expansion of bean production, can be reduced significantly only by the introduction of a new technology. The introduction of chemical weed killers is not recommended due to technical problems and the foreign exchange constraint. Rather, we strongly recommend the introduction of ox-drawn interrow weeders as the most feasible and inexpensive way to significantly increase weeding capacity, particularly in middle-and large-farm areas where draught animals are kept already.

Pests and Diseases

In certain areas, such as large parts of Meru, losses due to pests and diseases are so heavy that bean cultivation is simply not profitable. The most serious bean diseases -- halo blight, anthracnose, and common bean mosaic -- are seed borne. For this reason, all farmers should be taught to dress their seeds, for example using Adrin which is distributed by the Kenya Farmers Association, and a programme should be initiated at once to develop and distribute certified been seeds. In the areas most heavily infested by pests, the growing plants should also be sprayed with Rogor, Roxion, Thiodan or DDT. It is important to clear an area of pests by spraying virtually all the beans and other host crops. Random spraying of a few fields here and there will not be effective. For this reason the extension service will probably have to become involved in organising and even carrying out a spraying programme.

We propose that all bean farmers be taught to dress their seeds and that certified seeds be introduced as soon as possible. In areas where pest infestation is most severe, spraying programmes should be undertaken which will include all bean fields, rather than scattered individual plots.

Harvesting

The only problem connected with harvesting which was reported to the survey team was drying harvested beans in the high rainfall areas. Agricultural Officers reported that when the rains are prolonged a large part of the bean harvest can be spoiled by rotting -- as much as 50 per cent in one division. Th problem can be reduced significantly by drying beans on simple drying racks constructed out of sticks. Harvested beans kept on racks until threshing are fa less affected by rotting than beans kept in a pile on the ground, or even under a shelter if brought in wet.

[illegible] beans in pure stand need not be planted early, [illegible]

that they will be harvested at the expected beginning of the dry season. This does not apply to beans interplanted with maize, however. According to the results of N.M. Fisher's experiments, if maize is planted at the recommended spacing and beans are interplanted later rather than at the same time as the maize, the bean yields will be tremendously reduced.

We propose that recommendations for the timing of bean planting should be made according to the rainfall regime of specific areas. In high rainfall areas, beans in pure stand should not be planted early, but beans interplanted with maize must be planted at the same time as the maize crop. Drying racks should be introduced in areas where the rains are likely to be prolonged.

Storage

Most of the damage to beans during storage is caused by insects, and since insects can enter almost any container the only effective way to protect beans in storage is with some form of insecticide. Certain chemical insecticides are safe and effective when used in recommended quantities, e.g. 250 gm of Lindane or 100 gm of Malathion per 90 kg bag. Malathion, or 'Blue Cross', is sold by the Kenya Farmers Association at shs 3 for a 400 gm package which would effectively protect four 90 kg bags. However, these chemicals are poisonous, and farmers must be advised to wash the treated beans before eating them and to throw away the water used for washing.

Most of the farmers surveyed did not use chemicals to protect their beans at all, and the few who did often did not know which chemicals to use. A number of farmers were treating beans which would be used for food with DDT, which is a strong and persistent poison. A few farmers in Eastern Province treated their beans with wood ashes, and there are indications that ashes do have some effect in protecting beans from insects.[9] Farmers should be advised to use ashes in areas where suitable chemical insecticides are not available.

We propose that farmers should be advised to treat beans in storage with 'Blue Cross' or another suitable chemical insecticide. At the same time they should be told to wash beans treated in this way before eating them and to throw away the wash water. A broader distribution system should be established to make chemical insecticides available to farmers throughout Kenya, and the

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8. Other methods of low-cost storage and protection against pests are being demonstrated at the UNESCO-sponsored Village Technology Unit at Karen, near Nairobi.

application of wood ashes should be recommended where suitable chemicals are still not available.

MARKETING AND PRICING CONSTRAINTS ON THE EXPANSION OF BEAN PRODUCTION

The marketing and pricing of beans is a crucial problem area which inhibits the expansion of bean production in Kenya. Beans are a scheduled crop, which means that bean trading should be a monopoly of the parastatal Maize and Produce Board with prices fixed by Government. Beans can be traded by farmers in local markets, but they may not be transported over district boundaries without involving the Maize and Produce Board. However, after 1974 this system broke down completely, so that by early 1976 less than one per cent of all food beans produced in Kenya were actually traded through the Maize and Produce Board. Yet the law against private trading between districts still exists and is occasionally enforced by police action. This is a disastrous situation: a huge parastatal body, which is supposed to promote the marketing of beans and which has both central and decentralised storage facilities and a highly decentralised purchasing and distribution system, is totally paralysed.

At the same time private trading cannot develop because of the rule against trading beans across district boundaries. Farmers are faced with uncertain markets for their beans, and women have to carry small quantities to sell at local markets, which consumes much of their time. Poor communication between deficit and surplus areas results in great price distortions -- for example, beans can sell for shs 185 a bag in Kitui and shs 370 in Nyeri at the same time. Furthermore, the deficit areas have somehow come under the domination of black marketeers who can bring beans in from other districts with very little competition since the trade is illegal.

In spite of these marketing and pricing problems, the demand for beans has risen very rapidly in Kenya over the past three years. The substantial increase in income in the urban areas and the high-potential cash crop areas has combined with the increase in population to create a long-term increase in the demand for beans. In addition, meat prices have risen substantially and evidently more beans are being consumed as a substitute for meat. Although this trend toward increased bean consumption could have been recognised some time ago, particularly since around 1973/74, in fact bean production has received very little attention as part of Kenya's agricultural development planning.

they reached shs 100 to 150 per 90 kg bag, they still remain far below local market prices. Apparently, the Maize and Produce Board's prices for beans are based on export parity which means that the farm gate price is set by taking the price at a world trading centre, such as London, and subtracting from this all the handling, shipping and transport costs between the trading centre and Kenya. This procedure might be a sensible way to price products intended for export, but this is hardly the case with beans. In fact, the Kenya Government has declared a policy of promoting bean production in order to ensure an adequate nutritional status for the Kenyan population. If prices are to be based on the international market at all, then it would be more sensible to follow the import parity price which is the price at a world trading centre plus transport levies and other costs. For some bean commodities, the difference between the export parity and the import parity prices is over 100 per cent.

Another alternative would be to base bean prices on production costs, but this would be difficult in Kenya at the present time. Given present conditions, we see only two feasible alternatives for improving bean pricing and marketing:-

1. The Maize and Produce Board could actually assume the major role it is meant to have in bean trading. To do this, the Board would have to offer competitive prices which at present would be at least shs 200 per 90 kg bag. Trading through the Board would offer the farmers a number of advantages -- guaranteed markets and prices and the opportunity to sell the whole crop at once and receive payment immediately.

2. The present restrictions on the bean trade could be removed and private trading encouraged. This would reduce regional price differences, and the resulting average price level would be high enough to encourage the expansion of bean production in areas where this is most feasible, in other words where production elasticity is highest.

Should the Maize and Produce Board take up an active role in bean marketing, the Board could stabilise the selling price to the consumer by buying beans in the surplus areas and selling them in the major deficit areas (e.g. the cities) at a price which covers purchasing and handling costs but is still well below the open market prices in the deficit areas. The beans could be sold at Government-controlled outlets, such as the 30 or so Consumer C-

This policy of stabilising consumer prices could also help alleviate the substantial seasonal fluctuations in bean prices. In addition, bean production could be promoted in areas where it is possible to grow beans outside the usual season. In the so-called Gathano areas along the slopes of the Abedares and Mount Kenya, beans can be grown at a time when they are not grown anywhere else. In these areas, farmers plant in June and July and supply the markets from October to December. Bean production during this season should be explicitly promoted in these areas.

Proposals for Bean Marketing and Pricing

The present situation, in which a parastatal body has a legal monopoly on bean trading and price setting but in fact probably handles less than one per cent of the bean trade, does not encourage the expansion of bean production and urgently needs to be resolved. One solution would be to set competitive prices for farmers so that the parastatal body could purchase beans at least in the surplus areas and sell them in the deficit areas at controlled consumer prices, for example by selling through the consumer co-operative unions. Another solution would be to abolish the restrictions and promote private bean trading which would probably stimulate expansion of bean production in the surplus areas and reduce prices in the deficit areas. Bean prices should not be based on export parity prices or production cost calculations. They should either reflect the domestic supply and demand situation or they should be based on import parity if the Government is prepared to open the domestic market to imported beans. This possibility has not been investigated by the survey team and therefore is not a recommendation of this report. Finally, off season bean production in the Gathano areas should be encouraged in order to provide a steady supply of beans to markets throughout the year.

A SUMMARY OF PROPOSALS RELATING TO BEAN PRODUCTION AND MARKETING

Proposals for General Farm Management

1. In the high rainfall areas where land is scarce, the promotion of bean production should be based on improving the cultivation of the existing acreage under beans.

2. In the medium and lower rainfall areas the promotion of bean production should include the expansion of the acreage under beans.

3. The expansion of acreage under cultivation will require labour-saving innovations for seedbed preparation, planting and weeding.

Proposals for Crop Husbandry

4. Farmers should be taught to dress their seeds themselves and seed dressing material should be made widely available.

5. Certified seeds should be introduced as soon as possible and a wide distribution system established.

Land Preparation:-

6. In middle- and large-farm areaswhere land is not the major constraint, ox-drawn ploughs and other equipment should be improved and widely distributed and the draught cattle stock should be improved and better guiding methods introduced.

7. In small-farm areas where land is the major constraint, simple soil conservation practises should be introduced and the quality of ploughing and digging improved to prevent the formation of a 'plough pan'.

Planting:-

8. Recommendations should be developed for interplanting beans with maize on smallholdings.

9. The cultivation of beans in pure stand should only be recommended for commercial growers and for subsistence farmers during the short rains when maize frequently fails but beans succeed.

10. In general, planting in lines should be recommended except where beans are broadcast and covered with soil by ox-drawn equipment.

11. Improved ox-drawn and hand-operated planting equipment should be promoted, particularly for use on middle-size and large farms.

12. Specific plant density recommendations should be made for different groups of bean seed types and for crops planted in pure stand and interplanted with hybrid maize. Plant density recommendations should include consideration of weed control.

13. Until more specific recommendations are available, the existing general recommendations should be followed: beans should be planted in pure stand at 40 cm by 10 cm giving a plant population of 250,000 per hectare, and where beans are interplanted with maize, the maize should be spaced as recommended at 2.5 or 3 ft by 1 ft and one row of beans planted midway between two rows of maize at 15 cm, giving a bean plant population of 75,000 to 90,000 per hectare.

Fertilisers and Manures

growers with high standards of husbandry, and recommendations should be specific for particular soil types.

15. The application of barnyard manure should be strongly encouraged and composting should be introduced. Simple equipment to transport manure to the fields, such as ox carts and wheelbarrows, should be promoted.

Weed Control:-

16. Where land is not a limiting factor and cultivation could be expanded, the labour shortage at weeding time is a serious constraint which can be alleviated by technological innovation.

17. Chemical weed killers are not recommended at present.

18. The introduction of inexpensive, locally produced interrow cultivators and improved guiding methods for draught animals so that they can be used for interrow weeding is strongly recommended.

Pests and Diseases:-

19. Seed-borne diseases should be controlled by the introduction of seed dressing and certified seeds, as put forward in recommendations 4 and 5.

20. In areas severely infested with pests, systematic spraying campaigns should be initiated to clear the entire area, rather than spraying scattered fields which is ineffective.

Harvesting:-

21. Pure stands of beans in high rainfall areas should be planted so that they will be ready for harvesting at the beginning of the dry season to reduce rotting of harvested beans. Beans should continue to be planted early in lower rainfall areas, and beans interplanted with maize should be planted at the same time as the maize.

22. Drying racks for harvested beans should be introduced in high rainfall areas.

Recommendations for the Storage of Beans

23. For dressing stored beans, 100 gm of 'Blue Cross' or a similar chemical insecticide should be applied to each 90 kg bag.

24. The distribution system for appropriate chemicals for dressing stored beans should be improved.

25. Where suitable chemicals are not available, treatment with wood ashes can be recommended.

Proposals for Bean Marketing and Pricing

26. The Maize and Produce Board should either assume a major role in the marketing of beans by setting competitive prices or abolish the restrictions on private bean trading which in effect protect black marketeers from competition, resulting in high prices in deficit areas and low prices in surplus areas. The surplus areas have the greatest potential for the expansion of bean production, but farmers are not motivated to increase their production because of low prices.

27. If the Maize and Produce Board is to assume a major role in bean marketing, the Board must offer prices to farmers based on existing market conditions so that farmers in surplus areas will find it attractive to sell their beans to the Board. Prices based on export parity or calculations of the costs of production would not be effective because they do not reflect present market conditions. Prices based on import parity would only be feasible if the domestic market were open to imported beans, which is not the case at present.

28. The Maize and Produce Board could stabilise bean prices by buying in surplus areas and selling in deficit areas through Government controlled outlets, such as the Consumer Cooperative Unions, to prevent the creation of artificial shortages.

29. Out-of-season bean production should be encouraged in the Gathano areas.

PART 3: EXTENSION AND OTHER INFRASTRUCTURAL SUPPORT - A PROPOSAL

In this section we shall propose an extension project to encourage the production of beans in Kenya. First, we shall discuss the general principles on which the extension proposal is based, and then describe four distinct components of an extension programme to promote bean production and some of their administrative implications. Finally, we shall propose a specific extension package and recommend procedural steps for its implementation.

SOME GENERAL CONSIDERATIONS

A number of rather general questions need to be resolved before a major extension programme to promote bean production can be planned and implemented:-

1. What priority should the promotion of bean production receive, as opposed to other agricultural activities?
2. What financial and manpower resources should be devoted to this particular project?
3. Which types of farmers (target groups) and which ecological zones (target areas) should receive priority attention?
4. To what extent and for how long should the Government intervene to promote bean production?

Although we cannot, and do not wish to, anticipate the decisions of the authorities responsible for deciding these questions, any extension proposal is bound to be based on certain assumptions, whether they are spelled out or not. In the interests of clarity, we shall try to make our position on these issues fairly explicit.

The Priority Assigned to Bean Production

The Kenya Government has stated officially that the improved nutritional status of the population is one of its most important policy objectives, and the Government has further stated that the promotion of bean production is a crucial aspect of this goal of improved nutrition. We conclude from this that the promotion of bean production is meant to have a high priority as part of Kenya's agricultural development policy.

Financial and Manpower Resources

In general, it is reasonable to base development programmes on existing financial and manpower resources. If major constraints cannot be

be carried out with existing resources.

Target Groups and Target Areas

Target groups for extension projects are often defined in terms of farm size or the progressiveness of the farmers, but we do not feel that either of these criteria is appropriate for defining the target group for a bean extension project. The majority of bean growers are small farmers, and this is also the group most in need of improved nutrition, so they should certainly be included as targets for the extension programme. On the other hand, medium and large farmers are also an important part of the target population because they have the greatest potential to expand bean production significantly and increase the supply to deficit areas.

The progressiveness of farmers varies greatly, but it has not proved successful in the past to introduce innovations to the most progressive farmers and expect them to spread to the others. Often the innovations remain exclusively with the most progressive farmers because their circumstances are so different from those of the other farmers that they cannot serve effectively as models. For example, how can a small farmer who must interplant beans with maize imitate the practises of a commercial bean grower? The target group should be defined as all actual and potential bean growers, who may then be classified according to land, labour and capital constraints in order to receive specific extension treatment.

The target area should be defined as all zones where beans are cultivated or potentially could be cultivated. Specific areas should be classified according to rainfall regime and bean growing potential - which are not identical since the higher rainfall areas are not necessarily the areas with the highest bean growing potential.

The Extent and Duration of Government Intervention

By Government intervention we mean measures which affect bean production directly such as the distribution of seeds, the allocation of a lorry to help farmers market their bean crops, etc. Such activities might be necessary to get a project off the ground, but direct Government intervention should be kept at a minimum because the ministries are not equipped to provide long-term or large-scale services and their direct support is frequently unreliable. For example, the officers responsible for a project might plan an intervention which they are unable to carry out because of cuts in budgets, the transfer

Fortunately, in Kenya many forms of direct intervention can be carried out more effectively by institutions other than the Government ministries. There are private seed companies with wide distribution networks, the Kenya Farmers Association with a network for distributing a variety of agricultural inputs and shops in all the local markets which are ready to sell inputs. There are also the input, credit and marketing facilities of the cooperatives and the services offered by the Agricultural Finance Corporation. All these specialised bodies can be used for the promotion of bean production, and they are more reliable and more effective than the Government in providing their specialised services to farmers. Therefore, we would recommend that a project to promote bean production should be planned in such a way that it relies very little on direct Government intervention and becomes self-sustaining as quickly as possible.

THE COMPONENTS OF THE PROJECT AND THEIR ADMINISTRATIVE IMPLICATIONS

Four aspects of a policy to promote bean production in Kenya can be distinguished, each one necessary if the policy is to be successful. These are:-

1. Improvements in husbandry practises,
2. Technological innovation,
3. Improved provision of inputs, and
4. Improved marketing and pricing.

The most direct approach to increasing production is to improve crop husbandry practises. However, measures are often taken in this area without considering the other necessary components of a policy to promote production, and even major efforts to improve crop husbandry show little effect when taken in isolation. Technological innovation is a prerequisite if bean production is to be expanded substantially because innovation will be necessary in order to exploit the potential of the medium and low rainfall areas. Further, increased production will only be possible if crucial inputs, such as seed dressing material, improved equipment, certified seeds, and chemicals to control plant diseases and treat beans in storage, are widely available. Finally, without a pricing and marketing system which encourages production all other efforts may be useless.

Each of these project components implies certain administrative needs and responsibilities.

extension staff and partly on the Farmers Training Centres. However, as pointed out earlier, certain aspects of bean husbandry, such as the use of synthetic fertilisers, require further research. It is important that agricultural extension be interlinked with research so that extension recommendations can be basedon up-to-date research findings. The communication system between research and extension should be institutionalised so that the flow of information does not depend on the chance initiatives of individuals. In this report we shall limit ourselves to recommending that the flow of information be institutionalised without recommending any of the many ways in which this could be done.

Technological Innovation

The promotion of technological innovation is a much more complicated task involving a number of Government departments and other agencies. No framework exists for the coordination of programmes in this area because traditionally efforts to develop agricultural technology in Kenya have been limited to the promotion of tractor mechanisation. The Land and Farm Management Division of the Ministry of Agriculture might assume responsibility for the development of ox-drawn and hand-operated technology, and the dissemination of new methods and equipment could be taken over by extension workers and the staff of the Farmers Training Centres. However, a number of factors are involved which would make the participation of other bodies inevitable: feasible prototypes of equipment must be developed in Kenya or imported from other countries; they must be tested with farmers; the equipment must be manufactured, distributed and repaired; improved guiding methods for draft cattle must be developed and disseminated; and finally all these activities must be coordinated. Although it will not be possible to finalise the administrative arrangements for all these aspects of technological innovation and dissemination immediately, it is imperative that the various efforts already underway proceed without delay. Also, a number of innovations could be introduced right away. For example, it would be possible to introduce better ploughs immediately and to improve the distribution of equipment which is already available.

A number of research and development projects are now being carried out which should be encouraged so that new equipment will be available soon for introduction to the farmers. The Nakuru Machinery Testing Unit, the Bukura Institute of Agriculture, Egerton College, the University of Nairobi's Faculty of Agriculture and the Agroservice Centre at Siakago (part of the Mbere Special Rural Development Programme) have all been testing various items of ox-drawn and hand-operated equipment. Most of these institutions are also working on

Institute. The Rural Industrial Development Centre in Machakos is also working on the development of equipment -- for example, a simple interrow cultivator.

It is crucial that some agency take up the overall responsibility for animal-powered and hand-operated technology and coordinate the activities of the relevant departments within the Ministry of Agriculture and other institutions such as the Ministry of Commerce, the Rural Industrial Development Centres, private manufacturers, distributors and so on. Up until now, an Ad Hoc Committee on Rural Mechanisation has provided prototype equipment by importing items from Tanzania, Mali and India and has arranged for testing to be carried out. This Committee is made up of individuals from various Government departments and other organisations who work on a voluntary and informal basis, and clearly more formal institutional arrangements are needed.

Improved Provision of Inputs

The basic problem here seems to be that private distributors do not stock certain inputs throughout the bean-growing areas because they feel there is not enough demand from farmers, and at the same time farmers are not aware of certain inputs because they have never been available in the areas where they live. Farmers often complained to the survey team that inputs were not available, for example in the case of ploughs in Kitui. This vicious circle of no supply because there is no demand and no demand because there is no supply could be broken by Government intervention.

A very successful case of Government intervention in the supply of inputs occured as part of the Migori Special Rural Development Programme. As of 1970, no local retailers were prepared to stock inputs for hybrid maize production because they were afraid that sales would be slow so that the capital required to purchase the inputs would be tied up for some time. A maize input stockists credit scheme was devised as part of a hybrid maize extension project, whereby the S.R.D.P. offered credit to private stockists to finance the purchase of hybrid maize inputs. This helped them avoid the risk of tying up their capital if sales were slow. After two seasons the stockists were ready to carry hybrid maize inputs without receiving credit because the demand from farmers had been established. The repayment rate on the credit received was 100 per cent.

Another way in which inputs might be made available to local farmers would be for an extension or cooperatives officer to bring a group of farmers together to order jointly from a local stockist. Of course, an effective extension service wo d be necess ry to teach the f rmers about im ortant inputs,

storage. Effective extension and better provision of inputs are complementary activities.

Marketing and Pricing

As pointed out earlier, the Maize and Produce Board has not been able to play a substantial role in bean marketing because of an inappropriate pricing policy. The survey team could not discover which body or bodies has the responsibility for setting bean prices or on what basis official prices are determined. Responsibility for pricing is divided in some way among the Maize and Produce Board, the Ministry of Agriculture and the Ministry of Finance and Planning, and since the General Manager of the Board is employed by the Office of the President, it is possible that this office also participates in decisions on prices. Informal talks with officers involved in bean marketing and pricing suggested that export parity and calculations of production costs may be considered in setting bean prices, or that arbitrary decisions may be taken, but no clear formula for the determination of prices was discovered.

A THREE-STEP APPROACH TO EXTENSION

In the high-potential areas where farms are generally small, the first step of a bean extension project would be to show farmers how to protect their crops. Seed dressing and protection of beans in storage are simple tasks which require only very inexpensive inputs. In areas which are severely infested with bean pests and where seed dressing is already widely practised, the systematic spraying of plants in the fields could also be introduced. Finally, the provision of certified seeds might also be included in the first phase if they can be made available at reasonable, probably subsidised, prices.

As a second step, basic crop husbandry methods could be improved. There would be little use in improving husbandry before crop protection methods are introduced because increases in yield would likely be lost to pests and diseases. Simple soil conservation measures could be introduced and methods to improve soil fertility through manure application and composting. Farmers could be taught to plant in lines with appropriate spacing for beans interplanted with other crops and in pure stand, and simple drying racks could be introduced in high rainfall areas.

Once the first two steps have been successfully implemented, the extension project could encourage the further intensification of bean production through the use of additional inputs. Certified seeds could be made available

for commercial growers.

In the middle- and large-farm areas which tend to be dryer, the first step of a bean extension project should be the same as in the small-farm areas --the introduction of methods to protect crops from pests and diseases. As a second step, crop husbandry methods should be improved, for example by improving the fertility of the soil by composting and applying manure. For larger farms this will involve the introduction of simple equipment, such as ox carts and wheelbarrows, to transport the manure to the fields. These less densely populated areas hold the greatest potential for significantly expanded bean production, and this should be strongly encouraged with the introduction of improved ox-drawn ploughs and weeder/cultivators, and possibly ox-drawn or hand-operated planters. Along with the introduction of new equipment, farmers should be taught improved guiding methods for their draught animals and to plant in lines and in pure stand to facilitate weeding with ox-drawn equipment. The third extension step would be further intensification through additional inputs such as certified seeds at commercial prices and synthetic fertilisers, just as in the small-farm areas.

EXTENSION METHODS FOR REACHING LARGE NUMBERS OF FARMERS

Beans are grown by nearly all the local farmers in the areas where it is possible to grow them. Therefore an effective bean extension project in these areas must reach large numbers of farmers. The methods most often used by Kenya's extension service -- individual farm visits and isolated demonstrations -- would not be effective in reaching a large number of farmers in a short period of time. New methods are required, involving an approach to all farmers throughout an area, in groups rather than as isolated individuals.

Visits to scattered individual farmers are particularly inadequate when it is necessary to adopt certain practises systematically throughout an area. For example, in areas heavily infested with pests, it is not sufficient to spray the fields of scattered farmers, but rather all the farmers must be brought together to spray the entire area. Also, local shop-keepers will not be willing to stock important farm inputs, such as seed dressing material, chemical pesticides for treating beans in storage, farm equipment, certified seeds and fertilisers, if there is demand only from a number of scattered

and to order them as a group.

Another aspect of extension relates to the complexity of the particular message being conveyed. The recommendations for promoting bean production can be classified according to their simplicity or complexity: for example, dressing seeds to prevent seed-borne disease is a simple message compared to the introduction of ox-drawn interrow weeding equipment. The specific extension method used should be appropriate for the relative simplicity or complexity of the message being conveyed. For example, it would be inappropriate to conduct a course in a Farmers Training Centre to convey a very simple message because it would be expensive and time-consuming and only a few farmers could be reached. On the other hand, it would be inefficient to distribute handouts promoting a very complex innovation, because very likely no farmers would actually adopt the innovation at all.

We shall discuss the extension methods which would be appropriate for each of the three steps of a bean promotion project, concentrating on ways to reach large numbers of farmers in groups, rather than as isolated individuals, and looking for the most efficient way to communicate each extension message, in other words the cheapest and quickest way to effectively reach the largest number of farmers.

Extension Methods for Step One - Improved Crop Protection

The extension tasks for this step are introducing seed dressing, crop storage protection, spraying in areas severely infested with pests, and certified seeds if they can be made available at a low price. Seed dressing and crop storage protection are similar extension messages which can be treated together. Farmers can be taught these practises in the following way:-

1. The extension staff, together with the chiefs, could explain the innovations at sub-locational (assistant chiefs') barazas (meetings).
2. Later, demonstrations could be given to neighbourhood groups of farmers, showing the dressing materials, the amounts necessary and how to mix them with the beans. These groups, made up of 10 to 20 farmers who are neighbours, could be formed by the farmers themselves during the barazas.
3. The extension staff must arrange for the provision of the chemicals to be used in the demonstrations. Staff at the sub-locational level should also inform local stockists that the chemicals will be in demand by farmers. At the national level, the extension staff should inform the Kenya Farmers

storage could be recommended and explained through the newspapers and the radio.

Spraying bean plants in seriously infested areas is a more complicated task since, in addition to chemical pesticides, spraying equipment is needed which may be too expensive for individual bean growers. Spraying could be done on contract by private firms or cooperative societies, but in important bean growing areas which are very severely infested it is probably justified for the Government to intervene directly and carrying out a spraying programme itself. The District Agricultural Officer could decide whether a particular area is severely enough infested and a sufficient threat to neighbouring areas to justify a Government spraying programme. At first, spraying could be carried out free of cost as a demonstration, and subsequently farmers could be asked to pay enough to cover the costs according to their acreage. We do not make any recommendation in this report concerning who should actually carry out the spraying programme -- Ministry of Agriculture employees, coopertatives employees or special spraying teams.

The introduction of certified seeds can be included at this stage if they can be provided in the local areas at a reasonable price, which would probably be subsidised. Little extension effort is likely to be needed once the seeds are available, since nearly half of all the farmers surveyed are already accustomed to purchasing seeds in the local markets. The advantages of certified seeds and their availability could be announced at barazas and by the mass media. However, if it is impossible to supply certified seeds at a low price, this need not be included in the first step of the extension effort.

Extension Methods for Step Two - Improving Crop Husbandry and Expanding the Area Under Cultivation

In the high rainfall zones where land is limited, the extension tasks include introducing simple soil conservation methods such as ploughing and planting across the slopes, ridging, leaving uprooted weeds between rows, and on steep slopes planting lines of fodder grass or trees. Methods to increase soil fertility should also be introduced such as composting and the application of manure and green manure. Farmers should be taught to plant in lines in mixed and pure stands, and in areas where the rains are prolonged simple drying racks should be introduced. None of these tasks is very complicated, none requires substantial supporting systems, such as the delivery of new inputs, and none requires the farmers to invest large amounts of capital. However, the fact that none of these practises has been widely adopted in Kenya so far indicates that they will require a serious extension

effort.

Extension workers could probably reach the greatest number of farmers by working with neighbourhood groups. They need to motivate the farmers to adopt these practises by explaining them and discussing their advantages, and they need to let the farmers observe the new methods and practise them on a demonstration plot. The mass media and barazas can play a secondary supporting role, but these innovations are too complex to be diffused by merely passing on information to the farmers -- the farmers need to be motivated and demonstrations and practise sessions need to be carried out.

In the medium and lower rainfall zones where land is not a limiting factor, the extension tasks include improving ploughing equipment and introducing animal-drawn interrow weeder/cultivators. In connection with these innovations, farmers must be taught improved methods for guiding their draught animals and to plant their beans in lines in pure stand. Methods to improve soil fertility should also be introduced, such as composting and applying manure, which includes the introduction of simple equipment for transporting manure to the fields.

These innovations are relatively complex and cannot be introduced by extension staff alone. Improved ploughing equipment is already available in Kenya, and the extension staff could probably arrange for it to be distributed in the rural areas, particularly if they can work in cooperation with the Kenya Farmers Association. However, the introduction of interrow weeder/cultivators is much more complicated. For one thing, this equipment is not yet manufactured in Kenya, though it would probably be relatively simple to manufacture it here. Meanwhile the cultivators could be imported from Tanzania where a large factory already exists, at about Tanzanian shs 250 each. No distribution system exists for interrow cultivators, but a system could be set up through the Kenya Farmers Association and additional stockists appointed in the divisions. The first priority should be to make the cultivators available to farmers in the local areas.

At the same time that the cultivators are being introduced, the farmers must be taught improved methods for guiding their draught animals and also to plant in rows. Ox-drawn cultivation is usually practiced by a few farmers who hire out to their neighbours, so farmers who do not have oxen but rather pay to have their fields cultivated will also have to be taught to plant in rows. Finally, local artisans must be found who are willing to maintain and repair the new equipment.

Simple equipment such as ox carts and wheelbarrows could be manufactured in the local areas, possibly with the help of the Rural Industrial Development Centre in Machakos, but as in the case of input stockists, a vicious circle must be broken. No one will manufacture the equipment unless they are sure of sufficient demand, and at the same time no farmers will demand the equipment until they are familiar with it.

In planning the introduction of new agricultural equipment, extension agents must consider three interrelated target groups: the farmers who will use the new equipment, the farmers who will not use the equipment themselves but will hire services from those with the equipment, and the local craftsmen who will repair the equipment. It is important that a great many farmers in a particular area adopt the ox-drawn cultivator, for example, rather than a few scattered here and there. Otherwise, the local craftsmen will not be willing to stock the tools and spare parts necessary to make repairs. The new equipment should be demonstrated to groups of farmers and they should be allowed to practise with it. Not only those farmers who will actually use the cultivator, but also those who will hire their services, should be familiar with the innovation because they will all have to make appropriate arrangements, for example by planting in lines.

Farmers who will use the cultivator must learn improved guiding methods along with their draught animals, and this will take two weeks or more. There would be a number of advantages in carrying out this training with a group of farmers in their local village: the farmers could work with their own animals under competent supervision, and there would not be a broad gap between the training sessions and carrying out the new methods at home. Further, the necessary veterinary services, such as punching the animals' noses and putting through a nylon rope, could be carried out along with the training.

Extension Methods for Step Three - Further Intensification of Production Through Additional Inputs

Once the protection of bean crops from diseases and pests has been assured and crop husbandry methods have been improved, the last stage of the extension project would involve the introduction of certified seeds at ordinary commercial prices and the use of synthetic fertilisers. First the infrastructure must be established to provide these inputs at the local level. Then farmers can be told about the inputs through barazas and the mass media, and more intense promotion can be carried out through demonstrations to neighbourhood groups. The costs of these inputs might also require credit schemes which can be carried out as they have been for other crops through cooperative societies or other existing institutions.

EXTENSION STAFF PREPARATION AND MANAGEMENT

The effectiveness of an extension project can be increased tremendously by combining appropriate extension methods, careful preparation of the staff and proper staff supervision or management. We strongly oppose the frequently-heard statement that Kenya's extension service is generally weak. There is strong empirical evidence that extension in Kenya is extremely effective when these three conditions are met. (See 1 and 3.)

Figure 6. A summary of the three-step extension proposal.

	Small Farm Areas Where Land is Limited	Larger Farm Areas with Additional Land Available
First Step - Protection of Existing Crops	1. seed dressing 2. protection of crops in storage 3. spraying plants in areas seriously infested with pests 4. certified seeds if available at low prices	
Second Step - Improvement of Crop Husbandry and Technology	1. simple soil conservation 2. soil fertility improvement (with existing resources) 3. planting in lines 4. drying racks (where necessary)	1. improved or new equipment for ploughing, planting and - most important - weeding 2. improved guiding methods for draught animals 3. planting in lines in pure stand 4. soil fertility improvement (with existing resources and improved transport equipment)
Third Step - Input Intensification	1. certified seeds at commercial prices 2. synthetic fertilisers	

We have already described the extension methods which we feel would be effective for a successful bean promotion project. The careful preparation of extension staff could be carried out at short in-service workshops at Farmers Training Centres for each sequential step of the extension project. At these workshops, extension workers can receive information and training, and the specific extension activities can be planned jointly by the trainers and the extension staff. (See 3 for further details.) For the first step of the bean promotion project, there might be a three-day workshop with the following programme:-

First Day: General information and discussion of the whole bean project and all three extension steps.

Second Day: Specific information and discussion of the components of the first step - seed dressing, spraying, storage dressing and possibly certified seeds.

Third Day: Joint formulation of an action plan for the season - what activities each staff member is to carry out, where and when.

The second step of the extension project requires two different types of staff preparation. Improved crop husbandry methods could be covered in a one-week in-service workshop during which the extension staff would learn and practise such techniques as composting and would work with the trainers to devise an action plan for implementing this step. New equipment to be introduced would also have to be demonstrated and the extension staff would have to practise using it. Planning the introduction of new equipment would have to be relatively detailed and complex. Staff preparation for introducing improved animal guiding methods could not be carried out in a short in-service workshop, but would require three to six weeks of training in a specialised centre such as the Bukura Institute of Agriculture. A small number of staff members could be selected in each district to receive this training.

Training for the third extension step may again require only a three-day in-service workshop. The major concerns of such a workshop would probably be farm management issues (calculating input/output ratios) and detailed planning of implementation.

The effective management of extension staff begins with the joint planning of project implementation during the staff workshops. Once the project is being implemented in the field, a system is needed to control the extension workers' activities and to identify and resolve problems as they occur. This system could take the form of monthly staff meetings at the locational or divisional level where progress is discussed and a simplified reporting system, perhaps using cards where planned staff activities are listed and having the extension workers fill in what they have actually done. (Staff management systems are discussed in more detail in 3.)

TRAINING AND INFORMING SUPERVISORS AND TRAINERS

A one-week workshop could be held in each province to train and inform agricultural staff at the provincial and district level concerning the bean

extension project. The participants in each province would be:-

2	Ministry of Agriculture provincial staff members
4	District Agricultural Officers
4	District Development Officers
4	Crop Officers
4	Principals of Farmers Training Centres
20	Assistant Agricultural Officers
Total 38	Participants

At these provincial workshops, the district-level staff would be informed about all major aspects of the bean promotion project -- the general principles, strategies, cordination requirements, anticipated problems, etc. Since most district officers are not yet familiar with group extension methods, they would also learn about this approach and its advantages. Finally, the general plans for district bean promotion projects would be drafted.

The provincial workshops could be planned at a one- or two-day workshop in Nairobi involving the following institutions:-

1. Ministry of Agriculture: Scientific Research Division and Thika Team
   Crop Production Division
   Planning Division
   Land and Farm Management Division
   Extension and Training Division
   Provincial Directors of Agriculture
2. Ministry of Finance and Planning: Human Resources Division
3. Institute for Development Studies
4. Institute of Adult Studies
5. Programmes for Better Family Living (F.A.O.)

A SUMMARY OF THE PROPOSED BEAN EXTENSION PROJECT

Project Preparation

1. The project is agreed upon by the Ministry of Agriculture, the Maize and Produce Board and the Kenya Farmers Association.
2. A body is established in Nairobi to coordinate the project within the Ministry of Agriculture and with other relevant institutions such as the Maize and Produce Board, the Kenya Farmers Association,

the seed companies, the Rural Industrial Development Centres of the Ministry of Commerce, the administration (chiefs' barazas), etc.

3. A workshop is held in Nairobi to develop the content of the extension project and the way in which it will be carried out.
4. Workshops are held in each province to inform and train supervisory staff and trainers.

Project Implementation with a Focus on Training

5. Step One (protection of existing cultivation efforts) - Three-day in-service workshops are held at the district level for all relevant staff members.
6. Step Two (improvement of crop husbandry) - One-week in-service workshops are held at the district level for all relevant staff members.

(expansion of cultivation by use of improved technology) - One-week in-service workshops are held at the district level for all relevant staff and selected staff members receive special training in improved guiding methods for draught cattle.

7. Step Three (intensification of inputs) - three-day in-service workshops are held at the district level for all relevant staff members.

Steps One, Two and Three are stages of staff training which can be carried out strictly in sequence, adding a new step each season. However, at the same time the three steps represent stages of the extension activities carried out with farmers. A new stage of extension can be initiated every season, but they will overlap because farmers will not all adopt the various innovations at the same rate. For example, the second stage may be initiated with some farmers while others are still at the first stage. The extension activities will continue long after the staff training is complete: each extension step should be carried out as a priority for at least two seasons and on a routine basis after that until the new practises are self-generating. The introduction of new technology will probably require the longest priority treatment. The timing of the various extension activities is depicted in Table 37.

Finally, we would like to repeat that if a bean promotion policy is to be successful in Kenya, infrastructural support is just as important as extension. This would include a viable marketing system with appropriate pricing and a wide distribution system for the various inputs, such as seeds, chemicals and equipment.

Table 37. Priority and routine attention given to the three steps of a bean extension project.

	Step One	Step Two		Step Three
	protection	husbandry intensification	expansion with new technology	input intensification
Season				
1	XX	-	-	-
2	XX	XX	XX	-
3	XX	XX	XX	XX
4	x	x	XX	XX
5	x	x	XX	x
6	x	x	XX	x

XX = priority attention, and

x = routine attention.

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