ASSESSMENT OF FARMERS' PREFERENCES AND CONSTRAINTS TO MAIZE PRODUCTION IN MOIST MIDALTITUDE ZONE OF WESTERN KENYA*

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ABSTRACT

Maize is a staple food for most households in Kenya and is grown in almost all agro-ecological zones. In the moist mid-altitude zone of western Kenya, which is drought prone and *Striga* weed infested, on-farm maize yield is too low to keep up with the rate of population growth, leading to serious food insecurity and poverty. The low yield is associated with low adoption of productivity improving technologies such as improved seed, which many farmers believe is inappropriate. The objectives of this study were to determine maize varieties farmers grow, farmers' preferences in choice of the varieties and to evaluate farmers' perceptions of constraints to maize production, on which basis research strategies for improvement of maize production could be formulated. The study, which was conducted in 5 villages sampled from 3 Districts, involved 8 focus group discussions composed of 83 male and 60 female farmers and interviews of individual key informants using a checklist. Scoring and ranking techniques were used to assess farmers' preferences and constraints. Nearly 80% of the farmers predominantly grow local maize varieties, whose seed they recycle for many seasons, whilst about 20% grow improved varieties, often in addition to the local varieties. The key farmers' criteria for variety selection, in order of importance, are high yield, early maturity, tolerance to stresses especially *Striga*, drought and insect pests, low costs of acquiring seed, and ability of a variety to give reasonable yield without application of external inputs, especially fertilizers and pesticides. The main constraints to maize production are low soil fertility, poor cash flows, market failures and pests. *Striga* is considered the most important pest, followed by weevils and stem borer. For increased maize production, research scientists should take into consideration the farmers' circumstances and develop appropriate maize varieties and crop management packages in order to increase likelihood of the technology adoption. This study shows how an interdisciplinary team of KARI and CIMMYT scientists involved farmers not only as end-users of maize technologies, but also as

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essential contributors to formulation maize breeding research agenda that address the farmers' preferences and conditions.

Key words: Adoption, constraints, farmer preferences, participatory, maize varieties, *Striga*

INTRODUCTION

The national food security in Kenya is often pegged to availability of adequate supplies of maize to meet domestic demands. Maize is a staple food for most households in Kenya and is grown in almost all agro-ecological zones, including marginal areas, on both large and small-scale farms. Smallholder producers account for over 70% of the total production and above 80% of the total maize area. However, large-scale farmers contribute a significant proportion of marketed maize (Karanja, 1993). Under farmers' conditions, the national average maize yield is about 2 tons/ha, while potential exists for increasing the yield to over 6 tons/ha through increased use of improved seeds, fertilizers and good crop husbandry (GoK, 1997). Annual per capita maize consumption in Kenya is about 125 kg, which is among the highest in the world. Although most small-scale farmers do not obtain adequate maize production to meet their household needs, they still sell part of the produce to meet other domestic requirements.

In the moist mid-altitude zone of western Kenya, which is drought prone and *Striga* weed infested, maize is an important crop grown by almost all households in at least one cropping season per year. However, on-farm maize yield is too low to keep up with the rate of population growth, leading to serious food insecurity and poverty. Hassan (1998) reported that about 42.6 % of the total maize area in Kenya fall in the moist midaltitude zone. The total maize production in the zone is about 232,000 tons, whilst consumption is approximately 387,000 tons, indicating a deficit of 155,000 tons per year. A recent survey in Siaya District, western Kenya, reveals that maize yield in the area stands at 0.5 - 0.7 tons/ha., while on-farm trials indicate that 1.4 - 1.6 tons/ha can be achieved when improved maize varieties and fertilizers are applied. The low maize yield is associated with low adoption of productivity improving technologies such as improved seed, which many farmers believe is inappropriate and low or non application of fertilizers (Hassan, 1998; Achieng et.al, 1999; *pers comm*, 2000). Farmers' low adoption of technologies developed by research institutions show the need for client-orientation in research and development (KARI/ISNAR, 1996)

Stem borer and *Striga* are the two major biotic constraints to increased cereal production Kenya. Farmers in Kenya estimate crop losses due to stem borer at 15% of their ultimate harvest, amounting to 400, 000 tons of maize valued at US $ 90 million, whilst *Striga* infestation causes 30-100% loss in maize yield in eastern Africa (Hassan, 1998). Reducing the losses caused by stem borer and *Striga* could increase maize productivity in western Kenya and significantly contribute towards national food security and poverty alleviation.

To address maize yield loss due to stem borer, the Insect Resistant Maize for Africa (IRMA) project was launched in 1999 by the International Maize and Wheat Improvement Center (CIMMYT) and the Kenya Agricultural Research Institute (KARI), with financial support from the Novartis Foundation for Sustainable Agriculture. The goal of the project is to increase maize production and food security through development and deployment of insect resistant maize varieties, thereby significantly reducing the crop losses. In order to estimate potential adoption of the new varieties and facilitate overall evaluation of potential benefits of developing the varieties, an assessment of attributes of maize varieties preferred by farmers and socio-economic environment under which the farmers operate is an important starting point.

Farmers are more likely to assess a technology with criteria and objectives, which are different from criteria used by scientists. Complementary contributions of farmers and scientists are essential for effective research and technology development. Farmer evaluations help scientists to design, test and recommend new technologies in light of information about farmers' criteria for usefulness of the innovation (Ashby, 1991; KARI/ISNAR, 1996). In this context, participation is crucial. Participatory research allows incorporation of farmers' indigenous technical knowledge, identification of farmers' criteria and priorities and definition of research agenda. Participatory Rural Appraisal (PRA) tools were applied to capture farmers' perceptions and preferences. Some authors (e.g. KARI/ISNAR, 1996; De Groote and Bellon, 2000) emphasize that PRA, which involves local people in gathering and analyzing information, allows seeking of insights about local people and their actual conditions, and fosters dialogue between scientists and farmers. By integrating farmers' concerns and conditions into agricultural research, it is hoped that research would develop technologies that become widely adopted, resulting in more productive, stable, equitable and sustainable agricultural systems. The objectives of this study were to determine maize varieties farmers grow, farmers' preferences in choice of the varieties and to evaluate farmers' perceptions of constraints to maize production, especially insect pests, in the context of other constraints farmers face. The study forms a basis for formulating research strategies for improvement of maize production.

METHODOLOGY

The study area. The study was conducted in 5 villages from Butere-Mumias and Busia Districts in Western Province and Homa Bay District in Nyanza Province (Table 1). Largest area of the two Provinces is in moist mid-altitude agro-ecological zone (Figure 1), which falls within Striga infested Lower Midland (LM) agro-ecological Zone (Jaetzold and Schimdt, 1983). The zone is sub-divided into LM_1 to LM_4 zones based on altitude, which ranges between 1,100-1,500 metres above sea level. Mean annual temperature is 12-24^oC, while mean minimum temperature is more than 14 ^oC. There are contrasts of rainfall, mainly due to local air circulation. Annual rainfall averages 700-1800mm and is bi-modal. The rainfall amount and pattern are modified by altitude; higher elevation areas receive relatively more rainfall. First rainy season in a year starts in February/March and the second in August/September. At lower elevations, located at the shore of Lake Victoria, the rainfall is less and the second season is less reliable. Most farming activities follow the rainfall pattern. Soils are varied, but are mostly clay-loam and sandy-loam and generally less fertile because there is very little volcanic or other young parent materials. In some areas such as Busia District the soils have laterite horizons (Jaetzold and Schimdt, 1983).

Table 1. Sampled study areas in moist mid-altitude zone of western Kenya

District	Division	Location	Village	Male	Female	Total
Butere-Mumias	Butere	Shianda	Ebubala	17	23	40
Busia	Butula	Lugulu	Bulemia	17	20	37
	Matayos	Bukhayo West	Sirisia	24	3	27
Homa Bay	Ndhiwa	West Kanyamwa	Kayambo	12	10	22
	Rangwe	East Gem	Koyolo	13	4	17
TOTAL				83	60	143

The human population in the mid altitude zone is quite variable. Whilst Butere-Mumias and Busia districts are predominantly occupied by different Luhya sub-tribes, Homa Bay District is dominated by the Luo tribe. According to the recent population census (GoK, 2000), the population of the study Districts is shown in Table 2. Mumias-Butere is the most densely populated and Homa Bay the least. Density is computed based on land area available (GoK, 1997a; 1997b).

TABLE 2. Population and density of the study Districts

DISTRICT	AREA (km^2)	MALES (000)	FEMALES (000)	TOTAL (000)	DENSITY
BUSIA	1262	174	197	371	294
BUTERE-MUMIAS	935	227	251	478	511
HOMA BAY	1156	137	154	291	252

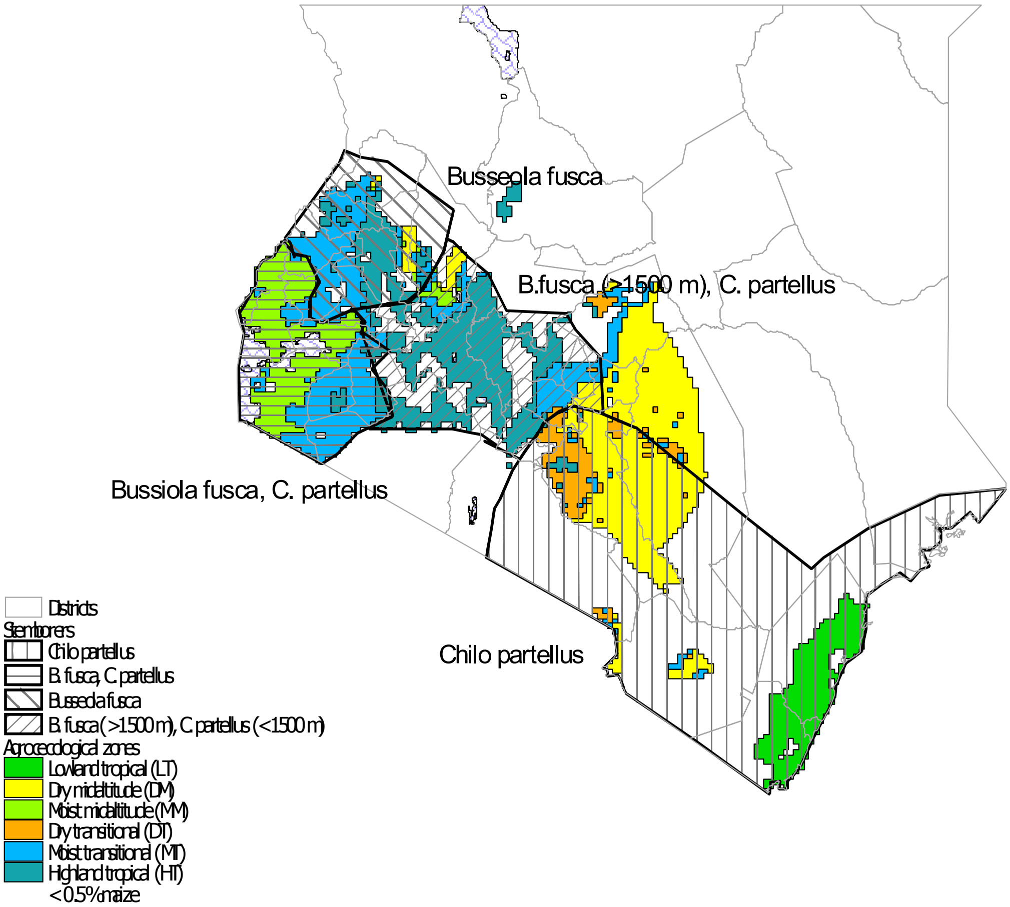
Source: 1999 National Population Census (Central Bureay of Statistics, 2001)

Data sources. Primary and secondary data sources were utilized. The primary data were generated through interview of male and female farmers as well as key informants using Participatory Rural Appraisals (PRA) approaches. Data were collected from 8 focus group discussions composed of 83 male and 60 female farmers (Table 1). The key informants included maize researchers, experienced farmers in the villages, local leaders and agricultural agents. Secondary data were obtained from the Kenya Government establishments and some relevant public as well as private institutions.

Sampling procedures. Multi-stage sampling techniques were applied to select the study sites that represent diverse ecological and socio-economic environment and varying maize production systems in the moist mid-altitude zone. The zone was stratified into three sub-zones to allow capturing of variability in the whole zone and one District purposively selected from each zone. Two Divisions were randomly selected from each District. The major criteria for stratification were relative importance of maize, severity of *Striga*, agroecological zones, ethnicity and presence or absence of sugarcane. It is believed that sugarcane acts as an alternate host for stem borer and thus reduces its incidence. Busia District was selected to represent *Striga* prone area, Butere-Mumias for sugarcane zone where maize is a very important crop and Homa Bay for *Striga*-and drought prone area where maize is a relatively less important crop.

A list of all Locations in each of the selected Divisions was obtained from respective Divisional agricultural and administrative staff, from which one Location was randomly selected and then a list of all Sub-locations obtained, from which 1 or 2 sub-locations were sampled. One village[1] was then randomly selected using lists of villages as the sampling frames.

Major Stemborers in Kenya's Agroecological Zones



Agroecological zones: after Hassan (1998), stemborers after W. Overholt (pers. comm.)

Data collection and analysis. The research team comprising an interdisciplinary team of KARI and CIMMYT researchers and Ministry of Agriculture Extension staff visited the chosen villages, under guidance of frontline agricultural staff. This visit aimed at enabling the research team know the study sites, establish a good rapport with the local people and relevant Government agencies and have a feeling of the study areas. After some discussion, the local administrators and extension staff were asked to mobilize farmers, both male and female for focus group discussion on an agreed date, venue

[1] Kenya is administratively divided into Provinces, Districts, Divisions , Locations, Sub-locations and villages. A village is the smallest administrative unit

and time. Checklists were developed and used to guide discussions with farmer groups and individual key informants. The objectives of the project and contributions of various actors were explained and communication procedures established to ensure that farmers and researchers were at the same wavelength and discussing the same issue.

The farmers were encouraged to use a language they were most familiar with. A member of the research team most versed with the local dialect facilitated the group discussions. For ease of focusing the discussions and reaching a consensus, the farmers were asked to form discussion groups depending on the number of farmers who attended and their composition. Sex and age were the important criteria the farmers used in categorizing themselves into discussion groups. The farmers were asked to list maize varieties they grow, and the relative proportions of the varieties. They were also asked to list and rank the criteria they used in variety selection in terms of their relative importance and main constraints to maize production. The groups were given some flip charts and felt pens to allow them write results of their discussions. In almost all cases, each farmer group appointed a rapporteur. The role of the research team was to guide and facilitate farmers' discussions, whilst the farmers took the lead of the meeting to allow free discussion. At the end of the exercise, whenever time allowed, there was a plenary session whereby each group was given a chance to present its results to the whole group of farmers who had attended the meeting for validation, verification and modification.

RESULTS AND DISCUSSION

Maize varieties grown. Table 3 shows maize varieties grown in the moist mid-altitude zone of western Kenya. Farmers grow an assortment of maize varieties, either on the same or different fields. Farmers grow both local landraces, often referred to as local varieties, and improved varieties to meet their multiple objectives in maize farming.. About 80% of the respondents predominantly grow local varieties, whilst only 20% dominantly grow improved maize varieties. In some instances, same local varieties are known by different names and different varieties known by the same names, depending on the area of reference or language under consideration. The names of the local maize varieties are often descriptive, referring to certain key identifiable characteristics especially grain colour, appearance, growth habit and the perceived place of origin. *Jowi Jamuomo*, for instance, refers to a charging buffalo, in apparent reference to high growth vigour of the variety. The variety is perceived to be able to survive despite the odds of harsh environment, including *Striga*, low soil fertility and drought. *Nyamula* and *Shipindi*, both yellow-grained landraces grown mostly in Nyanza and Western Provinces respectively, are reportedly tolerant to *Striga* and stem borer. The variety *Nyar Maragoli* refers to origin of the variety, which is perceived to be Maragoli area in Vihiga District in Western Province. In the same vein, the variety *Ke-Buganda* is a composite imported from Uganda.

Some varieties are grown in both long and short rain seasons, whilst others are only planted in either of the seasons. In Homa Bay and Butere-Mumias Districts, for example, most households plant *Nyamula* and *Shipindi* in both seasons respectively, while hybrid H622 and PH 1, which are not drought tolerant are only grown in long rain season by a small proportion of farmers as a risk management strategy since the short rain season is more unreliable. In Butere-Mumias, however, *Samaria*, which is white-grained, early maturing and perceived to be drought tolerant, is grown by most households in both long and short rain seasons. Women in Butere-Mumias perceived that all households grow *Samaria* in both seasons. While men confirmed that the variety is grown in both seasons, they are conservative in their figures of the proportion of farmers growing it. But since women are more involved in farming they probably provide the most reliable figures.

TABLE 3*. *Maize varieties grown by site and gender

Names of varieties	% farmers indicating that they grow the variety					
	Butere – Mumias n=40		Busia n=64		Homa Bay n=39	Mean %
	Male	Female	Male	Female		
H511	-	-	-	-	60	-
H512	-	-	-	14	-	-
H513	12	-	64	-	-	38
H614	53	28	-	-	25	35
H622	6	60	36	-	41	36
H632	-	-	25	-	-	-
Imodi	-	-	-	36	-	-
Jowi Jamuomo	-	-	-	-	20	-
Katumani	-	5	10	-	24	13
Ke-Buganda	-	-	93	100	-	97
Maseno double cobber	6	6	-	-	40	17
Nyamula	-	-	-	-	100	-
Nyar Maragoli	-	-	-	-	38	-
Opapari	39	22	-	-	-	-
Pannar	-	-	13	-	-	-
Pioneer 3253	12	10	100	-	-	41
Pwani Hybrid 1(PH 1)	-	-	-	-	40	-
Radier	-	10	-	-	-	-
Samaria	45	100	-	-	-	-
Shipindi/Sipindi	25	100	95	100	-	80

Note: 1) The composition of the number of farmers who attended the meetings per site were; 17 males and 23 females in Butere; 25 males and 14 females in Homa bay; and 41 males and 23 females in Busia.
2) Percentages are computed based on opinions of the number of farmers who attended the meetings and rounded to the nearest tenth..
3) - indicates that the variety was not mentioned
4) Mean % only computed when a variety was listed in at least two sites.

Farmers' choice of varieties. In all the study sites, farmers use many but similar criteria in selecting the maize varieties they grow. The main criteria farmers apply in choosing maize varieties they grow and the extent of contribution of each criterion are shown in Table 4. Farmers' perceptions and rating of the different criteria varied across the study sites. The most important criteria across the sites were high yielding, early maturing, and tolerance to *Striga* and drought. High yielding, early maturing and ability of a variety to perform well under low soil fertility, *Striga* infestation and drought conditions were the main criteria in all sites. Early maturing was considered an important criterion for three main reasons. Early maturing varieties allow farmers to prepare land in order to plant the crop twice a year to fit the bimodal rainfall pattern. Other reasons are that early maturity allows the crop to escape drought and ensures early provision of food to the households to alleviate hunger. In Homa Bay District farmers were divided as to whether drought tolerance or high yield was the most important criteria. However, after some lengthy discussions, they concurred that even if a variety has high potential yield and does not escape or tolerate drought, no yield could be realized, as such drought tolerance was considered the most important criterion. Taste was rated lowly in all sites because the farmers only considered taste as important when they have adequate output, however, most households often obtain less than they require for home consumption. Additionally, taste is considered somewhat important when the variety is grown mainly for farm household consumption. Although taste was mentioned in Ndhiwa and Butere, it was ranked among least important criteria in both sites. Women in Butere ranked taste least important, whilst men did not rank it at all. Resistance to insects and other pests as a criterion for selection of maize varieties was considered useful in practice if the attribute is combined with the most important criteria farmers apply in variety selection, thus adding value to the varieties.

TABLE 4. Scoring of main criteria for maize variety selection

Criteria for Preference	Site Scores			
	Butere-Mumias	Busia	Homa Bay	Mean score
	Score	Score	Score	Score
High yield	3.0	3	3	3.0
Large grain size	-	3	-	3.0
High no. of rows/cob	3.0	-	-	3.0
Tolerant to *Striga*	2.5	2.7	3	2.8
Early maturity	2.5	2.7	3	2.7
Drought tolerant	-	2.3	2.5	2.4
Low cost of seed	-	2.5	2.0	2.3
Tolerant to diseases	2.0	3.0	2.0	2.3
Compact grain/high flour density	2.0	2.5	2.0	2.2
Low external input demand	1.0	3.0	2.0	2.0
Resistant to field insects/ pests	2.0	2.0	2.0	2.0
Low lodging	2.0	-	-	2.0
Resistant to storage pests	1.0	2.0	-	1.5
Taste	1.0	1.3	1.0	1.0
Grain colour	1.0	1.0	1.0	1.0

Notes: 1) Scores: 1= of minor importance, 2= Moderate importance, 3= very important; and 0=criteria not mentioned
2) Mean scores are computed per site and for all sites

In Homa Bay, high yielding, drought and *Striga* tolerance were important factors. The local varieties, *Nyamula* and *Ke-Buganda*, for instance, were preferred to hybrids due to their tolerance to *Striga* and drought, as well as their ability to perform fairly under low soil fertility or no fertiliser application and their low vulnerability to diseases. These attributes of the local varieties are perceived by farmers to lack in most improved varieties. Heavy husks, especially of PH1, was considered an important attribute in Ndhiwa site because it minimizes attack by pests such as birds and stem borer. The low or non-use of improved maize varieties and preference for local varieties is attributed to several factors; most farmers lack resources to pay for improved seed on regular basis. In addition, negative attitude of farmers to the improved commercial maize seed mainly occasioned by previous experiences whereby farmers unknowingly purchased adulterated or fake seeds, which have low germination rates, low yielding and not true-to-type also contribute to low usage. Under these circumstances, farmers resort to planting their own seed which are cheap as seeds are recycled without marked yield loss. For example, most farmers in Homa Bay grow local landraces, especially *Nyamula,* which they recycle for a long time to the extent that they cannot precisely remember when they started. Some farmers also recycle hybrid maize for the same reasons and also due to lack of knowledge. In Homa Bay sites, unlike Butere-Mumias and Busia, farmers recycle both local landraces and hybrids. To recycle, cobs are selected at the time of harvesting and separated from others by not removing husks. The main criteria preferred across the sites are large cobs, the at least 10 lines per cob and free from disease/pest. The belief is that maize seed from larger cobs produce high yield in subsequent generation. The selected cobs are either hang at the fireplace till next planting season or sun-dried, then treated with ash to control weevil infestation. The farmers, however, experienced yield decline, high incidence of diseases and pests, and high crop variability upon recycling hybrid maize. The number of recycling is determined experientially.

Cost of accessing maize seed was also considered an important attribute in choosing the maize varieties. Farmers indicated that they were willing to buy new varieties that are resistant to stem borer if availed as long as the price is equal to current market price of other commercial seed maize and utmost 25% higher. In addition, the farmers' willingness to buy such varieties was contingent to the new varieties having other desired attributes, especially high yielding, early maturing and resistance to *Striga*.

Constraints to maize Production. Table 5 shows the main constraints to maize farming. Prioritization of the constraints was based on number of households affected, severity of the constraint, importance of the constraint in attainment of household objectives, frequency of occurrence of the constraint and the likelihood of a solution being provided by research team. The most important constraints farmers face in maize farming include lack of farm tools, low soil fertility, lack of financial resources to purchase inputs and high prices of the inputs (especially fertilizers and seed, and low technical know-how. Others are pests and diseases, vagaries of weather, unavailability of inputs, lack of access to credit facilities and agricultural extension services, and poor marketing of both inputs and inputs.

The farmers highly ranked poor cash flows as a key constraint because they believed that alleviation of the constraint would lead to alleviation of many other constraints. Although, in some instances, farmers did not explicitly indicate that the cost of seed and low soil fertility are some of the constraints they face, their assertion that they lack cash to buy the inputs, implies existence of the constraints.. Availability of low quality agricultural inputs in the market is the other constraint farmers face. Maize seeds, for instance, are often adulterated or not true to type.

TABLE 5. Farmers' perception and ranking of major constraints to maize farming.

	Scores by site			
Constraints	**Butere-Mumias**	**Busia**	**Homa Bay**	**Mean score**
Inadequate farm tools	4.0	-	3.5	3.8
Low soil fertility	5.0	2.0	5	3.5
Liquidity problems	5.0	4.0	1.0	3.3
Poor extension service	1.0	4.0	1.0	3.0
Labour shortage	3.0	1.0	1.0	2.5
Stemborer	4.0	1.0	-	2.5
Striga weed	1.0	2.3	2.5	1.9
Unreliable rainfall	2.5	2.3	1	1.9
Field Insect pests	2.5	1.0	1.0	1.5
Low quality seed	-	1.0	2.0	1.5
Rats and moles	2.0	1.0	-	1.5
Theft	1.0	1.0	1.0	1.0
Head smut	1.0	1.0	-	1.0
High price of seed	1.0	-	-	-
Maize streak	-	1.0	-	-
Termites	-	1.0	-	-

Note: 1) Each group that ranked the criteria as first (1), received 5 scores; second rank, received 4; third, 3; fourth, 2; and for 5and above, 1 score.
2) Mean scores computed based only on the sites that mentioned a constraint
3) Means not computed unless a pest is listed in at least two sites.

The major maize pests, in decreasing order of importance, are *Striga hermonthica***,** weevils and stem borer . *Striga hermonthica* is considered the most important pest in Homa Bay District and it was ranked first in both Ndhiwa and Rangwe Divisions, and it was a lesser constraint in Butere, where it was ranked fifth. The ranking was mostly based on the incidence and severity of the pest. *Striga* was closely associated with low soil fertility, drought and unavailability of effective control measures. Low soil fertility was linked to continuous cultivation without crop rotation or nutrient replenishment.

Stemborer, called k*undi* in Luo language and *tsingetsa* in Luhya, was considered as either the second or third most important maize pest in all sites. The symptoms of stemborer are not as conspicuously observed by farmers compared to symptoms and effect of *Striga* and this could explains why it is lowly rated. The fact that farmers have exact local names for stemborer proves existence of the pest and farmers' awareness that it affects maize yields.

CONCLUSIONS

This study identifies maize varieties farmers grow, criteria for choice of the varieties and constraints the farmers face in maize farming in the moist midaltitude zone of western Kenya and forms the basis for formulation of farmer-oriented maize research programme. Farmers grow a wide range of improved and local maize varieties, often without application of fertilizers and pesticides. About 80% of the farmers predominantly grow local varieties, whilst only 20% dominantly grow improved maize varieties. In some instances, same local varieties are known by different names and different varieties known by the same names, depending on the area of reference or language under consideration. In most instances farmers grow more than one maize variety to meet their multiple objectives. Different local varieties are known by different names. Conversely same varieties are known by different names, depending on the area under reference or language under consideration. The names of the local maize varieties are often descriptive, referring to certain key identifiable characteristics especially grain colour, appearance, growth habit and the perceived place of origin. Farmers have diverse perceptions and complex combinations of criteria they use in selecting maize varieties. The key criteria include high yields, early maturity, tolerance to *Striga*, drought and insect pests, low costs of acquiring seed maize, and ability of a variety to give reasonable yield without application of external inputs, especially fertilizers and pesticides.

Maize production in the moist mid-altitude zone is constrained by a myriad of related factors, the extent of contribution of the factors vary across the sites. The main constraints are low soil fertility, poor cash flows and pests. The most important pests, in decreasing order of importance, are *Striga*, weevils and stem borer. To cope with cash constraints, farmers recycle the varieties for long period of time, especially the local varieties and do not apply or apply low rates of fertilizers and pesticides in maize fields.

To increase maize production, research should take into consideration the farmers' circumstances and preferences and develop maize varieties and crop management packages meet farmers demands. Incorporation of farmers' preferences in selection of maize varieties in breeding process would increase likelihood of adoption of the varieties. Whereas maize breeding cannot incorporate all the desired attributes, the key attributes should be included in particular varieties and many varieties should be bred focusing the demands of different groups of farmers. Considering that farmers prefer recycling as a strategy for coping with cash flow constraints, effort should be made to breed composites or open pollinated varieties (OPVs) that are resistant to insect pests, as these are likely to be highly adopted by smallholder farmers, especially when the other key criteria they apply in maize variety selection are also incorporated.

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