Sharing Grazing Land and Water Resources in Semi-Arid Pastoral Areas: Social Tenure Domain Model Experience in Rural Kenya

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Abstract

Livestock play important roles in Kenya's socio-economic development and contribute towards household food and nutritional security. The livestock sector contributes about 12% of Kenya's Gross Domestic Product (GDP), 40% to the agricultural GDP and employs 50% of agricultural labor force. Over 60% of Kenya's livestock herd is raised in the arid and semi-arid lands (ASALs), which constitute about 84% of the country and home to nearly 30% of Kenyan population, and also home to most of the country's national parks that are the foundation of its thriving wildlife tourism. It is estimated that 10 million Kenyans living in the ASALs derive their livelihood largely from livestock. Some of the key challenges of livestock production is ASALs are resource degradation and private encroachment (grabbing) of the communal grazing lands, and limited access to land for fodder production by youth and women. This paper presents the experiences on the utilization of GLTN tools, particularly, the participatory enumerations, community mapping and database creation using the open source GIS based tool called the Social Tenure Domain Model (STDM) in promoting sharing of grazing land and water resources in semi-arid pastoral areas under the Smallholder Dairy Commercialization Programme (SDCP) in Dairy Commercialization Area 1 of Bomet County in Kenya. A total of 498 dairy farmers and 43 communal resources were enumerated, mapped and geo-referenced. The communities are using the maps to re-claim their grabbed grazing lands and deter further encroachments. The next steps will involve utilization of the data to improve natural resource use efficiency, reduce resource degradation, and promote production and market linkages. The database created will be used by SDCP in designing technical interventions on land and water utilization to enhance resource use efficiency. The geo-referenced database will also be used to enhance marketing information system. It is expected that tenure security of the communal land will be enhanced further when communities realize the enhanced economic value of their land following increased production and marketing efficiency that will drive up dairy profits and incomes that farming communities realize from their dairy business.

Key words: Smallholder farmers, pastoralists, land tenure security, common resources, STDM.

1. Introduction

The livestock sector contributes about 12% of Kenya's Gross Domestic Product (GDP), 40% to the agricultural GDP and employs 50% of agricultural labor force. Over 60% of Kenya's livestock herd is found in the arid and semi-arid lands (ASALs), which constitute about 84% of the country and home to nearly 30% of Kenyan population, and also home to most of the country's national parks that are the foundation of its thriving wildlife tourism. It is estimated that 10 million Kenyans living in the ASALs derive their livelihood largely from livestock. Livestock play important roles in Kenya's socio-economic development and contribute towards household food and nutritional security.

The stakeholders in the sector have recognized the role that a vibrant livestock industry can play to reverse the poverty levels and contribute to the nation's economic growth. The recognition is emphasized in various government policy documents such as the Kenya Vision 2030 and its respective five year medium term plans, the National Policy for the Sustainable Development of Northern Kenya and other Arid Lands, Sustainable Development Goals (SDGs) and the National Livestock Policy (NLP). To implement the NLP, the Government of Kenya has developed various projects, programmes and interventions. One of the programmes is the Smallholder Dairy Commercialization Programme (SDCP).

SDCP is a 13 year investment programme of the Government of Kenya implemented through the Ministry of Agriculture, Livestock and Fisheries and is financed by the International Fund for Agriculture Development (IFAD). The goal of SDCP is to increase the income of the poor rural households that depend substantially on production and trade of dairy products for their livelihoods. The overall objective of SDCP is to support commercialization of dairy and dairy products through the Market Oriented Dairy Enterprises (MODE) approach.

The programme operates in nine counties in western Kenya that are predominantly characterized by pastoralism. Some of the key challenges in the SDCP programme areas are resource degradation and private encroachment (grabbing) of the communal grazing lands, and limited access to land for fodder production by youth and women. With increasing competition for dwindling land resources, the smallholder dairy farmers are faced with challenges and risks as a result of growing populations, land degradation, climate change and land grabbing resulting in a threat to food security and land rights of poor and vulnerable people. In addition, women and youth have been excluded predominantly in terms of access to and control over land and other natural resources.

According to FAO (2017), the livestock sector is the world's largest user of agricultural land, through grazing and the use of feed crops.Therefore, land tenure security is important for rural development and poverty reduction. Secure access to land, whether through formal, customary or other means, is necessary for rural households to enjoy sustainable livelihoods, and is an important part of sustainable development (FAO, 2002). Without secure land rights, investment (financial and labour) and the uptake of new technologies in agriculture and sustainable land management is undermined. Women typically have

weaker land rights. Pastoralists use large percentages of what is often considered marginal land.

To address the challenge, SDCP requested the technical assistance of the Global Land Tool Network (GLTN) within the framework of its cooperation project with IFAD's Land Tenure Desk of Land and Natural Resources Tenure Learning Initiative for Eastern and Southern Africa (TSLI-ESA[1]).

TSLI-ESA is a collaborative regional initiative of the GLTN and IFAD that aims at building knowledge, awareness, and capacity of staff and partners of IFAD on integration of pro-poor and gender appropriate land tools for strengthening of access to land and security of tenure for communities targeted by IFAD supported investment projects and programmes in Eastern and Southern Africa (ESA) region. TSLI-ESA Phase 1 reviewed and identified a list of 22 on-going IFAD supported investment projects and programmes with lessons for the development of tools and approaches on five thematic areas: (i) Land and water rights, in the context of watershed management and irrigation schemes; ii) Recognising and documenting group rights to land and related natural resources; iii) Supporting women's access to land and related natural resources; iv) Using approaches and technologies for mapping land and natural resource use and rights; and v) Securing and valuing land and natural resource rights as part of establishing business ventures between rural communities and investors). In addition, to continuing with the knowledge management, TSLI-ESA Phase 2 selected 4 focus countries, Uganda, Kenya, Malawi and Mozambique for country-level engagement on capacity development for land tenure tool implementation.

At country level, the process of land tenure tool integration in the IFAD supported projects and programmes followed six stages (Figure 1):

Stage 1: Country Scoping - consultations with the IFAD supported projects and partners to identify land tenure issues and areas of collaboration with TSLI-ESA Project;

Stage 2: Orientation Workshop – platform to showcase GLTN tools, initiate plan of engagement with IFAD country office, IFAD supported project/programmes, and in-country GLTN partners;

Stage 3: Action planning – a joint meeting for putting in place a strategy and plan for tool pilot implementation;

Stage 4: Tool implementation of selected tools – on a pilot basis to assess appropriateness and efficacy of the tool;

Stage 5: Up-scaling – adopting the tool for implementation at large scale within the project area; and

Stage 6: Out-scaling – adapting the tool to another context or geographical area.

1 TSLI-ESA initiative has two phases, Phase 1 was a small grant agreement (October 2011 – June 2013) and TSLI-ESA Phase 2 (October 2013 – December 2017) is a large grant agreement.

Figure 1: Stages for land tenure tool integration in the IFAD supported projects and programmes

Source: Mkumbwa (2017).

In Kenya, SDCP is one of the two IFAD supported programmes that were selected for technical support. The other is the Upper Tana Natural Resources Management Programme.

This paper presents the experiences on the utilization of GLTN tools, particularly, the participatory enumerations, community mapping and database ncreatuion using the open source GIS based tool called the Social Tenure Domain Model (STDM) in the Smallholder Dairy Commercialization Programme (SDCP) in Dairy Commercialization Area 1 of Bomet County in Kenya. The next section presents the literature review followed by methodology section, then a sections on findings and discussion then conclusion.

2. **Literature review**

2.1. Theoretical basis for promoting participatory enumeration and mapping

2.2.1. Advantages and issues faced in conventional enumeration

Theoretically, professionals could undertake information gathering to produce immediate action. However, the challenges of informality and poverty encountered by the rural poor residing in pastoral areas require a degree of greater understanding. This is where the power of participatory enumerations by communities becomes important. Communities can demonstrate their immediate, medium, and long term use of the data they have collected

about themselves regarding simple things such as documentation needed to produce identity, as well as for seeking amenities and services from the state and many other purposes. The community itself becomes the custodian of the data, and thus is able to hold dialogues with whoever is currently employed at a given post. This gives the community the power to sustain the momentum for their demands. Several problems might arise during the process of conventional data collection by external parties. The data collected by external agencies is rarely verified by residents before. There would be pressure on the interviewers to work quickly and to limit the time spent interviewing each person or household, thereby obtaining inadequate or inaccurate data. In addition, the interviewers may not speak the language of those they interview, in which they might need translators in getting accurate responses. There are also those who do not want to be interviewed by outsiders. Finally, in many instances, the respondents do not necessarily answer correctly or truthfully.

2.2.2. Advantages of community led enumeration and mapping

There are many advantages of enumeration and mapping by the community compared to conventional enumeration. When the data is collected by professional, state, or non-state agencies, communities are not able to relate to them and in the process become passive "givers" while answering questions that are put to them. However, when stepping into the shoes of "active data collectors", the community can identify, address, and visualize a solution to their problems in a more precise and cohesive manner. The process of designing surveys, understanding the logic behind data parameters, learning to quantify answers and seeing the overall picture of their settlement provides vital insights to the community, which can then relate to the actual situation. It further deepens the links between intuitive understanding, coupled with evidence and logic and facilitates articulation by the residents themselves, rather than outsiders. In such cases, the ownership and responsibility of the data remains with the community. Information gathered by the community produces accurate data and knowledge regarding the settlement they live in and the issues that affect them. Since the information and knowledge about the community is obtained by the community themselves, the nature of the information becomes very powerful and self-instructive – the data they gather gives them additional insights into improving their own lives. Their ownership of the data empowers and motivates them to set up various organizational committees to use the data for their own benefit.

According to PRIA International Academy (2013) the process of community led enumeration and mapping started in the year 1975 In Mumbai by the leaders of informal settlements, which faced a constant threat of eviction by the civic bodies. The community realized that in order to explore long-term solutions to prevent the threat of eviction, it needed to allow its leaders to be organised and develop an understanding of the communities' composition and needs. These community leaders eventually established the National Slum Dweller's Federation (NSDF). Later on Society for the Promotion of Area Resource Centre (SPARC) and Mahila Milan joined in to build upon the work of NSDF. Collectively, known as the Alliance, they also facilitated building women's collective leadership to help women participate in these processes to secure habitat.

2.3. Land and natural resource tenure security

The common resources for smallholder dairy farmers in Bomet County are land, pastures and water. The question that arises from the resources in both production and management is; how do we use the Social Tenure Domain Model to secure the common resources? Figure 1 illustrates the relationship between STDM and land and natural resource management. In the context of the Arid and Semi Arid Lands (ASAL), land tenure security is critical for food production systems and livelihood sustainability that is heavily supported by water and pasture supply. Therefore proper management of land, water and pastures is required for sustainability. The use of technology has gained traction in enhancing security and protecting natural resources. This however is more possible when planning is properly done in a more inclusive and participatory way guided by the framework for tenure security learning initiative (Figure 1). STDM is a technology that was piloted in Bomet County of Kenya with components of milk production systems and common natural resources. Sustainability of resources depends on their security.

STDM provides the boundaries of the natural resources with certainty. These resources support milk and beef production as major sources of livelihood and these can be threatened if things change thus making them inefficient. Water includes rivers, streams, springs and wells. STDM was used to ascertain their status through mapping and to question their management. Who are involved in their access, utilization and management? Their status was also documented with respect to private ownership or if they are socially shared among the community members. Communal resources face a danger of over exploitation. The capacity of the people who depend on these water resources is documented. STDM helps in proper management and to show the realities on the ground. Livelihood systems become sustainable with natural resource tenure security and management.

The mechanisms of milk production, resource use and management are anchored on policy conversations. Some of the existing relevant policies include the ASAL policy, Kenya Vision 2030 and the Community Land Act. Poverty reduction strategy is achieved through enhanced land and natural resources tenure security that leads to increased productivity in terms of the quantity of milk produced per cow per day. Increases in milk output require an efficient milk production and marketing system. Profit maximization requires both technical and economic efficiency (Kibiego, 2015; Kembe and Ochola, 2016). The Smallholder Dairy Commercialization Programme (SDCP) supports the milk market for dairy farmers through infrastructure development including supply and installation of milk coolers, and advocacy for road improvements. Bulking of milk will enhance the market power of smallholder farmers leading to increased income and poverty reduction through the Market Oriented Dairy Enterprise (MODE) approach. This, in a sense, also promotes the need for;

- Investing in rural infrastructure (roads, irrigation, market centres, energy, information) (enabling environment)

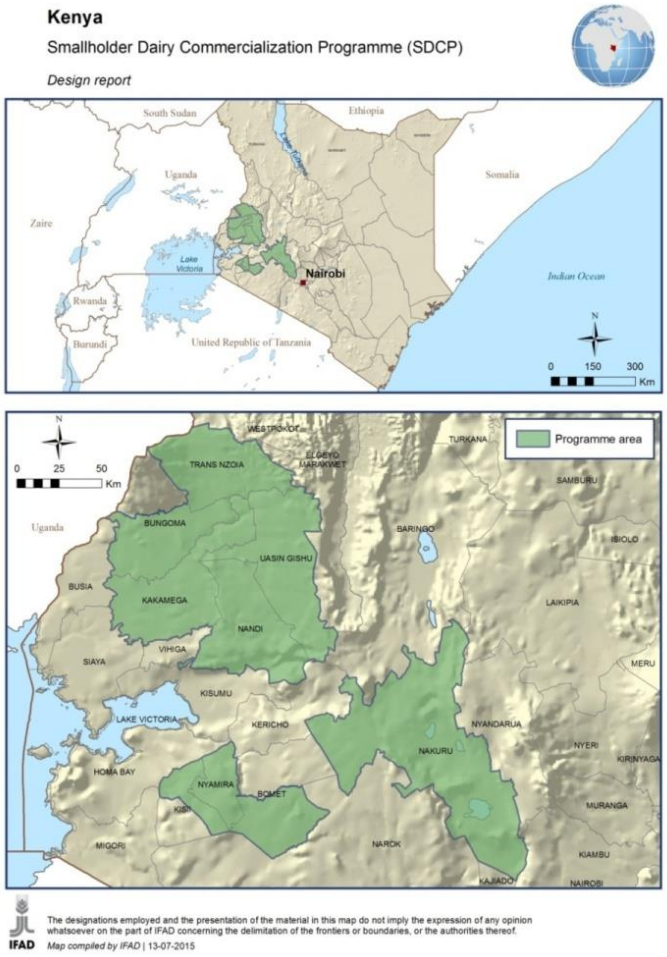
- Promoting long-term farm-level group-based value addition on traditional staples in addition to the current production e.g., cassava, sweet potatoes, sorghum and dairy products
- Strengthening local capacity to map and document quarterly [or seasonal] production and consumption requirements at village levels
- Developing institutional mechanisms for food inventory management [could entail government silos, farmer-group warehouses or private commercial storage systems]
- Manage climate-change induced yield variability through change of crop varieties over seasons
- Strategic production timing to avoid gluts shortages and price volatility • Promote direct participation of farmers in markets rather than through intermediaries (collective action)
- Manage food contamination and other forms of post harvest losses
- Scale-up/replicate good practices/strategies

3. Methodology

3.1. Pilot site and data collection

The population for this paper was all the 498 smallholder dairy producers of Sugumerka Dairy Commercialization Area (DCA) in Bomet county of Kenya. Sugumerka DCA was selected for the community driven enumeration and mapping process because it is a semi-arid pastoral area and the type of land and natural resources tenure arrangement is markedly different compared to other DCAs (Figure 2). The differences stem chiefly from differing ecological and climatic conditions, historical patterns of settlement, and the political and policy initiatives over time. The differing tenure arrangements have, in turn, had significant impact on land and natural resource management and productivity.

Figure 2: Map of the Kenya showing the project site



Sugumerka is a semi arid region of Bomet County (low potential) that borders the Maasai pastoral areas where communal grazing is a common practice. The lowland areas are parceled for individual households' farm plots, though most of them do not have registered titles. Seasonal droughts force the farmers to practice pastoralism. The fodder that the lowlands farmers produce on their gardens only last for 3 out of 12 months. There are fewer perennial water springs, and most of them have been designated for use as communal water points. The few wet valleys in the area are reserved for communal grazing during the dry season, while some bare hill tops are communal grazing areas for the wet rainy season. Due to limitations of water and fodder, and high incidence of parasites and diseases (mostly as a result of physical interaction of animals in the communal drinking, grazing and dipping grazing areas), farmers in the lowlands prefer low milk-yielding local and hybrid animals. These animals are easy to feed (can stand poor diets), and resist most parasites and diseases.

3.2. Implementation process of community enumeration and mapping

This pilot project was implemented jointly by SDCP, Global Land Tool Network (GLTN) through the 'Land and Natural Resources Tenure Security Learning Initiative for East and Southern Africa (TSLI-ESA), Resource Conflict Institute (RECONCILE), Pamoja Trust and Technical University of Kenya. These partners were selected because they have advanced experience in land and natural resource mapping. Data collection for the pilot application of STDM in securing grazing land rights in Bomet county took place from February 2nd to October 30th, 2016 in Sugumerka Dairy Commercialization Area (DCA). The project targeted securing of communal resources and was implemented through two main approaches; Mapping - using technically advanced geographic information technologies, such as aerial photography, remote sensing technology and geographic information systems for mapping land and natural resource rights, use and management; and facilitating training, documentation and two way learning (application of local expertise (indigenous) and experts). The participatory nature of the project during the 6 months period enabled communities to benefit from the application of on-site learning by piloting of the STDM concept and tool in a communal setting.

A partners' meeting in Nairobi reviewed the mapping tool and data collection template. The key engagement with the Bomet County government led to discussions with the relevant County government departments/ministries including Forest, Agriculture, Environment/National Environment Management Authority (NEMA), Lands and Water, and Fisheries. The documentation of the project process and implementation informed the learning and sharing with stakeholders. RECONCILE was the lead implementing agency that coordinated planning, consultations, selection of enumeration sites and recruitment and training of enumerators in Sugumerka DCA. In addition, it coordinated data collection, data analysis, and involvement of women and youth. These processes led to data ownership by the community.

In addition, a total of 43 common resources were identified and documented then questionnaires were used to capture their socio-economic data. Using a census in Sugumerka dairy commercialization area (DCA) of Bomet County, 498 smallholder farmers were interviewed using pre-tested structured questionnaires. The data collection instruments namely questionnaires, observations, focused group discussions and key informant interviews were used for data collection. The primary and secondary data were employed complementarily to give a unique category of data for this study. It was used particularly to fill in the gaps in primary data as per the study themes. The information collected included education level, marital status, gender and age of smallholder farmers. In addition, off farm employment of smallholder farmers, land size (ha) of household, quantity of milk produced and its price, income from milk sales and challenge of access to land, water and communal pasture was captured. For the common resources, their coordinates, management, sizes, tenure, usage, status and their problem were documented.

3.3. Data analysis

Data from the questionnaires was entered into SPSS software and analyze using descriptive statistical techniques including frequencies, percentages, mean, minimum, maximum and standard deviation. Descriptive statistics, commonly used by social scientists, is important

because it allows large data sets to be collected with a little expense (Wooldridge, 2009). Further analysis used inferential statistics namely correlation and regression techniques. The key benefits of using regression analysis are that it can: indicate if independent variables have significant relationship with a dependent variable; indicate the relative strength of different independent variables' effects on a dependent variable and help to make predictions (Mugenda and Mugenda, 2003; Mugenda, 2011).The regression model is given by:

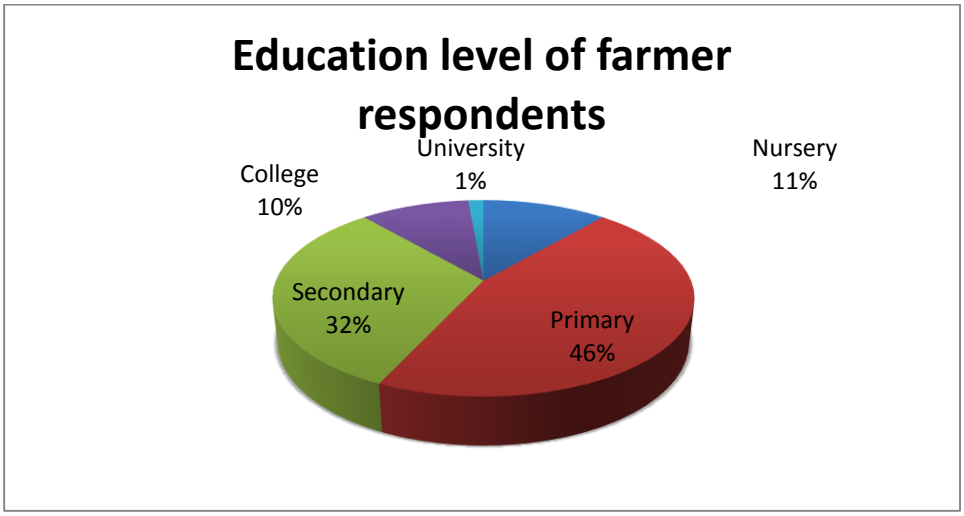
$Y = \beta_0 X_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_6 X_6 + e$
Y = Status of common resource
β = Coefficient
X_0 = Constant
X_1 = Location of common resource
X_2 = Ward of common resource
X_3 = Category of common resource
X_4 = Size of common resource (Ha)
X_5 = Problem of common resource
X_6 = Management of common resource
e = Error term
Finally, Geographic Information System (GIS) was used to generate a resource map.

4. Results and Discussion

4.1. Results

The Community driven enumeration and mapping process in Bomet generated information from 498 smallholder dairy farmers. Among them, 56% had received nursery or primary education while 32% had secondary education (Figure 3). Only 1% had completed university studies. Education may be a challenge to many of these farmers in accessing information for improved livestock production and natural resource management.

Figure 3: Educational level of farmer respondents



In Figure 4, majority (82%) of the farmers are married while 13% are widows/ers. Only 5% are single. Marriage is a customary practice associated with age.

Figure 4: Marital status of respondent farmers

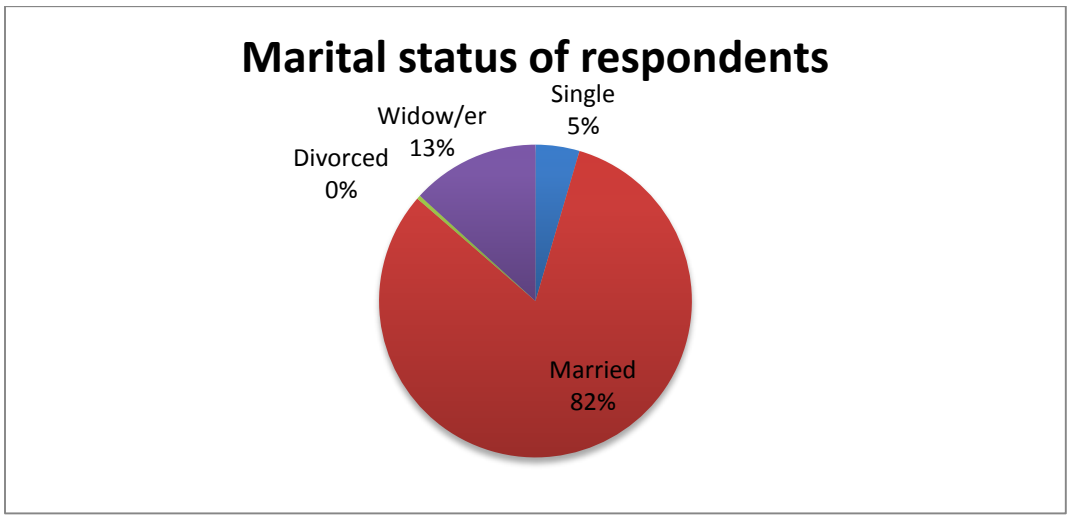
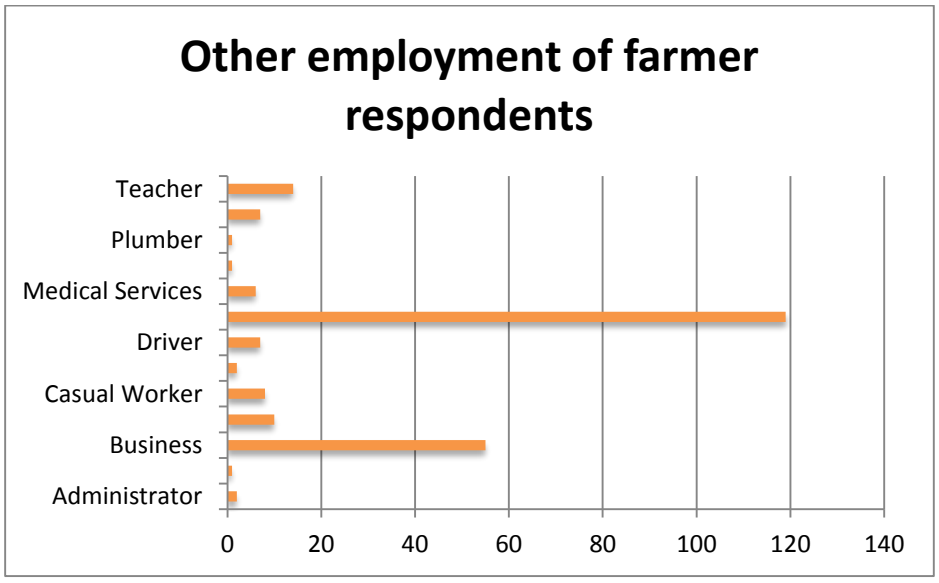


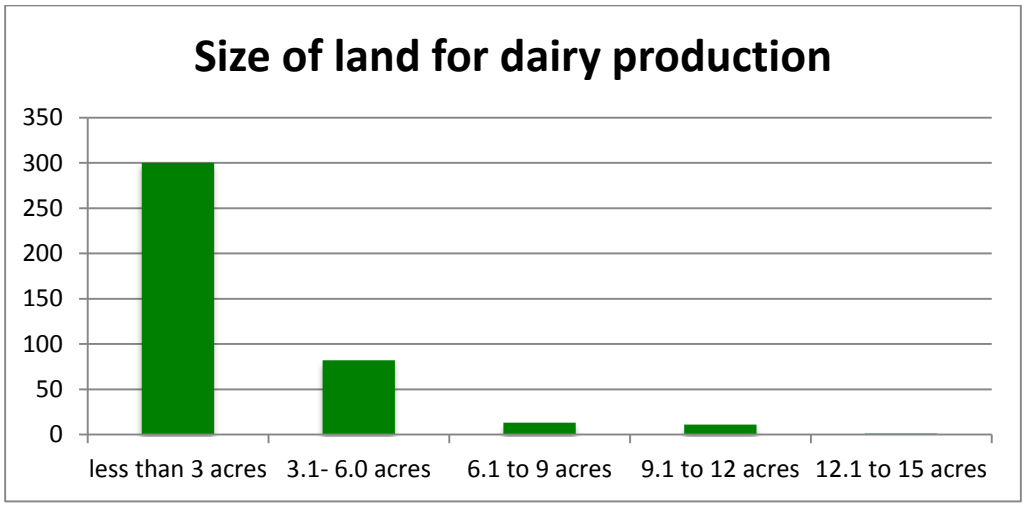
Figure 5 shows that based on their educational level, the small scale farmers are involved in low income off-farm employment such as being a watchman, plumber, engaging in masonry, casual work and being a driver. Among them, 24% only practice farming (Figure 5). Additional income from off-farm employment is important for food security, improving the livelihood of the family and land and natural resource management.

Figure 5: Off-farm employment of respondents



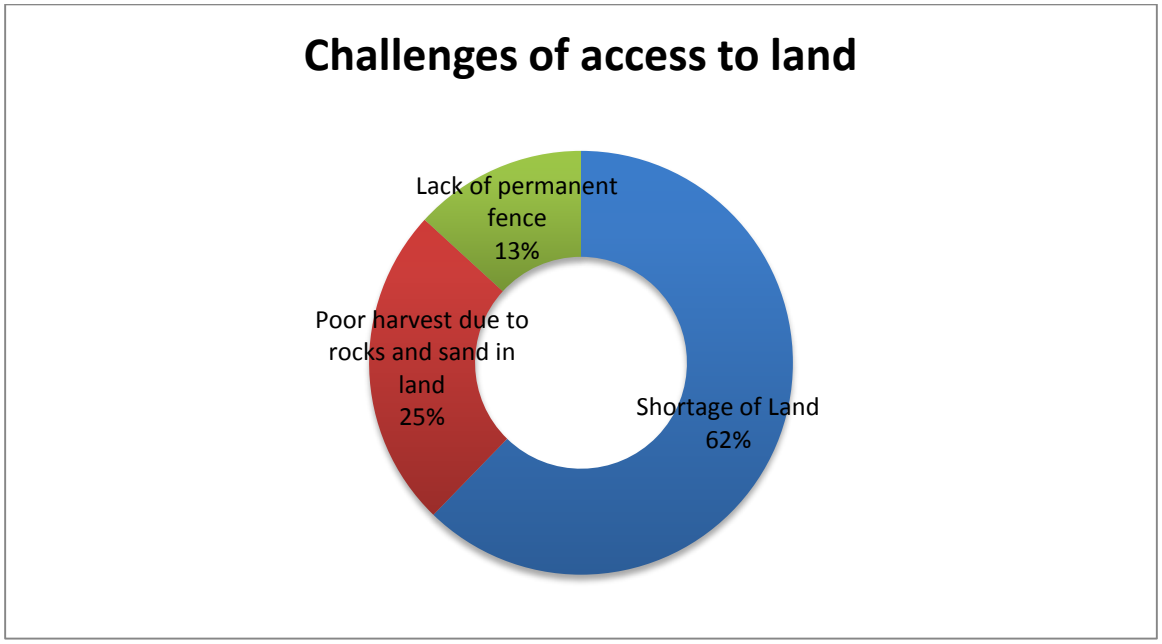
The distribution of the average size of private land holdings among the smallholder farmers is shown in Figure 6. Most of these farmers (61%) own land less 3 acres. Indeed, no farmers has land over 12 acres. The inter generational sub division of land has led to a decline in land sizes per household thus necessitating increased exploitation of communal land for grazing and provision of other services. In turn, the communal land has been overgrazed resulting in soil erosion and low productivity in terms of grazing.

Figure 6: Average household land sizes



There are many challenges of access to land in Bomet county (Figure 7). These include shortage of land, poor harvest due to rocky land and sandy soils, and lack of a permanent fence around the land.

Figure 7: Challenges to access to land



Similarly, the smallholder dairy farmers are faced with several constraints with respect to access to water resources (Figure 8). The most acute problem is shortage of water during the dry season (46%) since the region is semi- arid. Other challenges include long distances to the water source, water conflicts among communities, lack of a corridor heading to the river and water contamination. Contamination arises from sharing of water with cows, sheep, goats, donkeys and humans.

Figure 8: Challenges of access to water

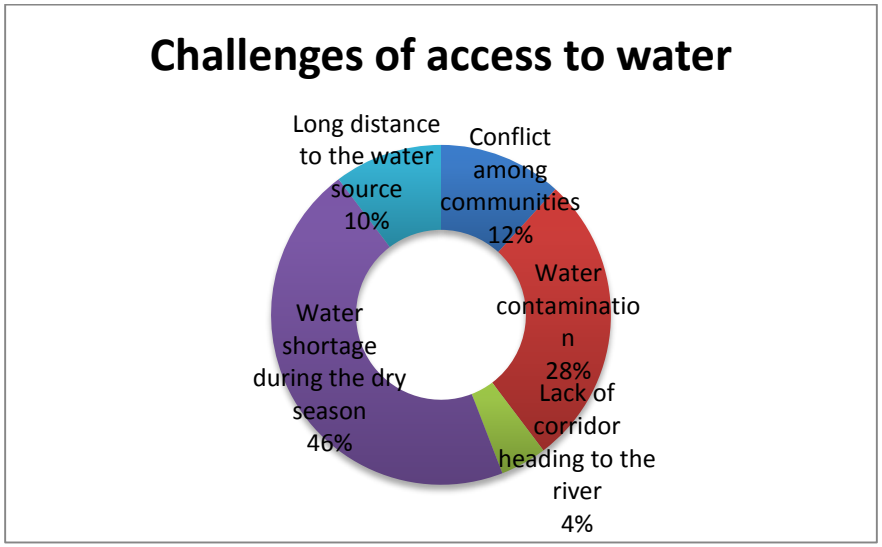
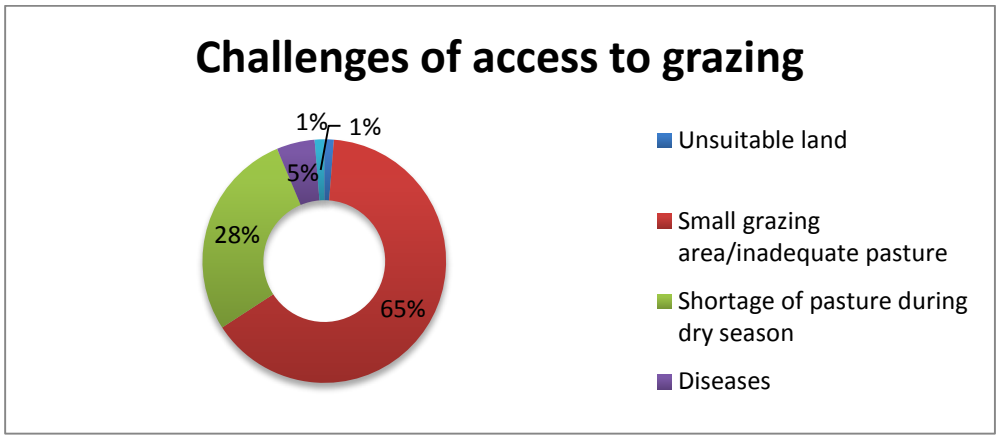


Figure 9 illustrates various constraints faced by farmers in accessing communal grazing lands. Among them, inadequate pasture contributes 93%. Others include spread of livestock diseases and boundary disputes. The disputes are generated by attempts to encroach on communal land.

Figure 9: Challenges of access to communal grazing land



Despite the challenges of land and water, the smallholder dairy farmers make efforts to increase milk production. Table 1 shows the milk production, consumption and sale in Sugumerka Dairy Commercialization Area. There is a significant variation between the wet and dry seasons arising from the seasonal nature of rainfall. Average milk production increased from 3.8 liters/cow/day to 6.6 liters/cow/day during the dry and wet seasons respectively. The smallholder farmers sold 62.7% of the milk produced in the farms which enabled them to earn USD 32.7/month and USD 51.4/month during the dry and wet seasons respectively.

Table 1: Milk production, consumption and sales

	Average Milk Production in wet Season (Litres)	Average Milk Production in dry Season (Litres)	Percentage of Milk For Sale	% of milk for domestic consumption	Value of milk sales - wet season (USD/Month)	Value of milk sales - dry season (USD/Month)
N	463	434	430	432	426	422
Mean	6.66	3.8	62.7	30.24	51.41	32.71
Minimum	1	1	1	1	10	5
Maximum	20	15	100	100	474.5	243

Figure 10 shows Bomet enumeration map. Both communal and private resources were mapped using GIS. The communal resources included land, water points, streams salt licks

and pastures. The documentation of these resources helps the pastoral community so that their communally held land is not encroached. In addition, the Dairy Commercialization Area Committee (DCAC), that is the custodian of the map can better understand and carry out land and natural resource management to prevent further land degradation and encroachment.

Figure 10: Bomet enumeration map

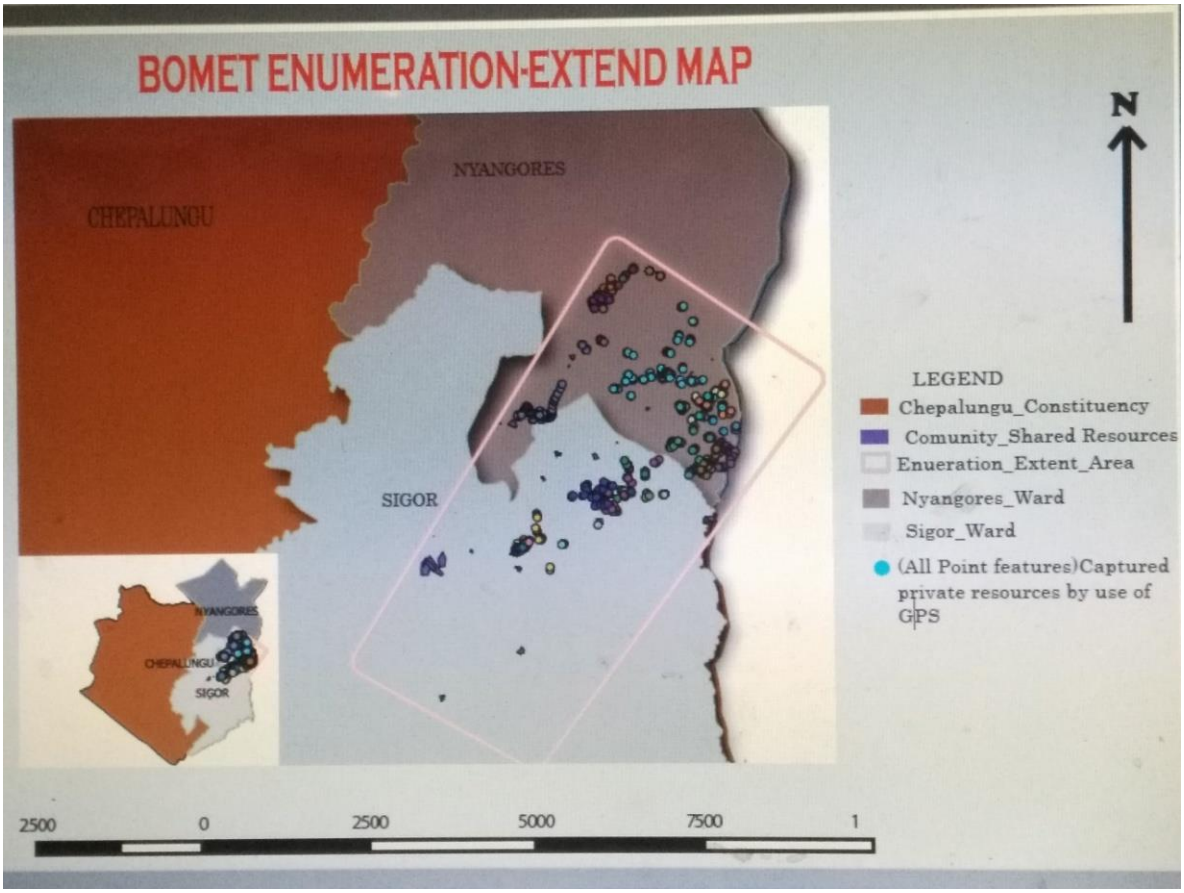


Figure 11: Location of common resources.

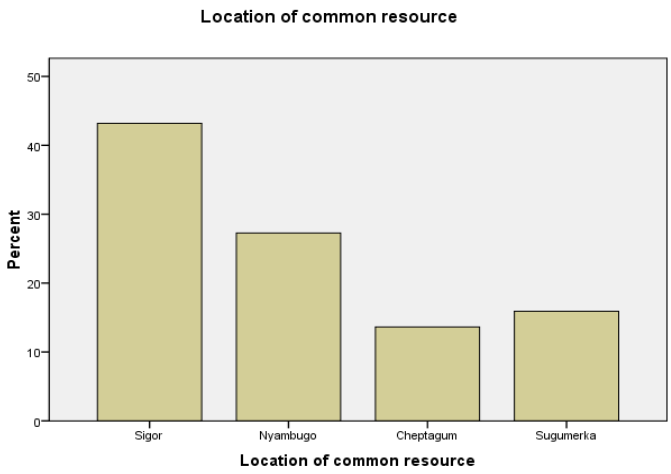


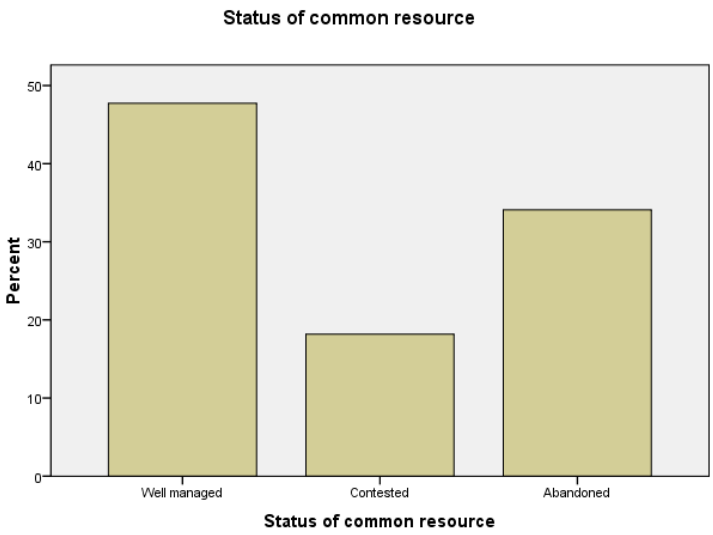
Figure 11 shows that Sigor location had more common resources while Sugumerka had the least amounts. Sugumerka is the drier part of Bomet county. The other locations are Nyambugo and Cheptagum.

Table 2: Category of common resource

	Frequency	Percent	Cumulative Percent
Grazing area	5	11.1	25.0
Salt lick	1	2.2	27.3
Milk cooler	1	2.2	29.5
cattle dip	7	15.6	45.5
water pan	17	37.8	84.1
Food security store	1	2.2	86.4
Animal crush	6	13.3	100.0
Total	44	100	

In Table 2, the common resources in the pilot area are shown. The major resources include grazing area, water pans and animal crushes. Others include salt lick, milk cooler, food security store and a cattle dip.

Figure 12: Status of common resources



Among the common resources, 47.7%, 18.2% and 34.1% are well managed, contested and abandoned respectively (Figure 12). This calls for an urgent need for improvement of land and natural resources tenure security. In Table 3, the problems associated with the common resources are listed.

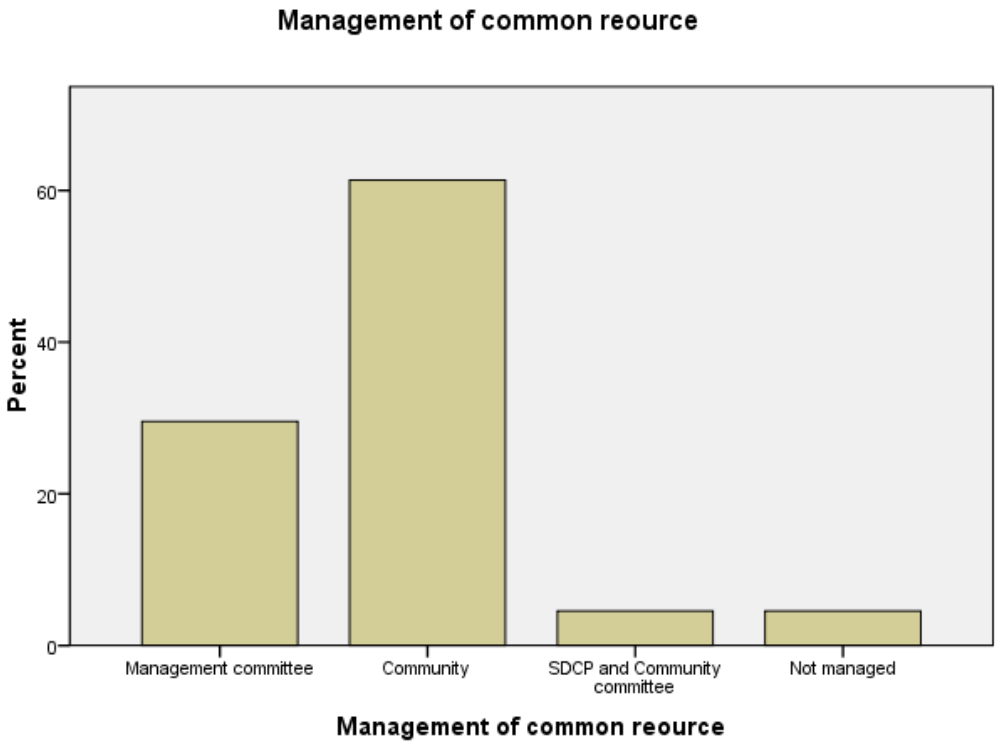
Table 3: Problems of common resources

	Frequency	Percent	Cumulative Percent
Requires maintenance	4	9.1	20.5
Poor status	7	15.9	36.4
Requires de-silting	3	6.8	43.2
Overgrazing	2	4.5	47.7
Soil erosion	1	2.3	50.0
Incomplete structure	2	4.5	54.5
Unprotected	4	9.1	63.6
Pan has plant cover	3	6.8	70.5
N/A	13	29.5	100.0
Total	44	100.0	

These include poor status (15.9%), the need for de-silting (6.8%), unprotected resource (9.1%) and over grazing (4.5%).

Figure 13: Management of common resources

The common resources are generally managed by the community (60%), management committees and collaboration with Smallholder Dairy Commercialization Programme (Figure 13). A portion of the resources are not managed and these are in a poor status.



Correlation results

The Pearson correlation results are presented in Table 4.

Table 4: Pearson correlation results

	Location of common resource	Ward of common resource	Category of common resource	Size of common resource (Ha)	Status of common resource	problem of common resource	Management of common resource	Usage of common resource
Location of common resource	1	.478**	0.094	-0.134	0.165	0.025	-0.26	-.387**
Ward of common resource	.478**	1	0.13	-0.201	0.095	.366*	-0.236	-.560**
Category of common resource	0.094	0.13	1	-0.267	-0.065	0.108	0.089	0.035
Size of common resource (Ha)	-0.134	-0.201	-0.267	1	0.052	-0.28	0.039	.316*
Status of common resource	0.165	0.095	-0.065	0.052	1	-.580**	0.29	-0.139
problem of common resource	0.025	.366*	0.108	-0.28	-.580**	1	-0.246	-0.226
Management of common resource	-0.26	-0.236	0.089	0.039	0.29	-0.246	1	0.241
Usage of common resource	-.387**	-.560**	0.035	.316*	-0.139	-0.226	0.241	1

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Positive and significant correlations were recorded for with respect to the common resources: location and ward; ward and problem; and usage and size. Negative and significant correlations were revealed between: usage and location; usage and ward; and problem and status. The results therefore show that the usage and problems of common resources are location specific. As expected, the usage of the resource is related in a linear way with its size. The nature of the problems of the resource influences the status of that resource.

Regression results

The regression results are given as:

$$Y = 1.446 + 0.58X_1 + 0.637X_2 - 0.036X_3 - 0.031X_4 - 0.155X_5 + 0.304X_6$$
$$(0.565)\ (0.113)\ (0.259)\ (0.049)\ (0.044)\ (0.031)\ (0.159)$$

The standard errors are given in brackets.

Where,

Y = Status of common resource
X_1 = Location of common resource
X_2 = Ward of common resource
X_3 = Category of common resource
X_4 = Size of common resource (Ha)
X_5 = Problem of common resource
X_6 = Management of common resource

The regression results show that the identified variables influence the status of the common resources in the project area. On one hand, location status of common resource and their management positively influence the status of the common resources. On the other hand, the common resource category, size and their problems negatively influence the status of those resources. The regression results are similar to the correlation results but they give the size of the relationships.

4.2. Discussion

This section summarizes the impact of collecting data on the community in Bomet County as follows:

1. Creating, deepening and strengthening networks of pastoralist communities

The process of undertaking and completing an enumeration process helps build organizational networks, skills, and confidence, which are necessary if the residents are to undertake larger improvement projects in the future. As such, the enumeration process is also useful for strengthening community organizations and also plays a role in community discussions regarding their needs and priorities.

2. Disaggregated data about communities and their residents

The data collected from the community level helps in amassing the information in detail. Disaggregated data was generated about settlements, grazing land, water points and salt lick points. The disaggregated data facilitates community networks to establish their priorities for action to address threats of encroachment and resource degradation.

Traditionally, the data collected by state agencies are viewed and stored in an aggregated manner, in which the details of each individual at the community level are lost. Furthermore, the disaggregated data can be utilized for community level planning and to make provisions for basic services as required.

3. Facilitating community networks to establish their priorities

Data collected by communities at their community level assists in prioritizing the issues to be resolved for a better living. Once the issues are prioritized, community networks active in a particular sector can take forward the initiatives to resolve the issues as per their vision. Furthermore, the data collected at the community level helps to bring various community networks together to work towards resolving the most pertinent issues affecting them.

4. Enabling dialogue between the government and communities

The information gathering process helps communities to improve their relationship with the local governments. It has enabled dialogue between Bomet county government and communities through the Dairy Commercialization Area Committee (DCAC) that is the custodian of the pilot results. Communities involved in detailed documentations are useful for local governments, who wish to engage with their networks towards the implementation of their programmes and schemes. Community networks are also able to use the information to change the prejudiced view of the government towards their community.

Following the pilot project, there are local institutional mechanisms for making decisions in implementing various alterations of the land surface in order to ensure protection of flows of water from natural streams, and to ensure access to that water for all. The major communal water points, located especially on the perennial rivers and water springs, are accessible to all farmers, located within the village, who can take their animals for drinking. These communal grazing land areas, water points and dipping tanks, are accessed through designated cattle corridors or paths – that are areas cutting across peoples' gardens set aside as animal routes. In both high and low potential areas, communal cattle corridors, grazing lands, water-points and dipping tanks are highly degraded - with poor water quality and pasture, due to resource over-exploitation and lack of proper management. Some communal grazing lands are being encroached that limits the area available for communal grazing during the dry season.

Conclusion and recommendations

The results of the pilot project strengthen land rights of poor and vulnerable people by recognizing diversity of tenure systems balanced with principles of social equity. They provide accessible, affordable and transparent land administration systems that integrate land rights recognition with participatory land use planning. Recognition of local and customary dispute resolution mechanisms has been achieved by developing the local capacity with multi-disciplinary skills. The role of private sector and civil society service providers has been strengthened while value chain enhancement and improved access to markets leads to increased income for the beneficiaries and sustainable natural resource management. The community enumeration and mapping has made substantive contribution at local and national level with respect to capacity and policy impacts based on STDM as

a new technology towards securing communal resources to strengthen livelihoods. Sugumerka DCAC in Bomet County of Kenya has a tool for lobbying for communal land tenure security and natural resource management with the County and National Government. There is a need to expand the use of STDM for land tenure security and natural resource management. In addition, SDCP is integrating STDM in programme monitoring and evaluation.

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