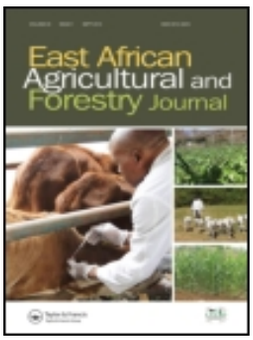

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Socio-economic and Institutional Factors Influencing Uptake of Improved Sorghum Technologies in Embu, Kenya

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ABSTRACT

Farmers' socio-economic status and institutional support play a complementary role in influencing adoption of various improved agricultural value chain technologies. Despite considerable research efforts towards improving sorghum production and commercialisation to improve farmers' socio-economic wellbeing in Kenya, a marginal number of farmers in arid areas are adopting improved technologies. The current study, therefore, evaluated farmers' socio-economic and institutional factors influencing uptake of improved sorghum technologies in Embu County, Kenya. The study systematically selected 129 farmers from four villages. Data was collected on household size, daily expenditure, land ownership, land sizes, sources of capital, the number of farmers growing sorghum, market outlets, institutional services offered to farmers and production challenges. The study revealed that 51% of the households comprised of six to ten members, whereas 76% of the farmers spent on average three thousand Kenyan shillings (US$ 30) on a monthly basis. The study results also showed that 88% of farmers accessed extension services from government agencies, whereas 56% of the farmers accessed credit facility from private microfinance institutions. The study findings also revealed 48% farmers sold sorghum products to private agents, whereas 44% farmers sold their products on local market outlets. It was additionally revealed that 57% of farmers faced challenges in accessing credit services. There was a positive Pearson's correlation ($r = 0.43$) between farmers owning individual land title deeds and the uptake of improved sorghum technologies with individual land ownership motivating farmers to invest in sorghum production. In addition, there was a positive Pearson's correlation ($r = 0.48$) between farmers accessing financial training services and the uptake improved sorghum technologies. The training services significantly ($p \leq 0.01$) influenced the farmers in embracing improved sorghum technologies. The study concluded that farmers' expenditure, land ownership, financial training and credit support were the key socio-economic and institutional factors contributing to farmers' uptake of improved sorghum technologies.

KEYWORDS

agricultural value chain; farmers; improved technologies; institutional factors; institutional support; socio-economic status; sorghum products

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Introduction

It has been documented that communities in arid and semi-arid lands in Kenya are particularly vulnerable to food insecurity, as a result of the recurring natural and emerging socio-economic challenges (Chamberlin et al. 2015). The socio-economic challenges facing Kenyan farmers include land ownership, drought, livestock diseases, animal and crop pests and limited access to appropriate technologies, information et hic resource conflicts, as well as credit and weak institutional support services (Kinyua 2004; Chamberlin et al. 2015). According to Salasya et al. (2006) there is a declining trend of improved sorghum production and the surplus yields for income generation at farm levels, putting farmers in arid areas in food security risk (KIRDI 2011). It has also been documented that sorghum products are nutritiously rich in micronutrients, such as minerals and vitamins and macronutrients, for example carbohydrates, proteins, and fat (Rehima et al. 2013). Moreover, sorghum is rated as the fifth most important cereal in Kenya besides maize, wheat, rice and barley (Rehima et al. 2013), and a second important crop produced for staple food among many households (Salasya et al. 2006). However, low sorghum yields in Kenya are often attributed to farmers growing low yielding sorghum varieties and using inappropriate technologies that give low yield levels of 150 kg $acre^{-1}$ instead of recommended varieties that yielding up to 900 kg $acre^{-1}$ (Mburu 1994).

The institutional players supporting socio-economic service provision to Kenyan farmers include government agencies, private extension advisors, NGOs, universities, farmers' associations, research institutes, banks and corporate entities (Qamar 2005). The research institutions in Kenya for instance, have channeled their economical research efforts towards improved sorghum production, increased yields, improved soil fertility and income generation among farmers (Ecarsam 2007). In response to these constraints, national and international research organizations and institutions have developed and released several high-yielding and stress tolerant varieties and corresponding technologies of sorghum with desirable agronomic and market traits (ICRISAT 2006). The improved sorghum varieties with desirable market and yields values in Kenya include *Gadam, Serena, Seredo*, KARI *Mtama 1*, KARI *Mtama 3* (Ecarsam 2007). According to Mwadalu and Mwangi, (2013) the release of these varieties ought to have been followed by an intensive promotion programme by the government extension agents under the minor crop multiplication programme. However, these efforts in arid areas have been constrained by lack of provision of weak extension services, poor inputs delivery system, and infrastructure. In addition, it has been documented that about half of estimated 42 million people living in Kenya are poor and some 7.5 million people live in extreme poverty, owing to chronic food insecurity, and sorghum could form part of the alternate food crop (GoK 2011).

Related to the study, institutions, such as the East Africa Brewery Limited (EABL), and microfinance have been instrumental in supporting buyers and sellers of sorghum products by contracting farmers and availing market outlets and empowering farmers with value addition, knowledge and skills (KIRDI 2011). It is documented (FAO 1995; Gachimbi et al. 2007) that the growing population in Kenya mainly depend on cereal grains as their main diet and consequently a requirement for a strong institutional support is required to guide farmers and country towards macro economics growth.

Industries in Kenya, for instance, add value to improved sorghum products by manufacturing flour, side dishes, malted and distilled beverages and special foods, such as popped grain (Aleke 2003; Dicko et al. 2006).

Sorghum production has also witnessed declined low processing capacity, low processing efficiency levels, post harvesting handing challenges and inadequate value addition technologies (Laico et al. 2011). The purpose of the study was accordingly to assess the socio-economic and institutional factors influencing the uptake of improved sorghum production and enhancing food security in Mbeere north, Embu county.

Materials and methods

Study site

The study was conducted in arid Mbeere north Sub-County, Embu County, Kenya. The region's topography slopes from North West to South East direction and is located on the East of Mount Kenya between coordinates 0°41'18" N and 37°55' E. The site altitude ranges from 500 m above sea level to about 1 200 m above sea level, making it suitable for sorghum (Matiri et al. 1999). The temperature ranges from 15 °C to 30 °C, with a mean temperature of 23 °C. The soils suitable for sorghum production in the region fluctuating between sandy, blackish gray and reddish brown (Matiri et al. 1999). Mbeere North Sub-County has a bimodal pattern of rainfall with the long rains falling between March and June, whereas short rains are experienced from October to December. However, the rainfall is not very reliable and it ranges between 500 mm and 1 100 mm per year, with a mean of 800 mm per year. In addition the Mbeere region has a population of approximately 516 212 inhabitants and the average farm size of 2.5 hectares (Gachimbi et al. 2007).

Sampling

The study employed a descriptive survey design suitable for describing information, data, events, perceptions and issues (Mugenda and Mugenda 2003). The study targeted a population of 2 047 farmers documented by the Ministry of Agriculture (MoA 2010). Multistage sampling technique was employed by dividing Sub-County into four village strata namely, Njura, Kangai, Njarange and Kiambungu villages of Embu County. Using the improved Kothari (2010) formulae and procedure (Equation 1), a sample size of 129 farmers was selected (Equation 2). The farmers to be interviewed were systematically selected by dividing 2 047 farmers by the sample size of 129; consequently yielding a Constant of 16. Using previously pretested questionnaires with open-ended and closed questions, every 16th farmer was selected, from the sampling frame obtained from the Ministry of Agriculture, and interviewed (Equation 3).

$$n = \frac{Z^2.P.q.N}{e^{2(N-1)} + Z^2.P.q} \quad (1)$$

Where:

n = sample size,

Z = standard variate at a given confidence level,
P = sample proportion of successes,
q = 1–P,
N = Size of population,
e = acceptable error (precision)
Hence, the most conservative number of farmers to be interviewed was:

$$129.12\ (n)\ = \frac{1.96^2(0.5)(0.5).(2\ 047)}{0.05^{2(2047-1)} + 1.96^2.(0.5)(0.5)} \tag{2}$$

$$\mathrm{K}\ = N/n = 2\ 047/129 = 15.87 \text{approximate every 16th farmer} \tag{3}$$

Where:
K = sampling interval
N = estimate of the population of smallholder farmers
n = desired sample

Primary data was gathered using pretested questionnaires. Besides this, secondary data was gathered on improved sorghum uptake rates, land ownership, land size, sources of capital, pest and disease control, market outlets, distance to the market, markets, postharvest practices, institutional support services and sorghum varieties.

Further information was obtained from the farmers' records, annual County agriculture reports, statistical abstracts, periodicals, journals, economic reviews and market reports. Furthermore, secondary data were collected from private organisations, such as the Cooperative League of United States of America (CLUSA) and the European Cooperative for Rural Development (EUCORD).

Data analysis

Data were analysed using Statistical Package for Social Sciences (SPSS version 20) to generate frequencies and percentages. Pearson's correlation tests were performed to determine the degree of relationship and significant differences between variables.

Results

Farmers' socio-economic characteristics

The study findings showed that 51% of a household comprised of six to ten members engaged in sorghum production activities (Table 1). In addition, 76% of the farmers spent on average three thousand Kenyan shillings (US$ 30) on monthly basis while 17% of farmers spent on average five thousand Kenya shillings (US$ 50) per month (Table 1).

Land ownership and size under sorghum production

The results also indicated 68% of the farmers were growing sorghum on approximately a half acre of land (Table 2). Furthermore, 70% of farmers were growing improved sorghum on individual owned pieces of land whereas 15% of growing sorghum on leased land and 14% were growing sorghum on ancestral land (Table 2).

Table 1. Respondents' household size and monthly expenditure.

Variables	Farmers' characteristics	Percentage %
Household size	1–5	45
(members)	6–10	51
	11–20	04
Average monthly expenditure (KES)	3 000	76
	5 000	17
	8 000	07
Total		100

$n = 129$

The relationship between socio-economic factors and uptake of sorghum technologies

There was also a positive Pearson's correlation ($r = 0.43$) between farmers owning individual land title deeds and the uptake of improved sorghum technologies with individual land ownership acting as a motivating factor for the farmers to invest in sorghum production. Besides, a positive Pearson's correlation ($r = 0.21$) between the size of land under sorghum and the uptake of improved sorghum technologies with land size under production significantly ($p \leq 0.02$) influencing farmers uptake improved sorghum technologies (Table 3).

Institutional support services to farmers

The study results showed that 88% of farmers belonged to organised groups and who were able to access support services. Furthermore, 78% of the farmers accessed financial support from non-governmental organisations, such as the European Cooperative for Rural Development (EUCORD) and the Cooperative League of United States of America (CLUSA). Also, 56% of the farmers accessed a subsidy and marketing services support from government extension agents, whereas 32% of the farmers accessed group marketing support skills from East Africa Brewery Ltd agents (EABL) on the improved sorghum varieties products (Table 4).

Additionally, the analyses indicated a positive Pearson's correlation ($r = 0.23$) between farmers belonging to groups and uptake of sorghum technologies with training and group networking support services motivating farmers to invest in sorghum production (Table 4). There was also a positive Pearson's correlation ($r = 0.48$) between farmers accessing non-governmental organisation support on uptake of technologies influencing farmers positive decision making towards uptake of improved sorghum technologies. The

Table 2. Farmers land ownership and size under sorghum production.

Farmers' land ownership and size under production	Number of farmers	Percentage %
Land ownership		
Individual/private	90	70
Leased	19	15
Ancestral/communal	20	15
Land size		
Less than 1/2 acre	88	28
Less than 1/4 acre	36	68
Less than 1/8 acre	05	04

$n = 129$

Table 3. The relationship between socio-economic factors and uptake of sorghum technologies.

	Uptake of improved sorghum technologies	
	Pearson's correlation	
Socio-economic factors	*r*	*p*
Individual land ownership	0.430	0.00***
Land size	0.211	0.02**
Monthly expenditure	0.009	0.92
Inputs access	0.004	0.96
Pest and disease control	–0.003	0.97
Access to sales outlets	0.067	0.07

relationship significantly ($p \leq 0.01$) influenced the majority of the farmers taking up improved sorghum technologies (Table 4).

In addition, the study findings also indicated that 97% of farmers processed harvested products by threshing, winnowing and packing sorghum products before selling (Table 5). Moreover, the study findings showed 48% farmers sold sorghum products to East Africa Brewery Limited agents and 44% farmers sold their products on local markets (Table 5).

Pearson's correlation between means of transport and uptake of improved sorghum technologies

Moreover, the findings indicated that 67% farmers walked short distances to the nearest markets to obtain various inputs towards improved sorghum production. Furthermore, 27% of farmers used bicycles as a means of transport to the markets (Table 6). There was no Pearson's correlation between means of transport to the nearest market and the uptake of improved sorghum technologies (Table 6).

The results also indicated that 63% of the farmers accessed saving services from non-governmental organisations and 50% of farmers received financial support from various financial institutions towards sorghum production (Table 7). The findings revealed that 91% farmers received capacity building assistance and empowerment on various topics and 87% accessed fertiliser subsidy services from the County agencies (Table 7).

Moreover, a minimal number of 26% of the farmers accessed financial support provided by microfinance institutions and cooperatives, respectively (Table 8). It was further revealed that a minimal number of 38% of farmers received financial support from promotional grants by County Ministry of Agriculture (Table 8).

Table 4. The number of farmers and the relationship between institutions support services and uptake of improved sorghum technologies.

	Uptake of improved sorghum technologies		
	Institutional support		
Institutions	Number of farmers (%)	Pearson's correlation (*r*)	Significance (*p*)
Group membership	88	0.23	0.02**
Group marketing	32	0.07	0.45
N.G.O membership	78	0.48	0.01**
County government	56	0.09	0.56

n = 129

Table 5. The number of famers embracing post harvest technologies and accessing markets outlets

Technologies and market outlets	Percentage %
Threshing, drying, winnow, packing and sale	97
Threshing, drying method, packing	03
Market outlets	
Local market	44
Farmers organisation	03
EABL agents	48
Others	03

$n = 129$

Table 6. The number of farmers and the Pearson's correlation between means of transport to market and uptake of improved technologies.

		Uptake of improved sorghum technologies		
Means of transport	Number of farmers embracing services	Percentage %	Pearson's correlation *r*	*p*
Walking	87	67	0.067	0.097
Bicycles	34	27	0.215	0.055
Vehicles	8	6	0.120	0.067
Animals		–	–	–

$n = 129$ Statistical Association significance levels $^{**}p < 0.01$, $^{*}p < 0.05$

Farmers institutional challenges

It was revealed that 57% of farmers faced inadequacy of credit services, whereas 17% experienced unfavourable repayment time and 13% cited high interest rates as the main challenges faced while accessing credit from the financial institutions (Table 9).

Discussion

The current study revealed that majority of the farmers had an income of (US$ 30 to $ 50) on monthly basis. The study findings implied that the lowest farmer spent less than one hundred shillings (US $ 1) on daily basis. The expenditure capacity of the farmers' is an indicator of the farmers investing in the improved technologies. Furthermore, it is expected that wealthier households have a higher probability of investing in new technologies, such as improved sorghum production. Related to this study, Inayat (2011) indicated that household income capacity is an indicator of prosperity and may be expected to have a positive effect on adoption of new farming technologies among farmers. Moreover, the study revealed that of farmers had household population comprising of five to ten

Table 7. Institutional services rendered to farmers.

Institutional services	Number of farmers (%)
Financial support	50
Training on sorghum production and credit access	34
Training on the importance of SACCO	91
Fertiliser subsidy	87

$n = 129$

Table 8. Institutions offering financial services offered to farmers.

Institutions	Number of farmers accessing services	Percentage %
Microfinance	30	26
Cooperatives societies	05	04
Merry-go-round groups	02	02
Ministry of agriculture	45	38
Church	24	21
Non-governmental organisations	11	09

$n = 129$

Table 9. Institutional challenges faced by farmers.

Institutional challenges	Number of farmers (%)
Few institutions available	1
Inadequacy of credit facilities	57
Absence of informal sources	8
Unfavourable repayment time	17
High interest rates	13
Others	4

family members. The study findings also indicated that majority of the farmers had individual land ownership and were growing sorghum on two and a half acres. Land ownership determines farmers' ability to invest in new technologies. Moreover, household size determines farmers' investment in improved technologies. The current results are in resonance to Kenya's national bureau of statistics mean figure of five members per household (CBS 2005). Likewise, current results could be attributed to the fact that most families in Mbeere north have an average number of dependants, which contribute towards labour service provision for a the highly productive regime and food secure community. Moreover, the household number indicates the availability of family labour and the likelihood of an increase in new technology uptake, as a result of the number of household members providing the required farm labour. In a related study, Ambitsi (2008) asserted that sources of capital, labour and other financial support are important prerequisites in farmers investing in new technologies, such as improved sorghum value chain.

The current study results indicated that farmers accessed varied private institutional support across improved sorghum value chain technologies, ranging from production to marketing and capacity building training. This scenario could moreover be attributed to the supportive services offered by national and county devolved governments. The study findings also indicated that farmers walked to the nearest markets to obtain various services and inputs towards improved sorghum production. The distance to the nearest market outlet usually influences and supports the farmers' source for value chains information and market sources. Related to this study, Biyissa (2015) asserted that in addition to the distance covered by the farmers to the nearest market areas, there are other institutional factors influencing adoption rates, including the linkage between researchers, agents, farmers, financial support, management of the scarce production resources.

Furthermore, the study revealed 87% of farmers invested in combined application of manure and inorganic fertilisers as the main source of soil fertility enrichment during sorghum production. The combined low inorganic fertiliser and high manure ratios

application efforts could be attributed to the fact that manure is readily available and ready markets act as a motivating factor for farmers to enhance farm fertility levels, so as to increase production yields and quality levels. According to Doss (2003) farmers tend to confront their daily micro- and macro-economics challenges based on their inherent tacit knowledge and skills. Besides, Ashiono et al. (2006) and Onyango (2010) documented that organic manure use is a popular practice among Kenyan small-scale farmers, because of its availability and farmers' knowledge on preparation. However, KIRDI (2011) documented that high yields and quality of improved sorghum products can be achieved if the farmer has defined a way of confronting low farm inputs utility, lack of ready a market and low processing efficiency levels. Moreover, high yields and income could be realised if an attack by Qualia birds could be controlled in arid regions (KIRDI 2011).

The study showed that majority of farmers' preferred selling sorghum products to East Africa Brewery Limited through agents. Besides, farmers sold their rejected sorghum products by EABL on basis of quality issues on the alternative local market outlet. Related to this study, Esipisu (2011) asserted that contract farming arrangement between farmers and the EABL has resulted into the uptake of improved sorghum varieties introduced by KALRO to semi-arid Eastern Kenya in 2009. Moreover, the uptake rates are attributed to farmers' attitude change towards improved sorghum production hence increasing food security and selling the surplus to earn income. It has additionally been documented that for a farmer to develop agribusiness so as to create market information support and integrated markets, the farmer requires insurance, markets outlet information, input delivery services, market protection, mechanisation, and subsidy schemes in place to bring change in the lives of farmers (Hall et al. 2001). Related to this study, Muui et al. (2013) asserted that low inputs use coupled with fluctuating inputs prices are the greatest hindrance on smallholder farmers adopting and embracing sorghum technologies and commercialisation in arid regions.

The study findings indicated that farmers were faced with a myriad of challenges during the improved sorghum production. The challenges could be attributed to the duplication of administrative functions by both County and national government in Kenya, weak marketing links, poor access to information on credit by farmers and limited agro-processing industries. Furthermore, the weak institutional support services could be attributed to the between national and county government in terms of funding of extension services in the Kenya created by the devolved agriculture services. Besides, agriculture service provision in Kenya is characterised with stringent administrative procedures, skewed strategic plans and protocols on farmers' inputs subsidy support and disjointed planning systems (Mwadalu and Mwangi 2013). In resonance with this study, it has been documented that budgetary allocation by the national government to the agricultural sector is averagely 3% of the national budget in Kenya (GoK 2010). This allocation is way below the Maputo declaration 2003 in support of state funding and allocating 10% of annual budget to agriculture. Besides, by 2008, the Kenyan government allocated highest ever 4.5% on agricultural activities way below the expected limit (GoK 2010). According to Biyissa (2015), development of any community is brought about by specific institutional factors, such as embedding farmers in a suite of institutional supports, providing inputs fund, providing farmers organisational development, enhancing technology, information transfer and training among farmers. Besides, recognizing farmer unions as partners in farm and rural development and exerting lobbing and political power is important.

Conclusions and recommendations

The study concluded that farmers' expenditure, land ownership, financial training support, and credit were the key socio-economic and institutional factors contributing to farmers' uptake of improved sorghum. We recommend that registration of land within arid regions be implemented, in order to enhance land ownership and confidence in future investment in improved technologies.

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