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Value chain analysis of grass seeds in the drylands of Baringo County, Kenya: A producers' perspective

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Abstract

Pastoral households are increasingly practising fodder production in response to forage scarcity associated with land degradation, climate variability and change. Understanding the grass seed value chain is a prerequisite for developing sustainable fodder production and guiding appropriate out-scaling in the drylands. This study investigated the producers' perspectives on grass seed production, marketing and challenges faced along the grass seed value chain in Marigat Sub-County of Baringo County, Kenya. The results show that the dominant actors were the bulking and processing agents who provided inputs and were a source of grass seed market to the producers. The producers preferred contractual agreements that allowed them to sell their grass seed to markets of their choice. As independent grass seed traders allowed for seed price negotiation, they were popular amongst the producers and thus handled the most volume of seeds marketed. Drought occurrence, inability of existing outlets to purchase grass seed at times, together with low prices offered for producers' grass seed were found to be among the challenges facing the producers. There is need to strengthen the fodder groups with a possibility of registering them as cooperatives for the purpose of collective bargaining for better grass seed prices.

Keywords: Land degradation, Fodder production, Pastoral households

Introduction

Livestock plays an important role in many developing countries' agricultural sector. In these countries, livestock production is constrained by the perennial challenge of fodder scarcity which reduces sustainable livestock development and often leads to conflicts over grazing lands among pastoral communities. This scarcity is caused by a combination of factors that include erratic rainfall, shrinking grazing lands due to competition for land for crops and changing land use patterns that favour urbanization and settlement (Hall et al. 2007; GebreMariam et al. 2010; Ayele et al. 2012). In Ethiopia, for instance, effective interventions that can address feed scarcity which limits the productivity and profitability of livestock production can lead to improved pastoral livelihoods. This opportunity arises from increasing domestic and export demand for livestock products, particularly meat (Tolera et al. 2012).

Fodder production and marketing (fodder value chains) in various parts of the world have been documented (Nyangaga et al. 2009; Kannan 2012; Grover and Kumar 2012; Singh et al. 2013; Nangole et al. 2013), but little still remains known about grass seed value chains. Globally, the largest producer and exporter of grass and legume seeds is America (USA), which is followed by the block of European Union (EU15) countries, Canada and New Zealand. Grass seeds vastly produced are from annual and perennial varieties of ryegrasses, and much of the production is consumed within the various production regions, particularly by the USA and within the EU (Wong 2005). Ryegrass production has high returns, and consumers, as compared to producers, are purchasing the most grass seeds as they tend to purchase coated seeds so as to increase water retention or seeds enclosed in mulch which makes planting easier (Paul 2013). In the USA, Oregon State produces about a third of the grass seed on the world market and its grass seed

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industry has had success in China. Together with other actors, it was involved in the development of the Chinese grass seed market. Its initial aim was to help Chinese grassland specialists apply modern techniques to grassland problems such as soil erosion (Durham et al. 2003). In Ireland, new technology in the grass seed market is driven by the opening up of beef export markets in China and the United States, the abolition of quotas and the Irish government's publicized commitment to increasing dairy output (Moran 2015).

Over the last three decades, the Njemps Flats of Baringo County in Kenya have been known to produce fodder and grass seeds. This has been in an effort to address declining pasture and livestock productivity as a result of a changing vegetation structure, declining diversity and increasing soil erosion attributed to increases in human and livestock populations (Wasonga et al. 2011). In the County, fodder is grown by agro-pastoral communities organized in groups as well as individuals who mainly plant the African foxtail grass (*Cenchrus ciliaris*) in enclosures meant to keep off grazing animals. The enclosures provide fodder banks for the owners' herds during the dry periods, feedlots for fattening livestock for sale and fodder and grass seed for sale to other farmers for income (KRDP/ASAL DM 2012; Meyerhoff 2012; Channer 2013; Odunga 2013). Communal pasture development has been embraced by pastoral communities in the same county, with promising benefits. Households produce more milk leading to improved nutrition and food security among the households engaging in fodder production. Furthermore, fodder availability throughout the year, even during drought periods, has lessened conflicts over grazing that were previously rampant (Meyerhoff 2012).

In an effort to combat land degradation and address their livelihood options, pastoral communities in the Baringo basin employ the use of enclosures to restore indigenous vegetation as well as produce forage to meet deficits during the dry seasons and drought. As a consequence, they are able to earn income from the sale of grass seeds, hay and leasing out dry-season grazing (RAE 2004; Mureithi et al. 2015). It has been reported that such enclosures, where successful, ensure that pastoralists can provide for their own households and livestock, leading to independence from food aid (Makokha et al. 1999). As reported by Kitalyi et al. (2002) and RAE (2004), households that have access to communal enclosures enjoy improved livelihoods as a result of income-generating activities that have enabled them to profit from the reclaimed land.

In rehabilitating degraded rangelands in Turkana and West Pokot Counties of Kenya, pastoralists practise fodder production through enclosures from which they benefit by selling cut grass and grass seeds, as well as having contractual grazing arrangements. Access to dry-season grazing reserves, healthier livestock, improved livestock productivity and easier livestock management are other benefits derived from fodder production (Musimba et al. 2004; Wairore et al. 2015). In West Pokot County, in the phase of ongoing privatization of land under different tenure regimes, there is high adoption of enclosures for the purposes of combating land degradation, fodder production and better land and livestock management. As a consequence, there is agricultural diversification and livelihoods are less dependent on livestock seasonal movement (Nyberg et al. 2015). In Baringo, Laikipia, Marsabit and other drylands in Kenya, 10 tonnes of indigenous perennial grass seeds are distributed and seeded annually. Pastoral groups are reported to generate incomes of about Kshs. 1.5 million per annum, and some pastoral communities engaged in group fodder production take loans worth over Kshs. 750,000 (approximately USD 7,353), using privately-rehabilitated fields as collateral (Meyerhoff 2012).

The growing popularity of fodder production offers a possible pathway for addressing land degradation and enhancing pastoral household income through the sale of grass seeds. Baringo County has both private and public sectors working alongside non-governmental organizations and fodder producers in the promotion of fodder and grass seed production. Their participation in grass seed production and marketing is important in ensuring that fodder and grass seed production is sustained. Their efforts have an impact on the livestock sector and consequently contribute to the country's economic growth. Thus, for the purpose of developing sustainable value chain and out-scaling the practice, information on the performance, as well as understanding of the entire value chain, is imperative.

A value chain is defined as the full range of activities required to make a product or service. It therefore incorporates all the activities inclusive of input sourcing, production, transformation, marketing all the way up to the final consumption and disposal after use (Kaplinsky and Morris 2001). Mapping is usually the first step in value chain analysis. A value chain map shows the actors involved in the chain, the relationships that exist among the identified actors and the economic activities that take place at each stage of the chain. In addition, the value chain map reveals the physical movement of the commodity and the changes in prices along the chain (Faße et al. 2009). Mapping of a particular chain represents the functional and institutional analysis, one of the approaches of mapping a value chain. In this process, a preliminary map is constructed where the actors and the functions they perform in the chain represent the institutional analysis and their interactions with one another represent the functional analysis. This preliminary map,

which consists of agents and their main functions at each stage as well as the main products in the value chain, can be presented in a flow chart or table (FAO 2005 as cited in Faße et al. 2009). Another approach to mapping a value chain is social network analysis which serves as a tool for mapping and analysing relationships and flows between people, groups and organizations. This analysis provides both visual and mathematical analysis of chain relationships (Faße et al. 2009).

The purpose of this study is to map the grass seed value chain in Baringo County, Kenya, document producers' perspectives on grass seed production and marketing, and the challenges encountered along the chain. The information generated will be important in identifying key areas where interventions can help improve the functioning of the value chain to the benefit of the chain actors. Moreover, Baringo County is known to be one of the leading grass seed producers whose output is supplied across the country, and its efforts need documentation. This will enable formulation of effective and efficient intervention strategies that can facilitate the growth and competitiveness of the Baringo County grass seed market in Kenya.

Study area

This study was conducted in Baringo County, located in the northern part of the former Rift Valley Province of Kenya. The county borders Turkana to the north and north east, Samburu and Laikipia to the east, Nakuru to the south, Kericho and Uasin Gishu to the south west, Elgeyo Marakwet to the west and West Pokot to the north west. The county is divided into six administrative units: East Pokot, Marigat, Baringo North, Baringo Central, Koibatek and Mogotio (RoK 2012). The exact study site was in Marigat Sub-County, and is located between latitude 00° 30′N and longitude 36° 00′E.

The Njemps Flats is classified as a Lower Midland (LM) Livestock-Millet Zone, which is best suited for livestock production (Herlocker et al. 1994; RoK 2002). Agro-climatic Zone IV is classified as semi-humid to semi-arid with an annual average rainfall of between 600 and 1,100 mm, and an annual mean evaporation of between 1,500 and 2,200 mm. Zone V is semi-arid, experiencing an annual rainfall mean of between 450 and 900 mm, with an average evaporation of 1,650 to 2,300 mm annually (Biamah 2005). The two agro-ecological zones are considered medium-potential rangelands. The study area is semi-arid and has an altitude which ranges between 900 and 1,200 m above sea level (Owen et al. 2004). The average minimum and maximum temperatures are 20 °C and 30°C, respectively (Kassilly 2002). The Njemps Flats receive an annual rainfall of about 500 mm (Tokida 2001).

The natural vegetation in the Njemps Flats of Baringo County is dominated by ephemerals, which regenerate after the rains, *Acacia* woodland (80%), permanent swamp and seasonally flooded grassland (15%), and shrub grassland (5%) are the main vegetation types (Verdoodt et al. 2010). Semi-deciduous woodland dominates riverine areas and the northern part of the Njemps Flats whereas *Acacia reficiens* and *Acacia mellifera* bushland dominate the lowlands. Due to land degradation, herbaceous vegetation especially grasses are almost non-existent, except within the numerous enclosures which have been established to rehabilitate the degraded rangeland. In the early 1980s, the Fuelwood Afforestation Extension Project introduced *Prosopis juliflora* in the study area. The invasive species has since spread to other parts of the area, and it is mainly a problem in Marigat and Ng'ambo where it has formed dense thickets thereby inhibiting undergrowth (Lenachuru 2003; Marangu et al. 2008).

The County has a population of 555,561 people (RoK 2010). The semi-arid lowlands of Baringo County are inhabited by three principal ethnic groups:: the Tugen (53%), Pokot (35%) and Njemps or Ilchamus (12%) (Sutherland et al. 1991). The primary economic activity in the county is livestock keeping, and this sub-sector contributes to the food and cash needs of the pastoralists and provides employment to 90% of the population. Poverty in the county is more pronounced in the rural areas especially the lower zones where income-earning activities are not diversified, and 35% of the population is considered poor (RoK 2005). Figure 1 shows the study area map.

Materials and methods

Research design

In order to get an overview of producers' perspective on the value chain, fodder producer groups were purposively selected while individual households that produce fodder were identified using snowball-sampling approach. Mugenda and Mugenda (1999) describe purposive sampling as a form of sampling where the researcher relies on his or her expert judgement to select units that are representative of the population. Under the snowball-sampling technique, initial subjects with desired characteristics are identified using purposeful-sampling technique. The few identified subjects then name others they know who have the required characteristics until the researcher gets the number of cases required. This method is suitable when the population that possesses the characteristics under study is not well known and there is need to find subjects. A pre-study was conducted in the larger community and on two fodder producer groups prior to the actual study. The same period was used to test the data collection tools and approaches, which were then adjusted accordingly from the field experience.

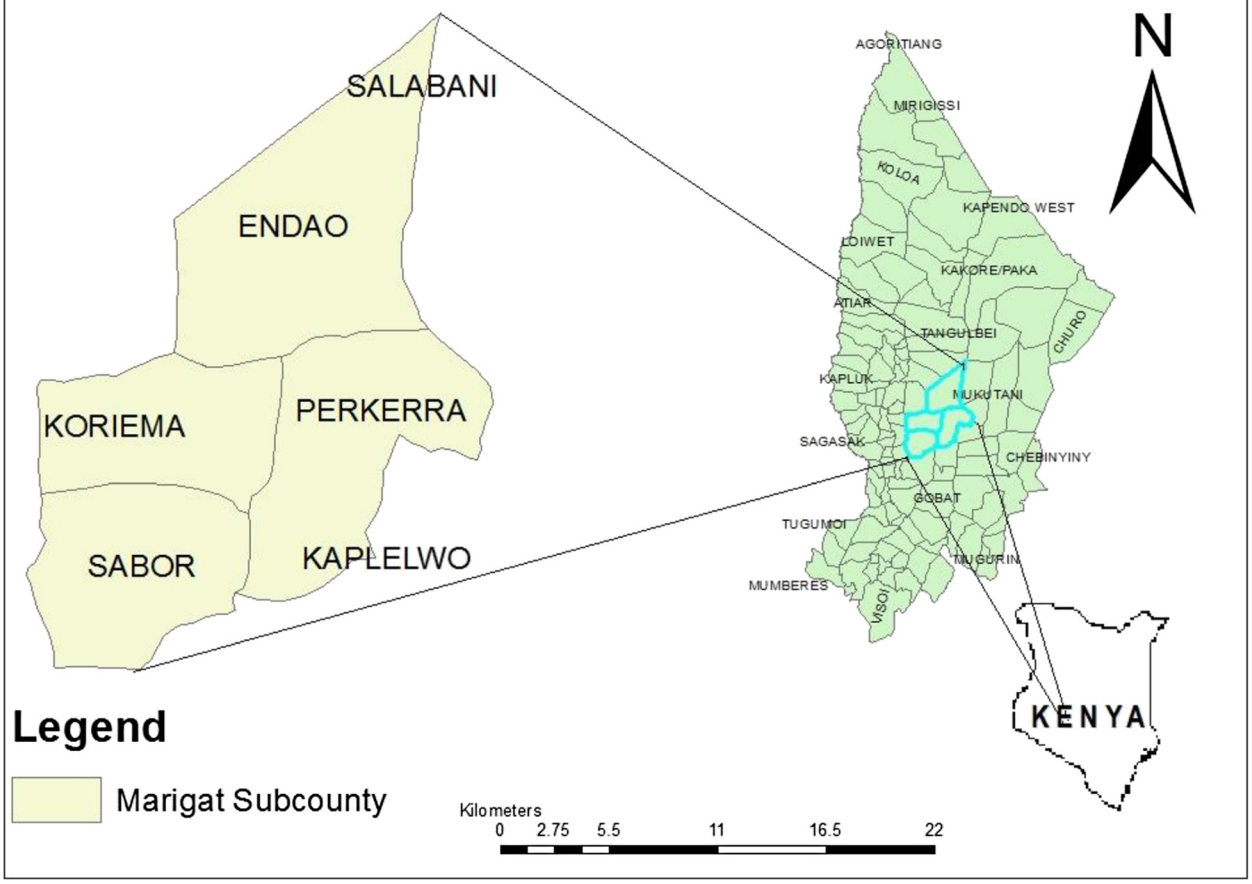

Figure 1 Study area map

Data collection and analysis

This data was collected during the September to December fodder-growing season of 2014. Five fodder producer groups under the 'Enhanced Community Resilience to Drought through Innovative Market-based Systems Approaches' project were purposively selected for this study. All members of the five fodder groups were interviewed, and a sample size of 78 was attained. Furthermore, five focus group discussions of 8 to 12 participants comprising men and women were held with the five fodder producer groups.

In snowball sampling, the exact selection probabilities are unknown for the samples and there exists no sampling frame but the subjects are connected by social relations (Shafie 2010). Following Shafie (2010), let U be the total population of Marigat Sub-County with an unknown number of fodder producers N. Each fodder producer is characterized by yi (attribute of being an individual fodder producer) which is unknown but observable if a fodder producer i is sampled. An initial sample $S0$ (five individual fodder producers) was questioned about yi and asked to give names and addresses of other members of the population whom they know of. $Zij = 1$ if person i mentions person j. An assumption was made that the relation is symmetric, that is, $Zij = Zji$ implying that if person i mentions person j, then person j will also mention person i. The usual procedure was to stop sampling after a sample of sufficient size was reached. Therefore, interviews were conducted until a sample size of 47 individual fodder producers who did not belong to any fodder producer group in Marigat Sub-County was attained. At the end, a semi-structured questionnaire was used to conduct a total of 125 individual interviews with the heads of the households practising fodder production. The interviews and focus group discussions were used to identify the sources of inputs, amount of grass seeds produced and sold and the available grass seed markets as well as the challenges encountered in the value chain.

The information obtained from the focus group discussions and individual interviews helped in identifying key informants who were involved in the grass seed value chain. Key informant staff of Kerio Valley Development Authority (KVDA), Rehabilitation of Arid Environments (RAE) Trust, Kenya Agricultural and Livestock Research Organization (KALRO), World Vision Marigat Area Development Programme and the Sub-County Livestock Production Office were interviewed, as well as the independent grass seed traders. The key informant interviews were conducted so as to have in-depth understanding of the functions and activities of the various actors. The collected information was used to map the grass seed value chain in the study area. The key informant interviews were used to identify the source of inputs sold to farmers; volumes sold; behaviour of demand, distribution practices; prices charged, and challenges faced in offering services and inputs to fodder farmers; and their grass seed markets.

The collected information was used to develop the grass seed value chain in the study area. The chain comprises six stages: input/service source, production, processing, marketing and consumption. When costs at each stage of the value chain are considered and compared against the standards, stages where costs can be effectively reduced are identified (Keyser 2006). The process of mapping a sector or industry qualitatively is usually followed by cost and time measurements of the various nodes of the value chain. Cost, time, value added and productivity are the metrics used to measure the performance of a value chain (Subramanian 2007). Marketing margins and prices can be computed to reflect the value addition by various chain participants (Kumar and Kapoor 2010). Value added is the value of output at the market price less the value of all intermediate inputs which are purchased (Subramanian 2007).

On the other hand, quantitative value chain analysis focuses on the price a customer is willing to pay for a firm's output (Keyser 2006). The assessment of price along a value chain is attained by considering the vertical margins, which are the differences between prices at different nodes of the chain and represents the ration of the final price absorbed by the producers, traders, processors and other chain participants (Kirimi et al. 2011). In the event of information asymmetry in the value chain, ineffective market functioning arises due to lack of trust among the participants. This frequently leads to overpriced inputs and underpriced output (Rota and Sperandini 2010). The farm-level competitiveness of grass seed production may be determined by the use of the value chain analysis software from the Food and Agricultural Organization (FAO) to conduct financial analysis. The software aids in building a step-by-step quantitative database of each node of the value chain and thus allows individual analysis of each chain participant (Odhiambo 2012).

Quantitative data was analysed using the Statistical Package for the Social Sciences (SPSS) version 20.0 and resulted in the generation of descriptive statistics such as percentages, frequencies and averages. Data from key informant interviews and focus group discussions was synthesized and used to validate and complement the information from individual interviews.

Results and discussion

Functional analysis of the grass seed value chain actors

Figure 2 presents the grass seed value chain map showing the main stages that include production, processing, marketing and consumption. The map also shows the actors in the chain and their roles, and the resultant output at various nodes of the chain. The first stage comprises the input providers which include fodder farmers who provide their own labour on their farms, ploughing service providers that comprised KVDA, and RAE Trust and famers who provide grass seed and ploughing services as well.

At the second stage, there are group and individual fodder farmers who produce and sell grass seed to various agents along the chain. Other actors involved in grass seed production included KVDA, RAE Trust and KALRO. The grass seed production activities of these organizations not only serve as demonstrations to the local community but also include sale of the produced grass seed for income. The agents involved in processing were found to be RAE Trust, KVDA and KALRO which bulk, process and market the grass seeds. The actors involved in marketing included farmers who sell their produce to other farmers, KVDA, RAE Trust and KALRO. In addition, there are independent grass seed traders who buy the grass seed from the producers and sell to farmers and various non-governmental organizations. KVDA, KALRO and RAE Trust sell the grass seed to fodder farmers and various organizations in Baringo and other counties such Laikipia, West Pokot and Turkana. The consumers were found to be mainly the residents of Baringo and other counties who buy grass seed for planting which entails the establishment of new pastures and reseeding that involves the establishment of pastures in fields previously with pastures.

Input supply for fodder production

Figure 3 shows that majority (55.3%) of the individual fodder producers bought their seeds from RAE Trust and obtained ploughing services from the same source. Three of the five groups whose farms were close to KVDA station obtained their seeds and ploughing services from KVDA through grass seed and ploughing service subsidies provided by the Netherlands

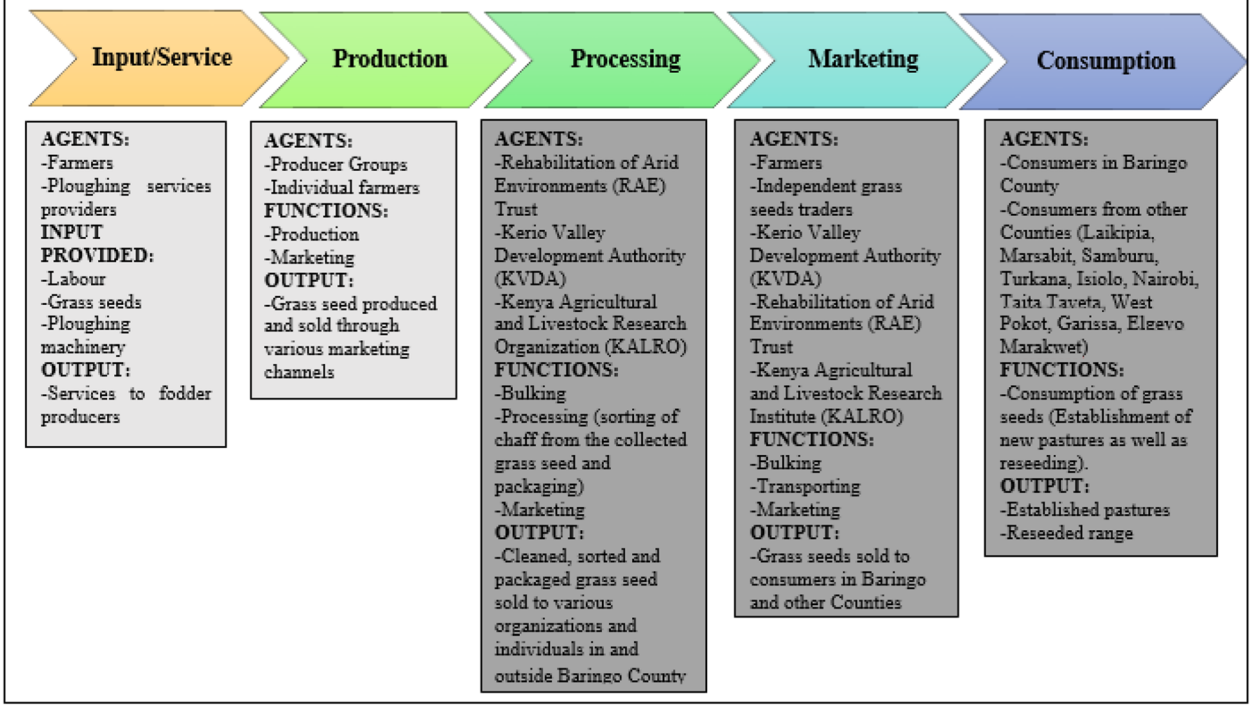

Figure 2 Grass seed value chain map for Marigat Sub-County

Development Organization (SNV). In other dryland counties of Kenya such as Mandera and Garissa, fodder producer groups are provided with subsidized inputs such as grass seeds, hay balers, hoes and spades and are trained on fodder production, conservation and marketing (VSF-Suisse 2009; CARE 2013). Both RAE Trust and KVDA offer ploughing services to fodder producers on contractual terms. This finding is inconsistent with the findings of Nangole et al. (2013) who reported that agrovets (shops selling agricultural inputs) and

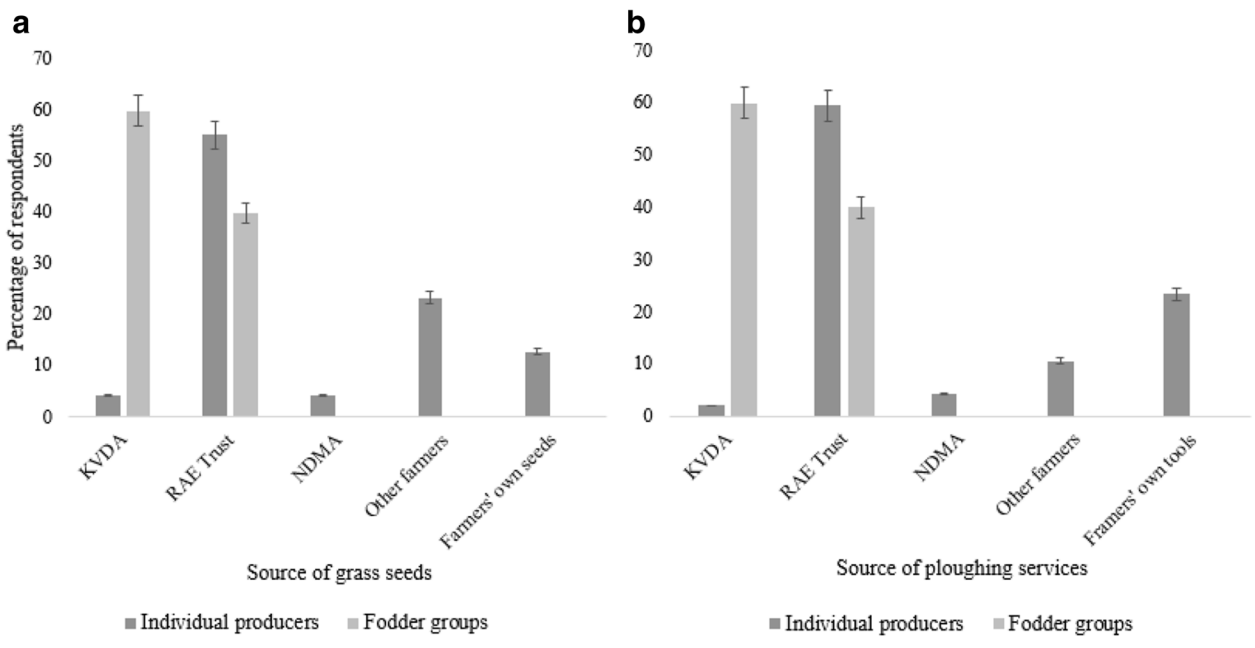

Figure 3 Sources of inputs to fodder producers. **a** Source of grass seeds. **b** Source of ploughing services

general retail shops are the only input suppliers in the existing fodder value chain in the Rift Valley region. The main sources of inputs were found to be government departments, non-governmental organizations and the fodder farmers.

The KVDA and RAE Trust are the two major organizations in the study area that offered ploughing services to the fodder producers. The KVDA provided ploughing services to farmers based on the agreement that the producers buy grass seed from them. They ploughed, contoured and harrowed the producers' farms at Kshs. 2,500 to 3,000 (USD 28.09 to 33.71) per acre (per 0.4 ha) depending on the distance of the farm from their station. Likewise, the RAE Trust ploughed for the farmers on an agreement that the farmer must sell the seeds back to them. RAE Trust provided ploughing services per acre (per 0.4 ha) for Kshs. 2,500 to 5,500 (USD 28.09 to 61.80) depending on the distance to the farm. The other farmers who provided ploughing services to fellow farmers charged Kshs. 1,000 to 2,500 per acre (per 0.4 ha). The fodder producers in the study area preferred KVDA's mode of contract since it allows them to sell their harvested grass seed to markets of their choice. Although contracts compelled the farmers to sell the seeds back to the RAE Trust, they preferred to sell to other markets, which offered better prices. The KVDA bought the grass seed from producers at an average price of Kshs. 250 (USD 2.81) per kg, KALRO bought at an average price of Kshs. 250 (USD 2.81), independent grass seed traders an average price of Kshs. 275 (USD 3.09), RAE Trust bought from the farmers at an average price of Kshs. 150 (USD 1.69) per kg and other fodder producers bought from the producers at an average price of Kshs. 175 (USD 1.97) per kg.

The price obtained for a kilogram of grass seed varied depending on the quantity of grass seed offered for sale by a producer, the market outlet and the price negotiation skills of the producer whenever that option was available. This accounts for the popularity of the independent grass seed traders and fellow producers as they allowed for price negotiations and the existence of social ties among them, unlike for the bulking and processing institutions that offer fixed prices.

Fodder production and grass seed processing in the study area

The only grass species that had been planted by all the fodder producers was *C. ciliaris*. This was attributed to easy establishment, drought tolerance, the ability to propagate itself and produce an output of viable seeds which can be easily harvested (Herlocker 1999; Mnene 2006). While conducting a study on dry matter yields and hydrological properties of three perennial grasses of a semi-arid environment in East Africa, Mganga et al. (2010) found *C. ciliaris* to yield the highest biomass production at the reproductive stage and was the best at improving the soil hydrological properties with an increase in its stubble height. Furthermore, Mganga et al. (2015) argue that the choice of grass species adopted by agro-pastoral communities in combating desertification is influenced more by its contribution as a source of forage for livestock than its contribution for rehabilitation purposes. This partly accounts for the popularity of this species among the dryland communities in Kenya. The species is considered the best among local grass species in Makueni County and has been found to be highly adaptive to the arid and semi-arid land (ASAL) climate, has high demand, and when fed to livestock leads to high milk production (Machogu 2013; Mutua 2014).

The average farm size under fodder production in the study area varied between the fodder producer groups and the individual producers. Five acres (2 ha) and 16 acres (6.4 ha) were the minimum and maximum land sizes under fodder production for the groups, respectively, while half an acre (0.2 ha) and 17 acres (6.8 ha) were the minimum and maximum land sizes under fodder production for the individual fodder producers, respectively. The main fodder production practices in the study area were broadcasting as the main method of sowing grass. The farmers never irrigate nor do they apply fertilizer on the pastures. Weeding was done at four to six weeks after planting. The grass seeds were harvested using the stripping method after flowering when the seeds' colour changed from green to light brown. This method of harvesting is common among the fodder farmers in the semi-arid rangelands of Kenya (Mnene 2006). Individual fodder producers used both family and hired labour in their production, while the groups collectively provided labour and only hired labour when the amount of work was overwhelming and needed to be accomplished quickly. Hired labour was mainly used in weed control and grass seed harvesting and cost Kshs. 100 (USD 1.12) per day per individual, while the wage for harvesting grass seed ranged between Kshs. 50 (USD 0.56) and Kshs. 150 (USD 1.69) per day. In their study on fodder production and marketing in Mandera County, (Nyangaga et al. 2009) found that family labour was employed in production. Fodder production in the County is being driven by several factors that include: availability of rivers that provide water for irrigation, a growing fodder market, improved household income from the sale of surplus fodder, and the existence of extension services.

In the wet season of September to December 2013, a total of 7.42 tonnes of grass seeds were produced by the interviewed groups and households and only 4.65 tonnes were sold. Three organizations, RAE Trust, KVDA and KALRO, were involved in the processing of grass seeds in the study area. Their functions entailed collection of grass seeds from the producers, sorting of the collected

seeds from chaff and packaging the seeds for sale. The role played by the bulking and processing agents of sorting the collected seeds from chaff shows that the producers need more training on grass seed harvesting and handling practices. This may help them fetch better prices for their grass seed when offered for sale as the quality of the produce will be high.

Marketing of grass seed in the study area

Marketing channels for grass seeds are presented in Figure 4. The fodder producers sold to other farmers at a maximum price of Kshs. 200 (USD 2.25) per kilogram; this is a lower price than the maximum price of Kshs. 350 (USD 3.93) per kilogram offered when they sold to the independent seed traders and processing and bulking agents. The fodder producers sold to other farmers at that price due to the social ties and kinship among themselves. The price received from processing and bulking agents as well as independent seed traders was higher since the fodder producers expected these agents to further market the grass seeds. However, the prices in the study area are lower as compared to those in Makueni County where a kilogram of grass seed fetches Kshs. 1,000 (USD 11.24) while seeds of rare grass species such as bush rye fetch as much as Kshs. 1,800 (USD 20.22) per kilogram (Mutua 2014).

The first channel comprised producers selling to other farmers at a price of Kshs. 175 (USD 1.97) per kg.

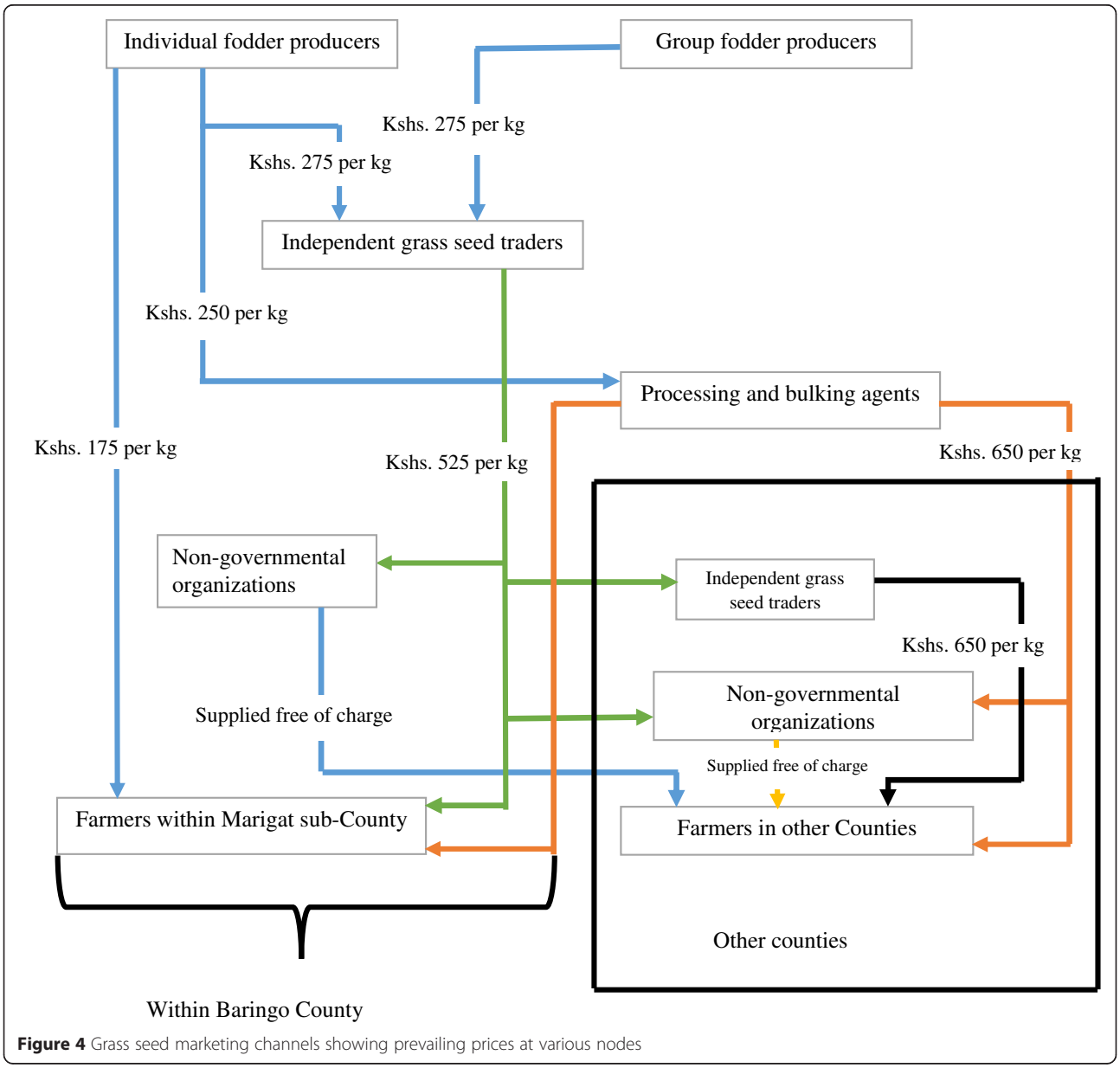

Figure 4 Grass seed marketing channels showing prevailing prices at various nodes

Channel 2 comprised producers, independent grass seed traders and farmers within Baringo County. The independent grass seed traders bulked seeds bought from the producers at an average price of Kshs. 275 (USD 3.09) per kg and in turn sold to farmers within the County at an average price of Kshs. 525 (USD 5.90) per kg. The third channel comprises producers, independent grass seed traders and non-governmental

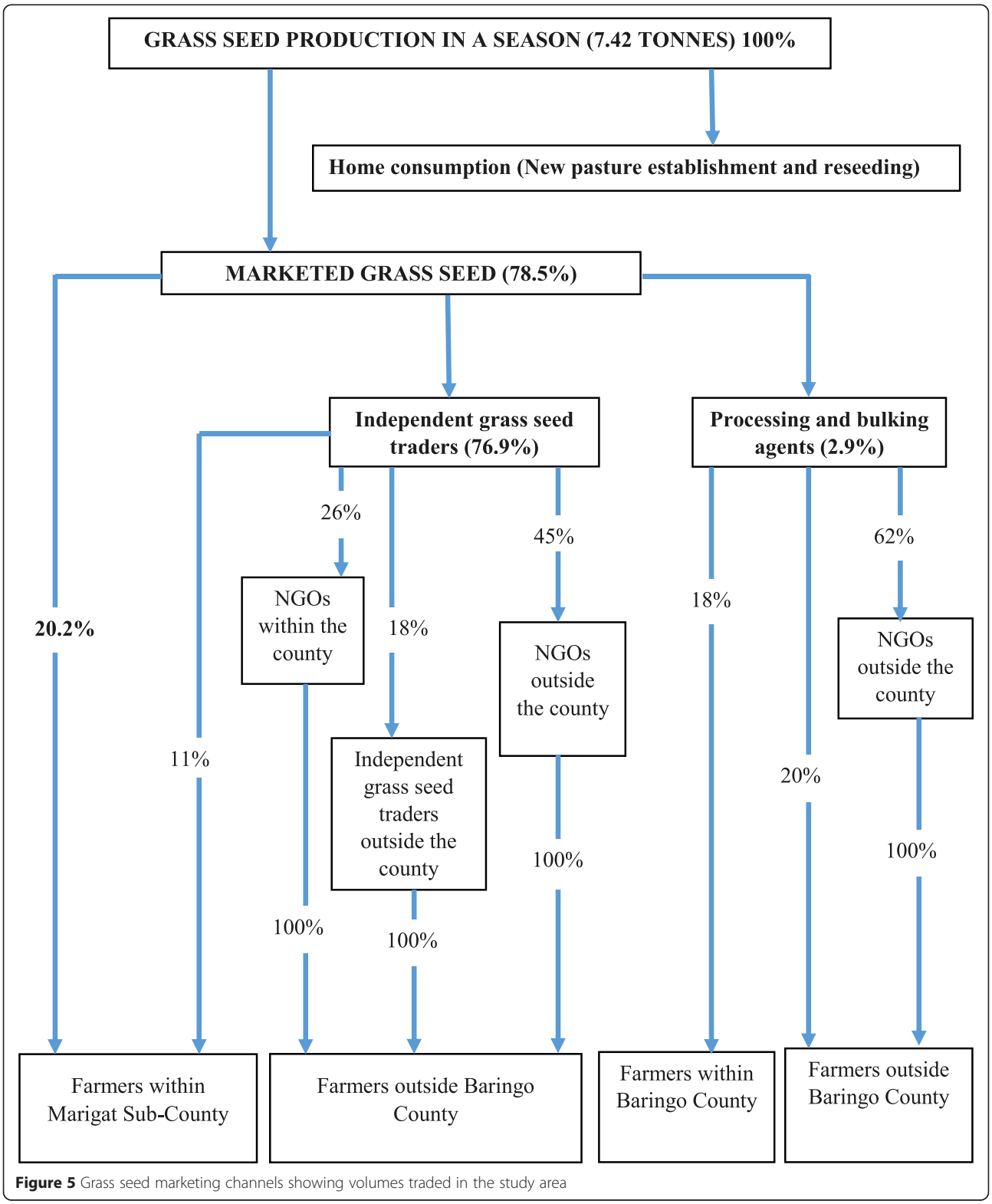

Figure 5 Grass seed marketing channels showing volumes traded in the study area

organizations within Baringo County. The independent traders bought from producers at an average price of Kshs. 275 (USD 3.09) per kg and sold to non-governmental organizations (NGOs) such as World Vision at an average price of Kshs. 525 (USD 5.90) per kg. The NGOs in turn distributed the grass seed free of charge to farmers in the neighbouring counties such as West Pokot.

The fourth channel was composed of producers who sold grass seed at an average price of Kshs. 275 (USD 3.90) per kg, independent grass seed traders within Marigat Sub-County who sold at an average price of Kshs. 525 (USD 5.90) per kg and independent grass seed traders outside the County who sold to farmers at an average price of Kshs. 650 (USD 7.30) per kg. Channel 5 included producers, independent seed traders and non-governmental organizations within the Sub-County who supplied the seeds to farmers outside the County. The sixth channel comprised producers who sold at Kshs. 225 (USD 2.53) per kg to processing and bulking agents and farmers in the county. Channel 7 was composed of producers, bulking and processing agents who sold to farmers outside the County at Kshs. 650 (USD 7.30) per kg. The eighth channel included producers, processing and bulking agents who sold at an average price of Kshs. 625 (USD 7.02) per kg to the NGOs outside the County, who in turn distributed the grass seeds to farmers free of charge.

The efforts by the various NGOs to distribute grass seeds to fodder farmers free of charge underscore the importance of fodder and grass seed production in the drylands of Kenya. This leads to improved households' livelihoods through the provision of pasture for livestock and grass seeds for sale, in addition to the aim of rehabilitating the degraded rangelands (Kigomo and Muturi 2013; Musimba et al. 2004; Kitalyi et al. 2002).

The volumes of grass seed handled in the various marketing channels are shown in Figure 5. About 20.2% (940 kg) of the marketed seeds were bought by other farmers directly from producers' farms. Channels 2, 3, 4 and 5, which entailed producers selling their seed to independent grass traders at the farm gate, handled most of the grass seed produced in that season, as compared to the quantities handled by channels 6, 7 and 8 in which the processing and bulking agents were the first point of sale. The producers mentioned the low prices for the grass seed and at times the unwillingness of the processing and bulking agents to buy from them, as some of the reasons why they preferred to sell to independent grass seed traders. Furthermore, only 8.1% of the fodder producers interviewed honoured their contract to sell their produce to RAE Trust. The other contracted producers preferred to sell their grass seeds to other available outlets such as KVDA and independent grass seed traders, who offered better prices than RAE Trust and gave room for price negotiations.

The independent grass seed traders in the grass seed value chain in Marigat Sub-County utilize their knowledge of the region to locate grass seed supplies, negotiate seed prices with the farmers and bulk sufficient

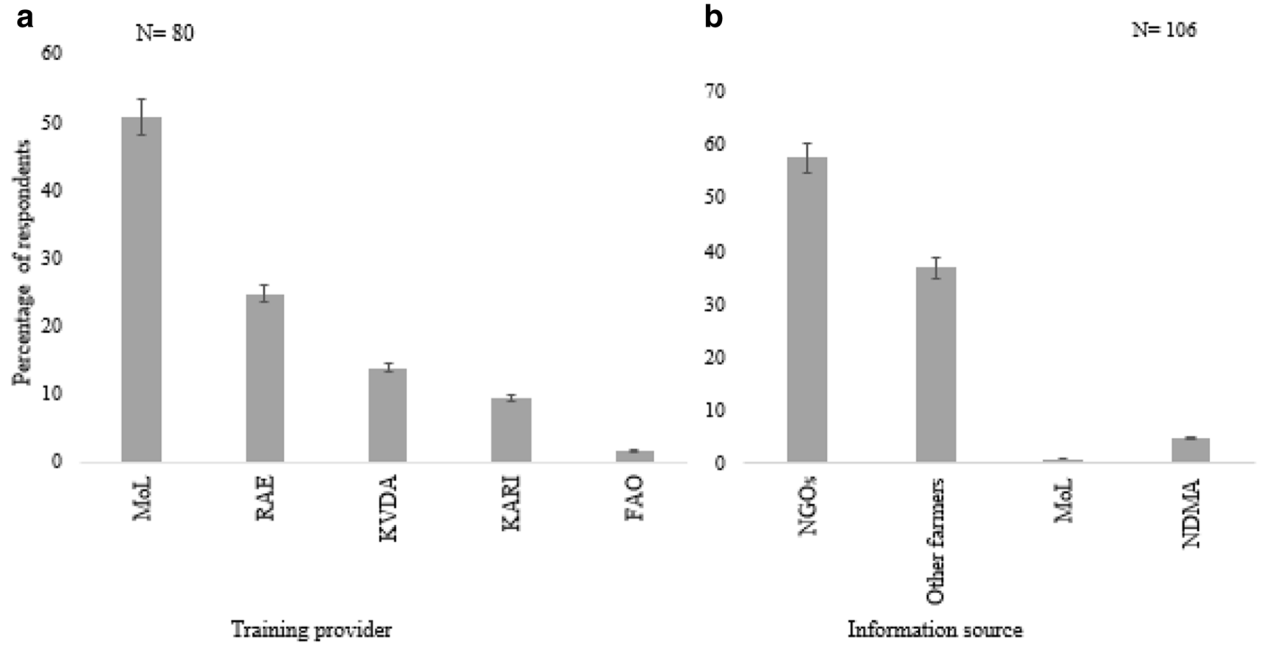

Figure 6 Training and information providers to fodder farmers. **a** Training provider. **b** Information source

quantities of the seeds. Since these traders do not act as brokers, they incur costs in seed purchases, transportation and storage. They have connections, within and outside the Sub-County, which serve as their seed markets. Rarely do these agents sell their bulked seeds to the bulking and processing agents within the Sub-County; rather, they view them as competitors. To the producers, the independent grass seed traders are seasonal market actors.

The bulking and processing agents are well-established institutions, both public and private, which promote fodder production in the study area by having demonstration plots and offer extension services to the fodder producers. They also offer ploughing services and seeds to the producers and have grass seed storage facilities from which they process the bulked seeds. Unlike the independent grass seed traders, these institutions offer fixed prices for seeds but are a source of seed markets regardless of the seasonality in production.

Supporting services to the fodder producers in the grass seed value chain

Extension services provided by NGOs and government institutions include information dissemination and training in new technology. Individuals who receive such training are able to plan their activities accordingly, consequently making appropriate and timely decisions, thus reducing uncertainties and risks associated with production (Elhadi et al. 2012). In this regard, only 64% of the fodder producers interviewed had received training in fodder production practices. As shown in Figure 6a, most of the producers (51.6%) received training from the Ministry of Livestock, while 25% were trained by the RAE Trust, 12.5% by KVDA, 9.4% by KALRO and 1.6 % by FAO.

Figure 6b shows that majority of the fodder producers had access to information on fodder production. The majority (57.5%) received the information from NGOs, 36.8% from other fodder producers and 0.9% from the Ministry of Livestock (MoL). Extension workers were the main information delivery channel to 60.4% of the fodder producers, while 38.7% of the producers received information through fellow producers. The KVDA, RAE Trust and the sub-county livestock production office all have extension workers who visit fodder producers in the study area. This explains the dominance of extension workers as the information delivery channel. Generally, access to agricultural information in Baringo County is high due to the focus of research and private institutions on the Perkerra irrigation scheme (Syomiti et al. 2015).

Access to credit is often viewed as an important mechanism for enabling intensification, and various financial institutions in Marigat Sub-County offer such services to fodder farmers (KRDP/ASAL DM 2012). However, Figure 7 shows that fodder producers in the area have little interest in taking credit for fodder production. The

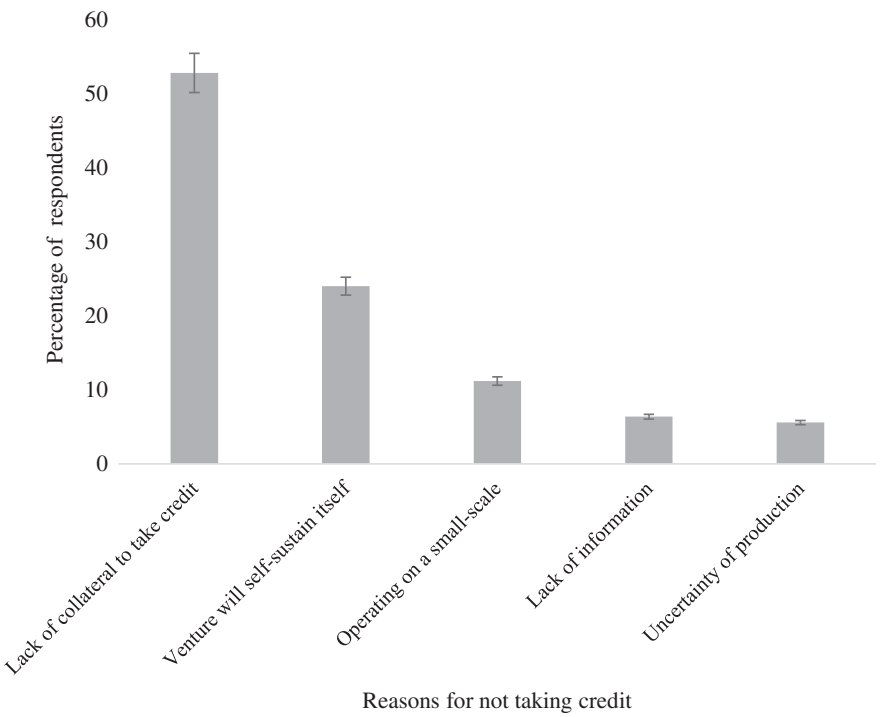

Figure 7 Fodder producers' reasons for not taking credit for fodder production

vast majority of the fodder producers have either never sought or do not see the benefit of seeking credit to enhance their fodder production activities. Even if they wanted to use credit facilities, most of the pastoralists lack collateral, partly due to the communal ownership of land. Access to credit facilities could enable them to invest in irrigation practices, thereby sustaining their grass seed production during drought periods, but it remains unclear whether this could be sufficiently remunerative to be beneficial.

Challenges facing the grass seed value chain

The fodder producers cited the shortage of planting labour as a challenge. This was attributed to the high demand for labour for other economic activities that usually makes hired labour expensive. In addition to the scattered small fodder farms that made ploughing an uneconomical venture for the service providers, poor bush clearing by the fodder farmers meant regular break down of ploughs, therefore making it costly for the service providers to repair and maintain their equipment.

Figure 8 shows major challenges facing fodder production in the study area. Frequent droughts and intrusion of goats into fodder farms due to poor fencing were the challenges reported by most of the fodder producers. These findings are consistent with those of Joosten et al. (2014) who found lack of hay and grass seed storage facilities, poor fencing systems on fodder farms, recurrent droughts which affect pasture establishment and growth, and communal land ownership to be some of the challenges facing fodder production in Baringo County. The problems faced at the production stage along the value chain were found to be similar to those faced by fodder farmers in Makueni County where continuous droughts and poor fencing of the fodder farms were some of the major problems (Mutua 2014). In a study conducted in southern Kenya to determine the financial returns of three range grasses, Ogillo et al. (2010) reported droughts, termite problems and seed loss to be the challenges faced in fodder production. Furthermore, Mnene (2006), while studying the strategies to increase success rates in natural pasture improvement through reseeding degraded semi-arid rangelands of Kenya, reported drought, poor establishment and lack of or poor grass seeds to be some of the challenges facing fodder production.

The fodder producers cited the inability of market outlets to buy grass seed at times and low prices offered for grass seed as their main challenges in the marketing of their produce. Independent grass seed traders and the bulking and processing agents mainly faced the challenges of poor quality of seeds due to improper post-harvest handling by producers. Such included inadequate drying, immature seeds and seeds mixed with chaff. The independent grass seed traders experienced delay in payment when organizations bought grass seeds on contractual terms. The high cost of an independent grass seed trader certificate which is issued by the Kenya Plant Health Inspectorate Service (KEPHIS) was also cited as a challenge.

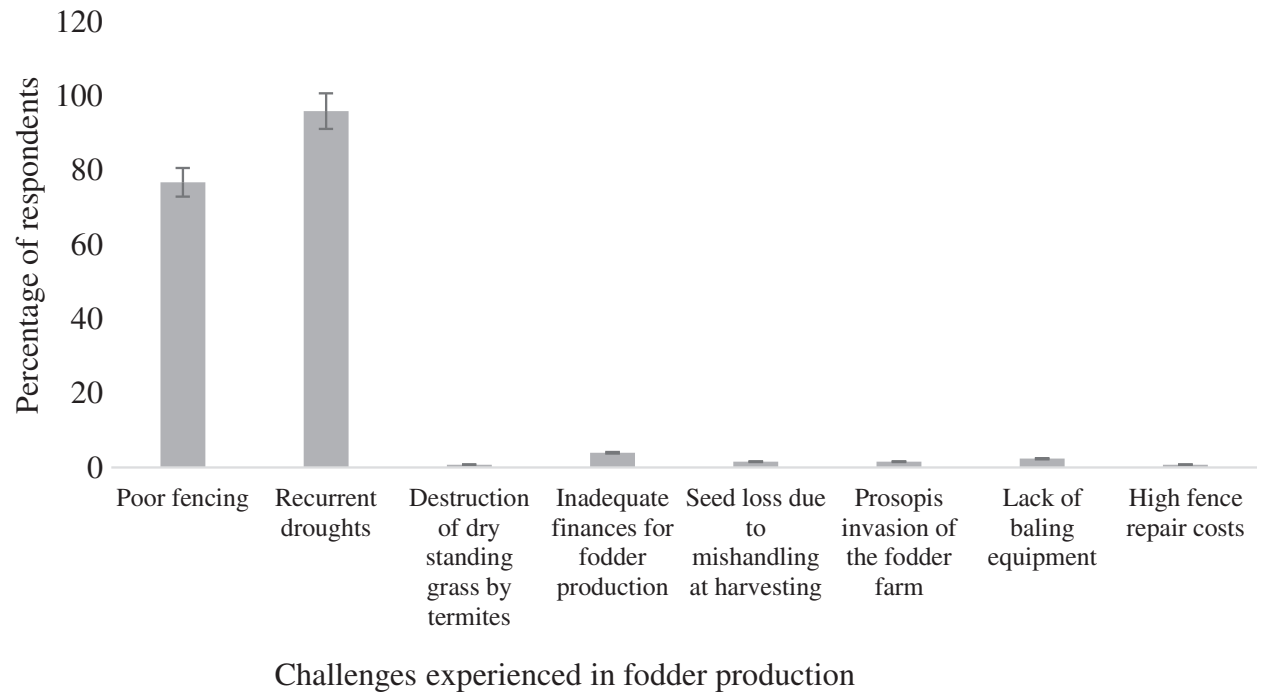

Figure 8 Challenges facing fodder production in the study area

The KVDA cited the following: the difficulty in predicting the grass seed harvest time as this is not usually indicated by the fodder producers. The harvest time is crucial to KVDA for the purpose of advising the seed buyers on the storage time needed to break seed dormancy before planting. The unscrupulous behaviour of mixing grass seeds with stones by some of the fodder producers,to increase the weight with the view of fetching more money, was reported by KVDA as a challenge. In general, the various challenges faced by actors along the chain are consistent with findings of Nangole et al. (2013) who found out lack of capital, seed quality issues, lack of consistent markets and lack of storage space to be some of the challenges faced by actors in the fodder value chain in the Rift Valley region of Kenya.

Positive developments in grass seed production in the study area

There is a Public-Private-Partnership between organizations such as RAE Trust, KVDA, KALRO and SNV which are supporting the pastoral communities in fodder production. RAE Trust, KVDA and KALRO all undertake fodder production on their respective stations which serve as demonstration plots for the communities. They also train fodder farmers on best production practices and make follow-up visits on fodder farmers' farms. SNV has supported selected fodder production groups by fully subsidizing ploughing and grass seed costs. Kenya Commercial Bank (KCB) and BORESHA SACCO in Marigat offer support to fodder production groups through the provision of loans and financial management trainings.

Conclusion

The grass seed value chain actors were found to play roles that complement each other. The value chain was dominated by bulking and processing agents who work through field agents. The fodder producers in Baringo County expressed preference for market outlets that allow for seed price negotiations over those offering fixed prices. Contractual agreements that integrate provision of inputs and purchase of seeds were not portrayed as advantageous by producers. Overall, the promotion of fodder production by provision of technical training and subsidization of start-up costs, but extending assistance to the marketing stage of the value chain, misses a large part that will make the system work better. As such, there is need to strengthen the fodder producer groups with a possibility of registering them as cooperatives for the purpose of collective bargaining for better grass seed prices.

Abbreviations

ASAL: Arid and Semi-Arid Lands; ASAL DM: Arid and Semi-Arid Lands Drought Management ; CARE: Cooperation for Assistance and Relief Everywhere; EU: European Union; FAO: United Nations Food and Agriculture Organization; KALRO: Kenya Agricultural and Livestock Research Organization; KARI: Kenya Agricultural Research Institute; KCB: Kenya Commercial Bank; KEPHIS: Kenya Plant Health Inspectorate Service; KIRA: Kenya Interagency Rapid Assessment; KRDP: Kenya Rural Development Programme; KVDA: Kerio Valley Development Authority; MoL: Ministry of Livestock; NDMA: National Drought Management Authority; NGOs: Non-Governmental Organizations; RAE: Rehabilitation of Arid Environments Trust; RoK: Republic of Kenya; SPSS: Statistical Package for the Social Sciences; USA: United States of America; USD: United States Dollars; VSF: Veterinaires Sans Frontiers.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

KOL contributed to the conception and design of the study, collected the data, carried out analysis and interpretation of data, drafted the manuscript and submitted the approved version. OVW contributed to the conception and design of the study, assisted in the interpretation of the data, revised the manuscript critically for intellectual content and gave approval of the version to be published. YAE contributed to the conception and design of the study, guided the data analysis process, revised the manuscript critically for intellectual content and gave approval of the version to be published. TAC contributed to the conception of the study, facilitated the acquisition of funds for the study, coordinated the data collection process, revised the manuscript critically for intellectual content and gave approval of the version to be published. All authors read and approved the final manuscript.

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