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BEAN CONSUMPTION AND PRODUCTION IN SUB-SAHARAN AFRICA
A PRELIMINARY REVIEW

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Although beans are an important crop in sub-Saharan Africa, few studies have tried to assemble existing information on regional bean production (Londoño et al 1981). This paper presents some available data on 1) Recent production trends, 2) The structure of bean production in some major African producers; 3) A review of consumer preferences and marketing issues.

Bean Trends 1962-81

Sub-Saharan Africa is second only to Latin America among the world's leading producing regions of Phaseolus vulgaris L. (East Asia's great production of dry beans being almost entirely of other species. See Table 1). Within Africa, bean production is concentrated in the cooler highlands. Eastern Africa accounts for some 850,000 tons/year, or over half (54%) of Sub-Saharan bean production, while Kenya alone contributes more than one fourth (29%) of the region's bean output (Table 2) Tanzania and Uganda are also major bean producers in Eastern Africa. The Great Lakes Region of Burundi, Rwanda and the Kivu district of Zaire is the second leading bean production zone in Africa, with 435,000

tons/year or about one-fourth of Sub-Saharan production. Southern and West Africa are much less important as bean producers than the highlands of East and Central Africa.

Available data on area planted similarly show that Eastern Africa is the leading Sub-Saharan region in terms of land devoted to dry bean production, followed by the Great Lakes Region and Southern Africa (Table 3). As with the production data, however, the interpretation of both regional totals and individual country trends is somewhat hampered both by gaps in the data (for Kenya and Zaire, two of the major producers) and also by obvious discontinuities in the data (eg. Malawi). This is largely a reflection of the difficulty of estimating the production of a basic food crop which is principally kept for home consumption on a large number of small farms which produce beans. Moreover, some important discrepancies exist for individual country data, depending upon the source used (Table 4). Comparison of FAO statistics with those provided by national sources suggests that FAO may be underestimating African bean production. Despite these problems in the data, the overall picture of where beans are important in Africa is clear: principally in Eastern Africa and also in the Great Lakes Region; less so in Southern Africa; and relatively unimportant in West Africa, except locally in the northwest of Cameroon.

Although Sub-Saharan bean yields are generally low (Table 5), particularly when compared to yields in the high income countries, (648 vs. 963 kg/ha in 1979-81), they compare quite favorably with the regional average yield of 549 kg/ha in Latin America. Higher yields in the developed countries are due in large part to greater use of chemical

inputs as well as production in monoculture. Africa and Latin America share the characteristics that in both regions beans are typically produced on small farms; much of the time in mixed cropping systems where bean yields are depressed by inter-species competition; and especially in Africa, with minimum use of chemical inputs. If the data are indeed reasonably correct, one possible reason for the apparently higher yields in Africa is that disease and pest pressures may be lower there since the crop is outside its center of origin. While this is highly speculative and is almost certainly not the only factor involved, with other factors such as soils and cultural practices being potentially different, the higher yields in Africa, and the likely lower disease pressure there both suggest that a bean improvement strategy for Africa may have to be somewhat different from that of one for Latin America where diseases are such a critical constraint.

Since 1962 of the sub-Saharan countries for which adequate time series data exist, half have experienced historic rates of growth in bean production that are at least 1% per annum less than current estimates of population growth, while in the rest of the countries there has been a rough balance between production and population growth (Table 6). However, yields have been essentially stagnant and past achievements in increasing output are due almost solely to expansion of area cultivated (Table 6). Since land is limited, this historic area expansion can not continue indefinitely, particularly in countries like Rwanda and Burundi where population densities are very high (higher, for example, than in China or Indonesia). The Great Lakes Region and Eastern Africa are likely soon to face increasing pressure to increase

bean yields so that output growth does not begin to lag significantly behind population growth. However, the Sub-Saharan record on yield increases is not favorable. Only some atypical countries in Southern Africa have achieved any consistent rises in bean yields.

The practical impossibility of sustaining long term production growth through continued area expansion is illustrated by a comparison of growth rate in the 1960's with those of the 1970's (Table 7). These data show first, that in many countries growth in bean production was quite buoyant in the 1960's furthermore, the relative success of output expansion in the 1960's was often principally a product of increased area (Uganda, Burundi, Rwanda). In the 1970's, almost all sub-Saharan countries experienced a marked decline in bean production growth rates, and this was largely a result of slowdowns in area growth (Uganda, Burundi, Rwanda, Angola, Madagascar). Thus, it is clear that many countries are finding it impossible to achieve needed production growth through area expansion, and future output growth will have to come increasingly from productivity improvements. As bean production is becoming progressively unable to match population growth from the 1960's to the 1970's, it is clear that many countries critically require an increased effort to raise productivity, either to reverse recent declines in per capita bean consumption, or in more favored countries, to at least be able to continue to maintain historic consumption levels which in many cases have been nutritionally inadequate.

The urgency of improving bean productivity and increasing output is made clear by data on per capita bean consumption in the decade of the 1970's in the Sub-Saharan region. Over 70% of the countries in the

region experienced declines in apparent bean consumption (Table 8). This development is particularly grave given the central role played by beans in the diet of many African countries. In Burundi and Rwanda, over one-third of total protein consumption is from beans, while in Kenya as much as one-fifth of protein comes from beans. They also supply one-sixth of protein in Uganda and in Angola about one-tenth. (Table 9). In three countries beans are the leading source of protein in the diet, while in another three countries beans are the third leading source of protein. The importance of beans for protein nutrition is especially great when protein quality is taken into account. Among high quality sources of protein (ie excluding cereals, roots and tubers), beans are the leading contributor of high quality protein in nine countries, where they provide between one-fifth and two thirds of high quality protein. Thus, 110 million people in sub-Saharan Africa live in countries where beans are the leading source of quality protein in the average diet. Consequently, the decline of per capita bean consumption observed during the 1970's, may have a critical impact on protein nutrition due to the prominence of beans as a protein source in African diets.

Production Structure

Beans are produced in a variety of cropping systems and environmental conditions in Africa. Despite this diversity, there are several important similarities in bean production in the region. First, and most importantly, beans are grown principally by small farmers. As a consequence, they are often cultivated in mixed cropping systems; they

are typically a subsistence crop; input use is almost frequently negligible. Some available information on bean cropping systems and regions for some major bean producing countries will now be briefly summarized.

Rwanda

Beans are grown throughout Rwanda (Table 10), and play a critical role in the diet in all regions (Table 11). In the central plateau bean production is greatest in the first rains from September-January (Table 12). Beans are grown principally with maize, in monoculture, or with bananas though it is also sometimes grown with cassava and sorghum. Bananas and coffee are the main cash crops in the system, while beans, cassava and sweet potatoes are the main foodstaples. Banana and sorghum production are both principally for the manufacture of beer. While in the central plateau and the south-east (Kibungo) bush beans predominate (types I, II and IIIa), in the northeast highlands (Ruhengeri) and along the shores of Lake Kivu climbing beans are cultivated, sometimes in association with maize, but also often on Pennisetum stakes (Davis 1982 a).

Land preparation is by hand and the bean crop is weeded once or twice. Chemical fertilizers, herbicides, fungicides and insecticides are almost never used in bean production (Nyabyenda et al 1981), but beans in storage are sometimes treated with Malathion (Pachico 1984). Some composte is applied, though it is not usually available in sufficient quantities to be used in all bean fields.

Malawi

Some 99% of beans in Malawi are estimated to be grown in mixed cropping systems, principally with maize, and most are climbing or semi-climbing types (Edje et al 1981; Laing 1984).

In the south (Thyolo, Mulanje, Chiradzulu), relay cropping of climbing beans with maize is the main system, while in the rest of the country indeterminate or climbing types are usually row intercropped or mixed with maize planted on ridges (Edje et al 1981; Davis 1982b). On tobacco estates a bean crop often follows the tobacco harvest in order to contribute to the food needs of the large labor force on the estates. Farmers do not usually fertilize beans directly, but maize is often fertilized when grown in association with beans (Edje 1983).

Tanzania

The northeastern districts of Arusha and Tanga comprise the main bean producing zone in Tanzania, supplying some 44% of total national production (Table 13). This region is characterized by a dual structure in production, with small farmers producing alongside state farms where beans are produced on a large scale with mechanization. Some of the mechanized production is for export to Europe, especially as seed (Karel et al 1981). The southern highlands (Mbeya, Rukwa, Ruvuma) form the second major bean producing region (23% of national production), while West Lake and Kigoma contribute 19% of Tanzania's beans.

Beans are commonly intercropped with maize, but are also sometimes grown in monoculture. In the short rains, indeterminate climbers are frequently grown with maize, while in the long rains, bush bean types are typically cultivated as a sole crop. Chemical fertilizers are not used in bean production in small farms, but composte is applied when available. (Karel et al 1981).

Kenya

Beans are by far the most important food legume in Kenya, and though they hold this prime position in all provinces except the Coast, bean production is concentrated in Eastern, Central and Wesbern Provinces (Table 14). The relative importance of Eastern Province, already the leading bean producer, may be still increasing as competition from cash crops continues to displace bean production from the high agricultural potential zones of Central Province. Much of Eastern province is semi-arid, however, so beans are moving to a more severely drought stressed environment where yield instability is likely to be greater (Mukunya 1983).

Throughout much of the three principal bean producing provinces, beans are cultivated both in one first rain (spring) and the second rains (fall). In general, the proportion of area planted to beans on small farms is greater than that on medium or large farms (Tables 15-23), making beans a relatively more important part of the farm enterprise for small farmers.

In general more beans are sown in the first rain than in the second, but in many districts of Eastern and Central provinces, the

second rain planting is quite important, amounting, for example, to more than 20% of total farm area (including Fallow and pasture), in small farms in Eastern Province (Table 15).

In the major producing zones of Kenya, beans are generally grown more often in association with maize, than in monoculture (Tables 14-23). However, monoculture bean production is fairly important in parts of Central and Eastern Provinces where in many districts it equals or surpasses association in terms of production area. Monoculture bean production tends to be relatively more important in the second rains season than in the first, and in some districts it surpasses association in importance during the second rains. In contrast, area planted to beans in association is usually greater in the first rains than in the second.

Yields also vary by cropping system and season (Tables 24-25). Generally, the average of monoculture bean yields is greater than that of associated bean yields (965 kg./ha vs. 480 kg./ha in the first rains), while differences between seasons are rather less marked, holding production system constant. Although monoculture yields are typically greater than bean yields in association, input use is more frequent and at a higher level in association (Tables 24-25). This occurs principally because farmers are applying inputs for the maize (Zoebl 1983). Nevertheless, beans yields may be boosted by fertilizer and pesticide applications, even if these inputs are applied primarily on maize. Some usage of improved bean varieties is also reported, though it lags far behind use of improved maize varieties. These data on input use need to be treated with some caution, as the sampling

procedure used to obtain these data probably contains some bias towards the selection of more commercial farmers.

Nevertheless these data are a reasonably reliable portrayal of the pattern of how inputs are currently used in Kenya, and are seen as good indicators of the likely trend in input use in Kenya by the mid-1980's (Jaetzold and Schmidt 1983). They do suggest that use of some low levels of inputs is possible in African bean production. Nevertheless, beans remain a relatively low priority for input use compared to more commercial crops (eg. coffee, tea, pyrethrum) which offer a higher return investment. However, with increasing urbanization and more specialization in agricultural production, commercial opportunities for bean production may well improve in the near future, thereby making greater investment in the bean crop more attractive (Zoebel 1983).

Consumer Preferences and Marketing

In much of the Sub-Saharan region, beans are produced in varietal mixtures (Edje 1983; Karel et al 1981; Nyabyenda et al 1981). While this doubtlessly contributes to yield stability, it is less clear that this practice maximizes yields. Typically African consumers appear to readily accept mixtures of grain types of varying, colors, shapes, and sizes. Despite this degree of flexibility, nonetheless important consumer preferences do exist. In most countries, it appears that large beans are preferred (medium are well accepted), especially red, tan red mottled, pinkish or purple grain types, though yellows and whites are also accepted in some regions. In general, consumers seem not to like small beans; in particular small blacks are not esteemed (Edje et al 1981; Karel et al 1981; Rubaihayo 1981). Another important food use of beans is the consumption of young green leaves as a fresh vegetable. Although most beans that enter the market are sold as mixtures (or blends), in Malawi the Agricultural Development and Marketing Corporation (ADMARC) requires growers to sort seeds into groups based on color and shape. Premium prices are paid for uniform grain types (Edje et al 1981). Similarly, in Uganda, mixed color beans receive lower prices than uniform grain types. (Rubaihayo et al 1981). In contrast, in Rwanda there is no price discount for mixtures (Pachico 1984; Davis 1982a). It is possible that as urbanization progresses and a greater proportion of beans enter market channels, there will be increasing pressure for standardization and grading of beans. Hence, economic incentives may to some degree tend to undermine the biotic

stability of the traditional system of producing beans in genetic mixtures. Such a development would, though, make increased disease and pest resistance in pure lines an important breeding objective to thus meet goals of maintaining production stability while meeting market requirements.

This change may not be rapid, however, since in most countries only a fairly small proportion of beans are marketed, with most still being produced for home consumption (Nyaybenda et al 1981; Edje et al 1981; Karel et al 1981; Rubaihayo et al 1981). Moreover, the development of commercial bean production has been inhibited in some countries by government policy. Marketing boards sometimes offer farmers prices well below parallel free market prices, either in an effort to keep consumer prices low, or in order to maintain a high profit margin in marketing. In Uganda, for example, in 1978 and 1979 the Produce Marketing Board was unable to execute any purchases of beans because it was not prepared to pay farmers a sufficiently high price (Rubaihayo et al 1981).

Likewise in Tanzania the official government fixed price of the National Milling Corporation has been half or less of unofficial (black) market prices (Karel et al 1981).

Maintenance of low bean prices tends to make bean production unprofitable, thereby discouraging increased production and the search for and adoption of new production increasing technology. Some studies suggest that small farm bean production is not profitable in sub-saharan Africa (Zoebel 1983; Nyabyenda et al 1981). While factors other than

price are involved, clearly artificially low prices for beans act as obstacle both to bean production and to investment in new technology. Consequently, economic studies of government bean Africa and storage policies are a critical adjunct of CIAT proposed research in the sub-Saharan region, as there policies may often be a critical determinant of the profitability of new technology.

Table 1. World Dry Bean Production, 1979-81 - ('000 tons).

	<u>('000 tons)</u>	<u>(%)</u>
<u>Developing Countries</u>		
East Asia	4888 ^a	37.3
Latin America	4116	31.4
Sub-Saharan Africa	1640	12.5
West Asia and North Africa	307	2.3
Total Developing Countries	10951	83.6
<u>Developed Countries</u>		
North America	1252	9.6
East Europe	425	3.2
West Europe	291	2.2
Others	173	1.3
<u>Total Developed Countries</u>	2141	16.4
World Total	13092	100.0

- a. The FAO dry bean figures officially cover Phaseolus vulgaris, P. lunatus, P. acutifolius, P. coccineus, Vigna radiata, V. mungo and V. angularis. These last three species are especially important in Asia, where less than 10% of dry beans are estimated to be P. vulgaris. Elsewhere P. vulgaris comprises the great bulk of dry bean production.

SOURCE: FAO Production Yearbook, Vol 35, 1982.

Table 2. Bean production in Sub-Saharan Africa,
1962-64, 1969-71, 1979-81 averages. ('000 tons)

	<u>1962-64</u>	<u>1969-71</u>	<u>1979-81</u>
<u>Eastern Africa</u>			
Ethiopia	62	74	15
Kenya	a	a	476 ^c
Somalia	0.3	2	8
Tanzania	92	123	150
Uganda	93	155	203
<u>Great Lakes Region</u>			
Burundi	119	190	173
Rwanda	86	145	176
Zaire ^d	a	a	86
<u>Southern Africa</u>			
Angola	60	70	47
Lesotho	2	4	6
Madagascar	48	59	49
Malawi	7	7	61
Rep. South Africa	45	50	68
Swaziland	0.3	1	1
Zimbabwe	21	24	23
<u>West Africa</u>			
Cameroon	48	33	98
Total	684 ^b	934 ^b	1640

a. Data not available

b. Not including Kenya and Zaire

c. Estimate for 1974-75. See Njungunah *et.al.*, 1980.

d. Zaire's bean production occurs in Kivu province in the Great Lakes Region.

SOURCE : Fao Production Yearbooks

Table 3. Bean Area in Sub-Saharan Africa, 1962-64, 1969-71, 1979-81 ('000 ha)

	<u>1962-64</u>	<u>1969-71</u>	<u>1979-81</u>
<u>Eastern Africa</u>			
Ethiopia	88	95	16
Kenya	a	a	763 ^c
Somalia	2	3	24
Tanzania	214	243	299
Uganda	143	78	249
<u>Great Lakes Region</u>			
Burundi	174	279	259
Rwanda	116	161	216
Zaire	a	a	167
<u>Southern Africa</u>			
Angola	67	120	113
Lesotho	6	15	9
Madagascar	62	65	56
Malawi	13	13	95
Rep. South Africa	87	75	66
Swaziland	2	2	1
Zimbabwe	53	50	40
<u>West Africa</u>			
Cameroon	64	73	154
TOTAL	1091 ^b	1177 ^b	2527

a. Data not available

b. Not including Kenya and Zaire

c. 1974-75 estimate. See Njungunah *et.al.*, 1980.

d. Zaire's bean production occurs in Kivu province in the Great Lake Region.

SOURCE: FAO Production Yearbooks.

Table 4. Alternative Sources for African Bean Production Data.
('000 tons)

Country	Year	FAO Production	National estimates
Kenya	1974-75	a	476
Tanzania	1975-77	144	254
Uganda	1975-77	194	305
Rwanda	1976-78	160	168

a. Data not available.

SOURCE: FAO Production Yearbooks, 1978, 1979; S. K. Njungunah, A.M.M. Ndeqwa, H. A. van Rheenen and D.M. Mukunya, "Bean Production in Kenya," 1980; Bulletin of Food Crop Statistics, Ministry of Agriculture, Tanzania; Rapports Annuels du Ministere de l'Agriculture et de l'Elevage, Rwanda; all cited in Londoño, Gathe and Sanders, Bean Production Trends in Africa, 1966-79.

Table 5. Bean Yields in Sub-Saharan Africa, 1962-64, 1969-71 and 1979-81 averages - (kg/ha).

	<u>1962-1964</u>	<u>1969-1971</u>	<u>1979-1981</u>
<u>Eastern Africa</u>			
Ethiopia	703	777	944
Kenya	a	a	624 ^c
Somalia	171	500	330
Tanzania	427	507	500
Uganda	651	594	816
<u>Great Lakes Region</u>			
Burundi	687	675	668
Rwanda	740	900	815
Zaire ^d	a	a	514
<u>Southern Africa</u>			
Angola	896	579	415
Lesotho	267	239	688
Madagascar	785	852	871
Malawi	560	539	644
Rep. South Africa	525	670	1033
Swaziland	349	373	419
Zimbabwe	398	487	583
<u>West Africa</u>			
Cameroon	701	449	631
TOTAL	627 ^b	794 ^b	648

a. Data not available.

b. Not including Kenya and Zaire

c. 1974-75 estimate. See Njungunah *et.al.*, 1980.

d. Zaire's bean production occurs in Kivu province in the Great Lakes Region.

SOURCE: FAO Production Yearbooks.

Table 6. Growth Rates in Bean, Production, Area and Yields in Selected^a

African Countries, 1962-81, and Projected Population Growth 1980-2000

<u>Country</u>	<u>Population</u>	<u>Production</u>	<u>Area</u>	<u>Yield</u>
<u>Eastern Africa</u>				
Ethiopia	2.8	-9.39	-10.10	-0.47
Tanzania	3.3	3.15	2.48	0.67
Uganda	3.3	4.41	4.53	-0.12
<u>Great Lakes Region</u>				
Burundi	2.5	1.94	2.35	-0.72
Rwanda	3.5	3.82	3.50	0.31
<u>Southern Africa</u>				
Angola	2.7	-0.65	2.00	-2.66
Madagascar	3.1	0.30	-0.39	0.68
Rep. South Africa	2.9	3.22	-1.44	4.62
Zimbabwe	4.3	0.55	-1.35	1.99

a. Countries with obvious discontinuities in data or short series of data have been omitted.

SOURCE : FAO Production Yearbooks; World Development Report.

Table 7. Growth Rates in Bean Production, area and Yields in Selected^a African Countries, 1962-70 and 1970-81.

	1962-70			1970-81		
	<u>Production</u>	<u>Area</u>	<u>Yield</u>	<u>Production</u>	<u>Area</u>	<u>Yield</u>
<u>Eastern Africa</u>						
Ethiopia	2.44	1.02	1.54	-20.21	-21.62	-1.53
Tanzania	4.25	1.24	2.50	1.43	1.61	-0.15
Uganda	7.95	9.62	-1.66	1.39	-0.53	1.92
<u>Great Lakes Region</u>						
Burundi	3.46	6.04	-2.58	-2.43	-2.67	-0.10
Rwanda	7.46	4.98	2.43	3.06	3.59	-0.55
<u>Southern Africa</u>						
Angola	2.20	8.60	-6.57	-4.34	-0.61	-3.76
Madagascar	2.08	0.51	1.50	-1.93	-2.11	2.81
Rep. South Africa	1.93	-2.43	4.29	3.87	-1.22	5.02
Zimbabwe	2.15	-0.45	2.88	-0.87	-2.41	1.55

^a Countries with obvious discontinuities in data or short series of data have been eliminated.

SOURCE : FAO Production Yearbooks.

Table 8. Apparent Per Capita Bean Consumption in Sub-Saharan Africa.
(kg/cap/yr)

<u>Country</u>	<u>1969-71</u>	<u>1979-81</u>
<u>Eastern Africa</u>		
Ethiopia	3.0	0.5
Kenya	a	6.1
Somalia	0.7	1.7
Tanzania	9.3	8.4
Uganda	18.1	15.4
<u>Great Lakes Region</u>		
Burundi	52.8	40.8
Rwanda	40.4	36.7
Zaire	a	3.0
<u>Southern Africa</u>		
Angola	12.3	6.6
Lesotho	3.8	4.5
Madagascar	8.1	5.6
Malawi	1.5	9.9
South Africa	2.5	2.3
Swaziland	2.4	1.8
Zimbabwe	4.8	3.1
<u>West Africa</u>		
Cameroon	5.7 ^b	11.6 ^b
TOTAL	8.6 ^b	7.5 ^b

a. Data not available.

b. Excluding Zaire and Kenya

SOURCE : FAO Production Yearbook; Njungunah et. al.; FAO Food Balance Sheets

Table 9. The Nutritional Role of Beans in Sub-Saharan Africa, 1975-77.

<u>Country</u>	Per Cent of Total Protein from Beans	Percent of Quality Protein from Beans ^a	Rank of Beans Among Protein Sources	Rank of Beans Among Quality Proteins ^a	Per Cent of Calories from Beans
<u>Eastern Africa</u>					
Ethiopia	0.5	1.4	15	11	0.3
Kenya	18.0	37.0	2	1	8.4
Somalia	0.8	1.4	8	6	3.0
Tanzania	8.5	20.7	4	1	3.1
Uganda	16.5	36.3	1	1	6.8
<u>Great Lakes Region</u>					
Burundi	33.8	68.1	1	1	13.9
Rwanda	33.6	65.7	1	1	13.5
Zaire	5.5	19.6	7	1	1.3
<u>Southern Africa</u>					
Angola	11.2	32.7	4	1	3.6
Lesotho	1.1	4.8	7	5	0.5
Madagascar	4.5	16.9	5	2	1.6
Malawi	6.0	22.0	3	1	2.9
Rep. South Africa	1.7	5.6	7	6	0.7
Swaziland	2.1	5.1	7	4	0.8
Zimbabwe	2.6	9.5	8	2	1.1
<u>West Africa</u>					
Cameroon	8.0	31.2	3	1	3.0

^a Quality protein is defined as protein from meat, fish, dairy, pulses, and eggs.

SOURCE: FAO Food Balance Sheets, 1980. Kenyan data adjusted by Njunganah *et.al.*, 1980.

Table 10. Population, bean production, yield and cultivated area per county in Rwanda in 1978

County	Area (ha)	Yield (kg/ha)	Production (t)	Population*
Kigali	26,986	800	21,589	698,063
Gitarama	21,949	700	15,364	602,752
Butare	25,416	720	18,300	601,165
Gikongoro	18,501	720	13,321	369,891
Cyangugu	19,700	880	17,478	331,300
Kibuye	15,111	800	12,089	337,729
Gisenyi	20,763	820	17,026	468,786
Ruhengeri	23,296	800	18,642	528,649
Byumba	22,675	800	18,140	519,968
Kibungo	20,542	890	18,282	360,934
Total and averages	214,939	721	170,231	4,819,237

*General population and housing census for 1978.

Source: Nyabyenda et.al.

Table 11 . Sources of Dietary Protein in Rwandan Diets.
Per Cent by Food.

	<u>Butare</u>	<u>Ruhengari</u>	<u>Kibungo</u>
Sweet potatoes	32.1	1.1	17.9
Beans	54.6	30.6	45.6
Potatoes	1.1	4.7	3.3
Peas	3.8	14.3	2.3
Maize	1.2	41.5	12.5
Sorghum	2.0	0.5	0.8
Yams	0.7	0	0.04
Greens	1.1	3.0	0.8
Milk	1.4	2.7	2.9
Meat	1.5	1.6	3.1
Bananas	0.5	0	10.8

Source: Calculated from data in Vis et al., 1975.

Table 12. Cropping Pattern in Central Plateau of Rwanda.

Average land use of 90 Farms, 1970-72.

	First Rains (%)	Second Rains (%)
Bean noncultivate	17.9	.06
Bean/Maize	9.3	.06
Cassava/beans	1.5	0.3
Cassava/beans/maize	1.0	0.2
Bananas/beans	7.7	0.8
Banana/beans/maize	2.5	0.6
Banana/sorghum/beans	0	0.4
Sorghum/beans	0	4.9
Peanuts	1.1	1.0
Potatoes	0.7	0.5
Sweetpotatoes	4.8	6.7
Cassava monoculture	8.1	7.3
Sorghum monoculture	0	31.3
Banana monoculture	14.1	9.4
Banana/sorghum	0	10.4
Coffee	20.7	17.5
Other crops	10.6	8.6

Source: Dalepierre

Table 13. Phaseolus bean production in Tanzania from 1963 to 1977.

Regions	BEAN PRODUCTION (T)	
	1963-64	1976-77
Arusha	12196	64431
Kigoma	20123	35086
Kilimanjaro	6870	1800
Mbeya	17176	27000
Morogoro	8333	5323
Mwanza	101	18313
Rukwa	-	23217
Ruvuma	606	15000
Tanga	12250	61350
West Lake	10163	27000
Others	4778	8425
Tanzania	92596	286945

Source: Karet et al.

Table 14. Estimated areas under grain legumes by province in the 1974-75 crop year.

Province	Area (000 ha)					Total
	Beans	Pigeon peas	Cowpeas	Field peas	Other	
Eastern	284.6	104.5	208.4	2.8	30.2	630.5
Central	232.4	4.2	7.8	13.6	0.0	258.0
Western	148.4	0.0	13.2	0.4	1.4	163.4
Nyanza	73.6	0.0	2.9	0.0	1.7	78.2
Coast	17.5	6.5	38.9	9.1	4.1	67.1
Rift Valley	7.0	0.0	0.0	0.0	0.0	7.0
Total	763.5	115.2	271.2	25.9	37.4	1204.2

Source : Thairu, 1979

Table 15. Role of Bean Production in land use Small farms Eastern Province Kenya 1979. Per cent of total farm area by bean Production system.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
EMBU(41) ^a	16.7	8.30	8.4	8.4
EMBU(42)	33.3	6.70	26.6	6.7
EMBU(43)	5.9	17.60	11.8	0
MERU(44)	20.0	10.0	10.0	10.0
MERU(45)	18.5	7.4	14.8	7.4
MERU(46)	18.2	9.1	27.0	0
MACHAKOS (47)	20.0	6.7	20.0	6.7
MACHACKOS(48)	46.2	7.7	46.1	15.4
KITUI (49)	16.7	5.5	16.7	5.5
KIUTI (50)	5.9	0	11.8	0

Source : Farm management handbook of Kenya 1983.

^a Area as defined in source.

Table 16. Role of bean production in land use Medium farms eastern province Kenya 1979. Percent of total farm area by bean Production System.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
EMBU(41) ^a	20.0	0	0	0
EMBU(42)	15.4	3.8	15.4	7.7
EMBU(43)	11.1	11.1	11.1	0
MERU(44)	16.7	0	5.6	0
MERU(45)	5.2	12.0	3.5	10.3
MERU(46)	15.8	0	5.3	5.3
MACHAKOS(47)	27.0	0	27.0	0
MACHAKOS(48)	10.8	5.4	13.5	8.1
KUTUI(49)	5.9	14.7	5.9	14.7
KITUI(50)	5.3	2.6	2.6	7.9

Source : Farm management Handbook of Kenya 1983

^a As defined in source

Table 17. Role of Bean Production in land use. Large farms Eastern Province Kenya 1979. Per cent of total farm area by Bean Production System.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
EMBU(41) ^a	26.7	4.4	13.3	0
EMBU(42)	1.7	6.6	1.7	11.6
EMBU(43)	3.8	7.5	7.6	0
MERU(44)	8.1	2.7	2.7	0
MERU(45)	2.3	4.7	2.3	4.7
MERU(46)	10.0	2.5	10.0	2.5
MACHAKOS(47)	2.0	1.9	1.9	1.0
MACHAKOS(48)	1.9	6.7	1.9	6.7
KITUI(49)	7.1	11.2	7.5	9.7
KITUI(50)	3.2	4.3	2.2	5.3

Source : Farm management Handbook of Kenya 1983

a As defined in source

Table 18. Role of Bean Production in land use Small farms Central Province Kenya 1979. Per cent of total farm area by Bean Production System.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
KIAMBU(29) ^a	14.3	7.10	7.2	7.2
KIAMBU(30)	11.1	11.1	11.1	0
KIAMBU(31)	5.3	0	5.3	0
MURANG'A(32)	23.1	0	23.1	0
MURANG'A(33)	30.0	0	20.0	0
MURANG'A(34)	41.7	0	2.50	8.3
NYERI(35)	25.0	0	8.3	0
NYERI(36)	18.2	0	18.2	0
NYERI(37)	27.3	0	9.1	18.2
KIRINYAGA(38)	25.0	0	25.0	0
KIRINYAGA(39)	41.7	0	16.7	16.7
KIRINYAGA(40)	33.3	5.6	38.9	5.5

Source :Farm management handbook of Kenya. 1983

^a As defined in source.

Table 19 Role of Bean Production in land use Medium farms Central.
Province Kenya 1979. Per cent of total farm area by Bean
Production System.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
KIAMBU(29) ^a	3.6	0	3.6	3.6
KIAMBU(30)	10.0	5.0	5.0	0
KIAMBU(31)	13.5	5.4	8.1	0
MURANG'A(32)	13.3	0	0	0
MURANG'A(33)	16.7	11.1	16.7	11.1
MURANG'A(34)	17.2	0	13.8	0
NYERI(35)	26.9	0	7.7	0
NYERI(36)	21.4	3.6	3.6	17.8
NYERI(37)	15.8	10.5	5.3	5.3
KIRINYAGA(38)	4.6	0	4.6	27.2
KIRINYAGA(39)	34.5	0	17.2	13.8
KIRINYAGA(40)	34.2	0	29.3	4.9

Source: Farm management handbook of Kenya.1983

^a As defined in source

Table 20 Role of Bean Production in land use large farms Central Province
Kenya 1979. Per cent of total farm area by Bean Production
system.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
KIAMBU(29) ^a	5.0	0	0	0
KIAMBU(30)	3.1	0	7.7	0
KIAMBU(31)	10.0	0	26.7	0
MURANG'A(32)	1.3	0	0	0
MURANG'A(33)	11.8	2.9	3.0	8.8
MURANG'A(34)	7.8	0	14.1	0
NYERI(35)	17.7	0	4.8	0
NYERI(36)	9.3	1.6	7.8	0
NYERI(37)	12.9	6.5	5.6	0
KIRINYAGA(38)	2.8	0	2.8	19.4
KIRINYAGA(39)	4.4	0	5.5	0
KIRINYAGA(40)	14.6	5.7	8.1	3.3

Source Management Handbook of Kenya 1983.

^a As defined in source.

Table 21. Role of Bean Production in land use Small farms Western Province Kenya 1979. Per Cent of Total farm area by Bean Production System.

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
BUNGOMA(11) ^a	37.0	0	0	0
BUNGOMA(12)	4.4	0	0	0
KAKAMEGA(13)	35.0	5	0	0
KAKAMEGA(14)	30.0	0	30.0	0

Role of Bean Production in land use Medium farms

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
BUSIA(9)	0	0	1.6	0
BUNGOMA(11)	40.4	0	1.8	0
BUNGOMA(12)	7.6	0	0	0
KAKAMEGA(13)	13.2	0	0	0
KAKAMEGA(14)	26.3	5.3	15.8	0

Role of Bean Production in land use Large farms

	FIRST RAINS		SECOND RAINS	
	Association	Monoculture	Association	Monoculture
BUSIA(9)	0	0	0.7	0
BUNGOMA(11)	15.4	2.5	0	0
BUNGOMA(12)	4.5	0	0	0
KAKAMEGA(13)	16.4	1.4	0	0
KAKAMEGA(14)	21.6	0	5.4	0

Source : Farm Management Handbook of Kenya 1983

Table 22. Input use in maize/bean association. First Rains, Kenya, 1977.

Province/District	Improved Seed (% farms)		Nitrogen (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)	Manure (tons/ha)	Insec- ticides (kg/ha)	Fungi- cides (kg/ha)	Yields (kg/ha)	
	Maize	Beans							Maize	Beans
WESTERN										
Bungoma (11)	95	0	38	26	6	0.08	1	0	3288	525
Bungoma (12)	88	13	0	16	0	0.79	0	0	2527	264
Kakamega (13)	100	5	9	37	0	0.09	1	0	2779	245
Kakamega (14)	87	0	14	51	0	0.06	2	0	2511	493
CENTRAL										
Kiambu (29)	55	9	3	23	0	0	0	0	1318	315
Kiambu (30)	20	20	28	70	0	0	8	0	1310	737
Kiambu (31)	69	6	2	7	0	0	0	0	713	321
Murang'a (33)	81	0	6	38	0	0.58	4	0	2513	682
Murang'a (34)	54	0	0	1	0	0.21	1	0	1194	332
Nyeri (35)	92	0	24	36	0	0.02	5	0	1741	655
Nyeri (36)	100	5	9	28	0	0.01	3	0	1982	376
Nyeri (37)	91	0	1	23	0	0.15	7	0	1496	316
Kirinyaga (38)	89	11	16	20	0	0.06	7	0	1567	505
Kirinyaga (39)	100	0	14	11	0	0.01	5	0	1577	396
Kirinyaga (40)	60	0	6	5	0	0	2	0	1503	512
EASTERN										
Embu (41)	100	0	5	35	0	0.10	9	0	2282	500
Embu (42)	100	0	6	31	0	0	5	0	1824	417
Embu (43)	60	10	0	1	0	0.49	1	0	1286	497
Meru (46)	85	0	0	38	0	0.19	3	0	2242	1000
Machakos (47)	41	0	3	6	0	0.92	2	0	974	454
Machakos (48)	40	0	0	6	0	0.31	1	0	1093	431
Kitui (49)	89	0	0	0	0	2.37	0	0	998	415

SOURCE: Farm Management Handbook of Kenya. 1983.

Table 23. Input use in maize/bean association, Second Rains, Kenya 1977.

Province / District	Improved Seed (% farms)		Nitrogen (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)	Manure (tons/ha)	Insec- ticides (kg/ha)	Fungi- cides (kg/ha)	Yields (kg/ha)	
	Maize	Beans							Maize	Beans
WESTERN										
Kakamega (14)	52	0	6	38	0	0	4	4	2016	411
CENTRAL										
Kiambu (31)	55	18	0	1	0	0	0	0	468	193
Murang'a (32)	86	29	9	11	0	0.07	0	0	1411	180
Murang'a (33)	87	0	8	37	0	2.95	10	10	2148	553
Murang'a (34)	35	0	0	1	0	0	1	1	756	220
Kirinyaga (38)	75	25	13	24	0	0	33	33	1166	568
Kirinyaga (40)	73	0	0	1	0	0.01	2	2	739	318
EASTERN										
Embu (41)	100	13	6	39	0	0	18	24	2726	510
Embu (42)	100	0	5	30	0	0	10	10	2656	383
Meru (44)	72	6	11	18	0	0	4	4	2059	857
Meru (46)	71	0	14	23	0	0.10	6	6	2140	760
Machakos (47)	40	0	3	6	0	0.87	3	3	1052	806

SOURCE: Farm Management Handbook of Kenya. 1983.

Table 24. Input use in bean monoculture, First Rains, Kenya 1977.

Province/District	Improved Seed	Nitrogen (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)	Manure (tons/ha)	Insec- ticides (kg/ha)	Fungi- cides (kg/ha)	Yields
	(% farms)							(kg/ha)
	Beans							Beans
WESTERN								
Bungoma (12)	0	0	0	0	0	0	0	706
CENTRAL								
Kiambu (30)	33	41	106	0	0	0	0	1290
Kiambu (31)	0	0	1	0	0	0	0	421
Nyeri (36)	0	17	46	0	0	3	0	909
Kirinyaga (40)	13	3	3	0	0	0	0	896
EASTERN								
Embu (43)	31	0	0	0	0.06	0	0	994
Meru (44)	0	0	0	0	0	0	0	777
Meru (45)	14	0	0	0	0.02	2	0	1487
Meru (46)	20	0	0	0	0	0	0	2124
Machakos (47)	0	6	0	0	0.98	0	0	915
Machakos (48)	0	0	3	0	0.21	0	0	708
Kitui (49)	0	0	0	0	0.25	0	0	656
Kitui (50)	0	0	0	0	0	1	0	661

SOURCE: Farm Management Handbook of Kenya. 1983..

Table 25. Input use in bean monoculture, Second Rains. Kenya 1977.

Province / District	Improved Seed	Nitrogen (kg/ha)	P ₂ O ₅ (kg/ha)	K ₂ O (kg/ha)	Manure (tons/ha)	Insec- ticides (kg/ha)	Fungi- cides (kg/ha)	Yields
	(% farms)							(kg/ha)
	Beans							Beans
WESTERN								
Bungoma (11)	0	0	17	0	0	0	0	304
CENTRAL								
Kiambu (30)	25	41	104	0	0	0	0	1031
Murang'a (33)	0	8	3	0	0.43	0	0	802
Murang'a (34)	0	0	36	0	0	0	0	438
Nyeri (35)	0	0	0	0	0	0	0	1049
Nyeri (36)	0	4	12	0	0.10	1	1	691
Nyeri (37)	0	0	0	0	0	0	3	687
Kirinyaga (38)	0	2	2	0	0	0	0	860
Kirinyaga (39)	0	0	0	0	0	0	0	723
Kirinyaga (40)	11	0	0	0	0	5	5	569
EASTERN								
Embu (42)	11	0	12	0	0	1	1	892
Embu (43)	21	0	0	0	0.04	0	0	1383
Meru (45)	14	0	0	0	0.05	5	5	1672
Machakos (47)	0	5	0	0	0.59	0	0	845
Machakos (48)	0	0	9	0	0.18	0	0	765
Kitui (49)	0	0	0	0	0.27	0	0	572
Kitui (50)	0	0	0	0	0.03	2	2	714

SOURCE: Farm Management Handbook of Kenya. 1983.