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AREA UNDER GRAIN LEGUMES CULTIVATION AND PROBLEMS FACED BY SMALLHOLDER FARMERS IN LEGUME PRODUCTION IN THE SEMI-ARID EASTERN KENYA

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ABSTRACT

A structured questionnare was used to collect information on areas under legume cultivation, grain legume yields, and problems faced by farmers in grain legume production at four selected sub-locations in semi-arid Makueni district of eastern Kenya. Results obtained showed that areas under grain legume cultivation ranged from 48% to 92%, increasing with a decrease in cultivated farm sizes while grain legume yields ranged from 30 kg/ha to 416 kg/ha varrying with sub-location. Problems faced by farmers in grain legume production included low soil fertility, inadequate farm inputs, weeds, pests and diseases, and lack of grain legume seeds during planting in the short rains. On average, fertile soils covered less than 10 % of the cultivated area and 67% to 97 of the respondents interviewed said that manure, the main farm input in the study sites, was not adequate. Further, notorious weeds, pests and diseases occurred in all sub-locations and over 90% of households experienced famine and seeds of grain legume during short rain seasons that follows long dry spells. This study indicated that a very high proportion of cultivated land was under grain legume cultivation, soil fertility improvement was necessary in the study sites and grain legume seed deficit was common in the households during planting seasons after long dry spells. It is, therefore, necessary to look for strategies to enhance soil fertility and boost grain legume production in the semi-arid lands of Makueni district in eastern Kenya.

Keywords: Area under grain legume, famine, fertile soils, semi-arid

INTRODUCTION

Grain legumes are valued for their multiple uses as food, green manure, fodder, and cover for crops. Besides these direct benefits, legumes generate cash and grain legumes fetch more cash when sold than cereals, such as maize. In Kenya, many types of grain legumes are grown in various parts of the country. However, common legumes cultivated in the semi-arid eastern Kenya include bean (*Phaseolus vulgaris* L.), pigeon pea (*Cajanus cajan* (L.) Millsp), cowpea (*Vigna unguiculata* (L.) Walp), and green grams (*Vigna radiata* Wilczek).

Bean is the most common legume incorporated in different cropping systems in Kenya (Chui and Nadar, 1984). The main bean production areas in the country are Eastern, Central, Western, and Nyanza Provinces at altitudes varying from 1,500 to 2,500 m above sea level. In addition, the most common bean is grown in Eastern Province, where there are two rainy seasons with a mean of between 500 to 800 mm annually (Masumba, 1984; Stoetzer and Waite, 1984). Like other legumes, beans provide dietary protein and contribute to the maintenance of soil fertility (Chui and Nadar, 1984). In Kenya, the common bean accounts for 10% of the proteins consumed in the country (CIAT, 1986).

Pigeon pea is a multipurpose grain legume extensively used for food, animal feed, and green manure for soil amelioration (Khan, 1973; Yeboah *et al.*, 2004) and grows well in areas with less than 1,000 mm of annual rainfall (Okoko *et al*., 2002). Eastern, Coast, and Central provinces are the major pigeon pea growing areas of Kenya. The Eastern Province leads in hectarage and about 90% of the total area under pigeon pea is in the province.

Green gram (mung bean) is an important crop in the warm dry parts of eastern Kenya where it is grown for both subsistence and as a cash crop (Shakoor *et al*, 1984). Dry grain is used for food, although the Asian community, the largest consumer of the crop, cooks it as split grains (Dhai). The grain protein content of green gram varies from 21-29% depending on the variety and environment where the crop has been grown. Mung bean is generally free from flatulence, inducing factors that are common in many grain legumes. Mung bean is pan-tropical and is able to grow in adverse conditions. It can escape drought through its early maturing ability (Rowe, 1980) and some varieties are perhaps more resistant to drought than cowpea (Waite *et al*., 1984).

Cowpea is an annual or bi-annual grain legume commonly referred to as cowpeas. In Kenya, it is the third most important grain legume, after beans and pigeon pea, and covers about 18,000 ha, excluding the cowpea grown in home gardens (Muthamia and Kanampiu, 1996). About 85% of the total area under cowpea is in arid and semi-arid lands (ASALs) of Eastern Province and 15% in the Coast, Western, and Central Provinces (Muli and Saha, 2000; Muthamia and Kanampiu, 1996).

Cowpea is used for food, fodder, and as a source of income. Leaves, young pods, and grain are the parts of the plant used for food. The same plant parts are sold to generate cash for farmers. Mean crude protein for leaves, grains, and crop residues are 32-34%, 23-35%, and 11-12%, respectively (Imungi and Porter, 1983). Cowpea has the ability to tolerate drought and fix atmospheric N, which allows it to grow and improve poor soils. It has a well-developed deep root system and grows well under drought conditions (Shakoor *et al*, 1984; Muruli *et al*., 1980).

Legume production in the drylands of Kenya is very low partly because soils are commonly nutrient deficient, especially of nitrogen (N) and phosphorus (P). This is largely due to continuous cropping without external inputs (McCown *et al.*, 1992). However, many farmers use manure because they are aware of its benefits, but the quanties avilable are insufficient and of poor quality (Probert *et al*., 1995). As a result, crop yields are low and yields of grain legumes rarely exceed 500 kg/ha (Mathuva *et al,* 1996). Therefore, the main objective of the survey was to establish the area under grain legume cultivation, grain legume yields, and problems faced by farmers in grain legume production.

Site Selection and Methodology

On-farm surveys were carried out in four sub-locations covering two divisions of the dryland Makueni district in eastern Kenya. The sub-locations included Yikivumbu, Ndunguni, Kavuthu, and Matiku. The process involved single random visits to households; a total of 119 farmers were interviewed.

Data Statistical Analysis

The collected data was analysed using SPSS for windows Release 10.0 of 1999. The analysis was done by sub-location to allow for comparison of site differences.

RESULTS AND DISCUSSION

Characteristics of Household Heads in the Selected Study Sites

Gender distribution across the study sites where surveys were carried out was documented (Table 1).

Table 1: Gender Proportions (%) of Respondents in the Study Sites

Gender	Yikivumbu	Ndunguni	Kavuthu	Matiku
Female	53.1	60.9	19.1	25.6
Male	46.9	39.1	81.0	74.4
Total	100.0	100.0	100.0	100.0

Although interviews were carried on random visits to households, generally more males than females were interviewed in the selected sites. However, notably higher proportions of males were interviewed at Kavuthu (81%) and Matiku (74%) sub-locations compared to Yikivumbu (46.9%) and Ndunguni (39.1%) sub-locations. It was observed that at Yikivumbu and Ndunguni sub-locations, where livestock keeping was common, most men were out herding livestock during day time when surveys were conducted.

A majority of the respondents (between 43% and 70%) had primary education only (Table 2). Respondents cited poverty and lack of post-primary education institutes in the study sites as the main factors that resulted to low post-primary education in the study sites. For example, it was observed that there was no post-primary education institute at Yikivumbu sub-location. Nyangito (1986) reported that agricultural production and adoption of new technologies in agriculture were positively related to education level of the farmers. Respondent age-group distribution varied across selected sub-locations (Table 3).

Table 2: Level of Formal Education of Respondents (%) in Selected Sites

Education level	Yikivumbu	Ndunguni	Kavuthu	Matiku
None	15.6	4	19	12
Primary	65.6	70	43	58
Secondary	15.6	26	38	30
Degree	3.2	0.0	0.0	0.0

Table 3: Age Group (%) of the Respondents in the Study Sites

Age-group (years)	Yikivumbu	Ndunguni	Kavuthu	Matiku
< 20	3.1	4.3	0.0	0.0
21-30	28.1	17.4	4.8	23.3
31-40	15.6	30.4	4.8	16.3
41-50	9.4	21.7	19	20.9
51-60	37.5	17.4	33.3	23.3
> 60	6.3	8.7	38.1	16.3

For example, there were more respondents with less than 50 years at Yikivumbu, Ndunguni, and Matiku that could provide farm labour. However, at Kavuthu most respondents were above 51 years. This was partly because the sub-location was located near Nairobi-Mombasa highway and youth from the sub-location were either employed or engaged in small businesses near the highway. There was also sand harvesting in a nearby seasonal river (Muoni River) where mainly the youth were engaged in sand harvesting activities.

Area under Grain Legumes and Legume Grain Production

Yikivumbu sub-location had the largest farm sizes followed by Ndunguni, Kavuthu, and finally Matiku sub-locations; the total cultivated farm sizes were in the same order (Table 4). The number of cultivated fields generally increased with decreasing total farm size. In addition, the area under cultivated legumes increased with decreasing farm size and ranged from 48% to 92% (Table 4).

Table 4: Area under Grain Legume Production in Selected Sub-Locations

Description	Yikivumbu	Ndunguni	Kavuthu	Matiku	SED
Number of cultivated fields	1.1	1.4	2.1	2.0	0.3
Total Farm size (ha)	4.9	4.4	2.3	1.5	1.3
Cultivated farm size (ha)	2.5	2.0	1.8	1.2	0.7
Area under legume cultivation (ha)	1.2	1.1	1.5	1.1	0.6
Proportions of the Cultivated area under grain legumes (%)	48	55	83	92	

The increase in land under legume cover was due to increased intercropping of grain legumes with cereals, commonly maize. Intercropping of legume and cereal crops is a common practice of smallholder farmers throughout the tropics (Sakala *et al.*, 2000) and in East Africa maize is commonly intercropped or rotated with grain legumes (Pilbeam *et al.*, 1995).

The main legumes grown in the study sites included common bean, cowpea, green gram, and pigeon pea; with grain yield ranges of 30 to 416 kg/ha (Table 5). Yikivumbu had the highest yields of cowpea and green gram of 239 kg/ha and 416 kg/ha, respectively. In addition, the highest amounts of common bean and pigeon pea of 250 kg/ha and 189 kg/ha, respectively, were recorded at Ndunguni.

Table 5: Average Legume Yields (kg/ha) in the Selected Sub-Locations

Grain legume	Kavuthu	Matiku	Ndunguni	Yikivumbu	SED
Bean	42	91	250	63	29
Pigeon pea	81	178	189	187	35
Cowpea	107	130	102	239	42
Green grams	30	60	178	416	88

Sites with relatively larger cultivated areas, Yikivumbu and Ndunguni sub-locations, had relatively higher grain yields, probably indicating that farm size in the study sites was more important than the area under legume cultivation. Legume yields ranged from 30 to 416 kg/ha, which was below the potential grain legume yields documented by Kenya Agricultural Research Institute (KARI). According to KARI, the potential grain yield of common bean lies between 1,350-1,980 kg/ha, that of pigeon pea between 1,200-2,500 kg/ha, green gram from 1,000-1,500 kg/ha, and that of cowpea between 1,200-1,800 kg/ha (Audi *et al*., 1996).

Problems Faced by Farmers in Grain Legume Production

Common problems faced by farmers in grain legume production were identified as (1) low soil fertility, (2) inadequate farm inputs, (3) noxious weeds, (4) pests and diseases, and (5) lack of seeds during planting times. Soil fertility was rated as fertile, moderate or poor (Table 6). Most of the farms in the study sites had moderate soil fertility status, with the exception of Kavuthu. Fertile soils in other sites covered less than 10% of the cultivated area. In addition, Kavuthu and Matiku had the highest percentage of farms with poor soils that covered about 24% and 23%, respectively.

Table 6: Soil Fertility Status (%) of Farms in the Selected Sites of Makueni District

Soil fertility status	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Fertile	0	22	5	7	8.5
Moderate	100	70	71	70	77.7
Poor	0	9	24	23	14

The respondents said that higher proportions of poor soils at Kavuthu (24%) and Ndunguni (23%) relative to the other sites were caused by continuous cropping without farm inputs, overgrazing between seasons, and runoff after long dry spells.

Animal manure was the main farm input used by farmers in the study sites. However, most respondents, 98%, 91%, 67%, and 86% at Yikivumbu, Ndunguni, Kavuthu, and Matiku sub-locations, respectively, said the amounts of animal manure available in households were not adequate (Table 7). There were seven main noxious weeds recorded in the study sites (Table 8).

Table 7: Adequacy of Farmyard Manure (%) in Households

Manure is adequate	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
No	87.5	91.3	66.7	86.0	83
Yes	12.5	8.7	33.3	14.0	17

Table 8: Noxious Weeds (%) Found in the Selected Sites of Makueni District

Weed	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Digitaria scalarum	9	52	62	40	41
Cynodon dacylon	28	74	62	49	53
Trichodesma zeylanicum	97	96	91	81	91
Bidens pilosa (L.)	41	83	91	72	72
Cyperus rotundus (L)	78	96	67	61	76
Launaea cornuta	100	96	81	61	85
Acanthospernum hispidum	100	96	91	81	92

Grass and non-grass weed types were recorded. Non-grass weeds included *Trichodesma zeylanicum* (Burm.f.) R. Br., *Acanthospernum hispidum* (DC), black jack (*Bidens pilosa* (L.) and *Launaea cornuta* (Oliv. & Hiern)) O. Jeffre, while grass weeds included couch grass (*Digitaria scalarum* (Schweinf.)) Chiov., star grass (*Cynodon dactylon* (L.) Pers. and *Cyperus rotundus* (L.)). The seven weed types were very difficult to control. For example, *Digitaria scalarum* and *Cyperus rotundus* have underground rhizomes that continually multiply underground. *Bidens pilosa* and *Launaea cornuta* germinate at the same time with crops, grow very fast, and can choke crops; as a result, weeding has be done within the first two weeks after crop germination. *Trichodesma zeylanicum and Acanthospernum hispidum* germinate after the first weeding in very large numbers, forcing farmers to do two more weedings to ensure good legume yields. Farmers used hand hoes, ox-ploughs, and burning to control weeds. However, culturally farmers controlled *Digitaria scalarum* by planting pumpkin (*Cucurbita maxima* Duchesne) that chocks it.

All sites experienced grain legume pest and disease infestation at varying levels. For example, monkeys were most common in Ndunguni (39%), while squirrels and birds were very common in Yikivumbu and Ndunguni (Table 9). According to farmers, occurrences of field pests were commonly influenced by the presence of weeds within the farms and nature of vegetation growing near the farms. For example, Ndunguni sub-location bordered an unsettled and forested Nguu scheme that harbored monkeys. In addition, storage pests were common where farmers failed to dust harvested legume grains with pesticides before storage. Further, it was noted that diseases were rampant where crop rotation was not practiced.

Table 9: Farmers (%) that Reported Pests and Diseases

Pest or disease	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Monkeys	6	39	6	9	15
Squirrels	100	100	95	97	98
Birds	100	100	86	72	90
Aphids	97	74	86	84	85
White flies	97	74	95	61	82
Weevils	100	78	86	88	88
Leaf rust	88	74	91	81	84
Powdery mildew	100	74	100	100	94

About 96% of the households in the selected sites experienced food shortage during long dry spells (Table 10). This shortage resulted to grain legume seed deficit for planting during the subsequent rain season. This had a significant effect in grain legume production in the study sites because the long dry spells precedes the short rain season, which is the most reliable crop production season in the drylands of eastern Kenya (Nadar, 1984).

Table 10: Grain Legume Shortage (%) due to Long Dry Spells

Grain legume shortage	Yikivumbu	Ndunguni	Kavuthu	Matiku	Means
Yes	100	91.3	95.2	95.3	95.5
No	0	8.7	4.8	4.7	4.6

CONCLUSIONS AND RECOMMENDATIONS

Results from this study revealed that legume production in the semi-arid Makueni district was far lower than the potential yields and that farm size was more important than area under grain legume production. There is, therefore, need to increase legume grain yields in the study sites either through introduction of drought resistant, early maturing, or high yielding legume varieties. There is also need to improve soil fertility through interventions, such use of integrated soil fertility management (ISFM).

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