



The Role and Sustainability of Community-based County Government Funded Agricultural Infrastructure Projects: A Case of Community Cattle Dips and Acaricides Use in Kilifi, Kajiado and Nakuru Counties

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The study objective was to provide baseline and reference data on status and use of acaricides based on type or active ingredients by individual farmers and in public cattle dip maintained by county governments. The survey was conducted through a cross-sectional study in three counties

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(Kilifi, Kajiado and Nakuru), based on livestock farming intensive (low, medium and high) respectively. A total of 72 farmers were sampled where Questionnaire and informal interview were used to collect data on acaricides use, grazing method, herd characteristics, production and marketing. Data obtained was stored in excel spread sheets coded and analyzed using Statistical Package for social Scientists (SPSS). Grazing systems were conventional grazing (31), zero grazing (10) and fenced pastures (41). Collapse of county governments maintained cattle dips was observed. Hence use of alternative methods by farmers; spray race (22) and mechanical (hand) spray (31). Chemicals used included TRIATIX (12), DUODIP (11), STELADONE (7) among others with majority of the farmers (32) spraying once a week. Water sources for use were tap (piped) water (8), Borehole (54), community dams (3), river water (4) and harvested rain water (1). Majority of farmers (43) used manual methods of milking while 29 farmers used automated machines. Nakuru had highest number of lactating cattle (1422) and milk production (22,480 litres), followed by Kajiado (247) with low milk production (371 litres) compared to production Kilifi production (1470 litres) herd (150). Milk was sold to KCC, Brookside and vendors with farmers adding little value (Yoghurt and Mala). In conclusion, extensive use of chemicals may accumulate in the ecosystem thus a public health problem with little productivity. Data forms basis for further research and policy formulation on acaricides use. Analysis of hydro-chemical parameters and acaricides in the water source is recommended to ascertain its suitability for Agricultural and domestic use.

Keywords: Acaricides; pray race residues productivity; agricultural; cattle-dips community-based; infrastructure; sustainability.

1. INTRODUCTION

In most African countries, the livestock business supports livelihoods of large proportion of rural households and may have an important role to play in rural poverty reduction strategies [1]. In Kenya, livestock production is the main economic activity especially in nomadic pastoralism living in the arid and semi-arid lands (ASALs) [2,3,4]. Its role is even bigger nationally and stronger for large proportion of most rural households supporting over 14 million people and 70% of the total country's livestock population [5,1]. Similarly, a good number of urban households are directly dependent on income for selling livestock products or by getting employment in livestock-related agro-processing industries such as dairy, meat, and leather [6,7,8,1]. However, national and regional development policies have rarely recognized the actual and potential roles of livestock sector development in reducing poverty among rural households in Sub-Saharan Africa [1].

Livestock has been the main source of subsistence for the communities in the drier zones of Kenya [9,10]. The sector contributes about 12% of Kenya's Gross Domestic Productivity (GDP), 40% agricultural GDP and employs 50% of agricultural labour force [11,2]. About 60% of Kenya's livestock herd is found in the ASALs, which constitute about 80% of the country [10]. It is estimated that 10 million Kenyans living in the ASALs derive their

livelihood largely from livestock [10]. Further, livestock production contributes almost 90% of the livelihood of households and accounts for nearly 95% of family income in the ASALs [10,12,13,1]. Livestock play important roles in Kenya's socio-economic development and contribute towards household food and nutritional security [14,15]. However, the actual contribution either direct or indirect of the livestock sector on the wider economy has been substantially underestimated [16,17]. 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 ninth National Development Plan – 2002 -2008, Poverty Reduction Strategy Paper (PRSP), Economic Recovery Strategy for Wealth and Employment Creation (ERSWEC) 2010, Strategy for Revitalizing Agriculture (SRA) 2004 – 2014, Kenya Vision 2030, Millennium Development Goals (MDGs) and the National Livestock Policy (NLP) [18]. However, national and regional development policies have rarely recognized the actual and potential roles of livestock sector development in reducing poverty among rural households in Sub-Saharan Africa.

Most parts of the county are ASAL thus livestock rearing is the predominant economic activity [19,20]. Key challenges facing livestock farmers are frequent drought spells, poor quality of breeds, inadequate fodder and feed, wildlife

invasions, inadequate infrastructure, poor marketing of ranch products, pests and prevalence of disease outbreaks resulting in the imposition of disease-related export restrictions [19,20]. These had a negative impact on recovery of trade in livestock and livestock products. Despite these challenges, livestock production still shows a 60% potential to alleviate ASALs population from poverty [20,21, 22,23,24,25]. In this regard, investing in upgrading of local breeds, strengthening marketing strategies, strengthening disease control strategies through creation of a disease free zone to curb endemic diseases has been prioritized by the Kenyan Government in leveraging the sector's contribution to poverty reduction besides ensuring high quality livestock products both for national and international markets. Furthermore, the country has institutions and centers involved in training, research and dissemination of information vital for supporting agricultural and livestock production and productivity. These include Agricultural Training Centres (ATCs), Kenya Agricultural and Livestock Research Organization (KALRO), Veterinary Investigation Laboratories, Kenya Veterinary Vaccine Production Institute (KEVEVAPI) and Universities. Besides, many county governments and the central government have partnership with non-governmental organization (NGO) such as International Livestock Research Institute (ILRI), Japan International Corporation Agency (JICA), World Vision, DANIDA, United Nation World Food Programme, Plan international among others in strengthening Agriculture and livestock production.

The collapse and failure of the infrastructures and programs of strengthening pest and disease control strategies in the country has lead farmers to seek for alternative solutions. This is through use of acaricides of different classes including Organochlorinated (OCs), Organophosphates (OPs) or organic phosphoric acid esters (OPAEs), Carbamates and Pyrethroids. Methods of application include dip baths (Plunge dips, dip tank), Spray race residues (Mechanical or hand sprays), Hand-dressing, Pour-on, Ear-tags and Injectables and Ruminal boluses. With lack of proper regulatory guidelines and management of the residues after application of these chemicals, they accumulate in the environment through water sources and find their way into the food chain through milk and milk related products. Further, the vectors (ticks) have developed resistance to chemicals these chemicals besides

their toxic effects to humans. Thus, studies to provide reference data on the extent and use of acaricides in Kenya based on the type or active ingredients in the acaricides used by individual farmers and those in public cattle dip maintained by county governments and private investors is paramount important. This will provide avenues for further research on accumulation of these chemicals in milk and milk related products. Besides management of resistance of the vectors against these acaricides and their accumulation to the environment and food chain can be looked into.

2. MATERIALS AND METHODS

2.1 Study Design, Area and Population

The use of acaricides baseline survey was conducted through a cross-sectional study design. The study population was taken livestock farmers. Three counties (Kilifi, Kajiado and Nakuru) were purposively selected based on the intensity of livestock farming (low, medium and high respectively). A random sampling technique was used by establishing a list of groups of the study population names from each of the selected counties upon which the sample for study was picked and list established.

2.2 Data Collection and Analysis Methods

The data collected primarily using questionnaire, informal face-to-face interview and personal observations. Information on the various acaricides used, their packaging, labeling and other materials were recorded. Data was analyzed by use of both qualitative and quantitative methods. The *Statistical Package for Social Scientists* (SPSS) Version 20 was used to analyze quantitative data while content method was used to analyze qualitative data.

3. RESULTS

3.1 Acaricides Usage

Total of 72 farmers from Kilifi (18), Kajiado (22) and Nakuru (32) were reached during the survey. The information collected included the brand name, company, active compound and number of farmers using the acaricides as presented in Table 1. The study revealed that the most common used brand was Triatix (12 farmers) followed by Duodip (11 farmers) and Steladone (7). Based on the intensity of use of acaricides to control ticks and tick borne diseases, Nakuru had the highest number of Farmers (32) followed by

Kajiado (22) and Kilifi (18). The frequently used acaricides contained more than one active compound as exemplified by Duodip (Ops and synthetic pyrethroids) and Tixfix (Ops, Arsenicals, Organochlorides and Carbamates).

3.2 Functional Status and Use of Cattle Dips

The study revealed the collapse of livestock based government funded infrastructure and projects such as cattle dips and extenuation services with farmers seeking private ownership to maintain them. In Kilifi County, only two public cattle dips, Chasimba-Galana in Kilifi south and Mariakani in Rabai were functional while the others as exemplified by Chanagande cattle dip Mnagoni cattle dip, Kolongoni cattle dip and Kibao Kiche cattle dip were not functional (Table 2). Furthermore, in Kilifi County the functional cattle dips were owned by private investors in the livestock industry. In Nakuru and Kajiado all, the cattle dips that were still functional were privately owned (Table 2).

3.3 Methods and Frequency of Application and Management of Acaricide Residues

The survey identified methods, and frequency of application and management of acaricides residues by the farmers in Kilifi County, Kajiado County and Nakuru County. Dip baths

(Plunge dips), spray race residues, mechanical or hand sprays, Pour-on and a combination of these as methods of acaricides application as described in Table 3 were observed during the survey. Other methods such as Hand-dressing, Ear-tags and Injectables and Ruminant boluses were not used by the farmers in the three selected counties. Mechanical (hand) spray was the most method of application of acaricides where Kajiado dominates (14) followed by Kilifi County (11) and lastly Nakuru County (6). Spray race method was common in all places with high livestock intensity farming especially in Nakuru County (22). Most farmers applied acaricides on their livestock on weekly basis (32).

Furthermore, through observation, the study revealed a lack of proper drainage system with the chemicals ending up in water sources that are used by human beings and for animals. In most cases, the run-offs are left to drain freely into the soil (32 farmers). Pit drainage was also common (27 farmers) whereas modern methods of acaricides residues management such as storage in septic tank and use of pressure pumps were less common employed by 9 and 4 farmers in Nakuru and Kajiado, respectively. In some farms of Nakuru County, for instance the replacement of the dip wash is carried out after five (5) years and thereafter disposed of using the mechanisms as outlined (Table 3).

Table 1. List of chemicals used to control ticks in Kilifi, Kajiado and Nakuru Counties

Brand Name	Active Compound	Number of farmers using the brand		
		Kilifi	Kajiado	Nakuru
DUODIP	OPs and synthetic pyrethroids	1	2	8
SYPERTIX	Alphacypermethrin	2	2	0
TRIATIX 12.5	Amitraz 12.5%	4	5	3
TIXFIX E.C	Amitraz 12.5 w/v	2	0	1
BAYTICOL	Flumethrin (synthetic pyrethroid)	1	0	1
STELADONE EC	Organophosphate (Chlorfenvinphos)	4	1	3
ACTRAZ	Amitraz 125g/L	2	0	0
ECTOMINE	Cypermethrin (High-cis) (pyrethiod)	1	0	3
DELETE	Deltamethrin 50g/l	0	2	4
DOMINEX	Alphacypermethrin	0	1	1
GRENADE	Cyhalothrin 5%	0	0	2
NOROTRAZ	Amitraz 12.5%	0	1	1
ECTOPOR	Cypermethrin 20g/l	0	0	1
FARMTRAZ	Amitraz 12.5%	0	0	1
MONSTRAZ	Amitraz 12.5%	0	0	1
NEOCIDOL	Diazinon 600g/l	0	1	0
ALMATIX 125	Amitraz 12.5% w/v	0	3	0
BYE BYE	Amitraz 125g/l	0	3	0
Total		18	22	32

Table 2. Functional status of cattle dips in Kilifi, Kajiado and Nakuru Counties

Name of cattle dip	Sub county	Ownership	Status
Marere	Ganze	Public	Not Functional
Cassava	Ganze	Public	Not Functional
Kilifi Plantation	Kilifi North	Private	Functional
Pwani University	Kilifi North	Private	Functional
Kilifi Prison	Kilifi North	Private	Functional
Tezo cattle dip	Kilifi North	Public	Not Functional
Mwandoni cattle dip	Kilifi North	Public	Not Functional
Marafa	Magarini	Public	Not Functional
Kijiwetanga	Malindi	Public	Not Functional
Mark Tosha Farm	Malindi	Private	Functional
Furunzi	Malindi	Public	Not Functional
Mutangani Prison	Malindi	Private	Functional
Kolongoni	Kaloleni	Public	Not Functional
Kibao Kiche	Kaloleni	Public	Not Functional
Mnagoni	Rabai	Public	Not Functional
Kibarani	Rabai	Public	Not Functional
Jimba	Rabai	Public	Not Functional
Mkapuni	Rabai	Public	Not Functional
Mariakani	Rabai	Public	Functional
Chasimba-Galanema	Kilifi South	Public	Functional
KALRO – Mtwapa	Kilifi South	Private	Functional
Ubma Farm	Nakuru	Private	Functional
Chemusian Farm	Nakuru	Private	Functional
Kabaraka High School	Nakuru	Private	Functional
Marula estate farm	Nakuru	Private	Functional
KALRO - Naivasha	Nakuru	Private	Functional
Egerton University	Nakuru	Private	Functional

Table 3. Method and frequency of application and management of acaricide residues by farmers in Kilifi, Kajiado and Nakuru counties

Parameter	Number of farmers			Total
	Kilifi	Kajiado	Nakuru	
Method of application				
Mechanical or hand spraying	11	14	6	31
Pour-on method	1	1	0	2
Dipping	3	0	6	9
Spray race	1	7	14	22
Dipping and spray race	2	0	6	8
Total	18	22	32	72
Frequency of application				
Once a week	8	6	18	32
Twice a weeks	1	1	7	9
Thrice a week	1	1	4	6
Once a month	4	12	1	17
Twice a month	2	1	1	4
Thrice a month	2	1	1	4
Total	18	22	32	72
Management of acaricides residues				
Drainage into the soil	10	14	8	32
Drainage into a pit	8	7	12	27
Septic tank	0	1	8	9
Pressure pump	0	0	4	4
Total	18	22	32	72

Table 4. Source of water, place and method of milking used by farmers in Kilifi, Kajiado and Nakuru Counties

Parameter	Number of farmers			Total
	Kilifi	Kajiado	Nakuru	
Water sources				
Tap (Piped) water	8	0	0	8
Bore hole	4	20	32	54
Community Dam	3	0	0	3
River water	2	2	0	4
Harvested rain water	1	0	0	1
Total	18	22	32	72
Separation of milking and spraying				
Sample place for milking and spraying	11	6	8	25
Different place for milking and spraying	7	16	24	47
Total	18	22	32	78
Milking method				
Manual	18	22	3	43
Automated Machines	0	0	29	29
Total	18	22	32	72
Method of grazing				
Zero Grazing	4	1	5	10
Free range	9	15	7	31
Fenced pastures	5	6	20	41
Total	18	22	32	72

Table 5. Milk production, value added products and marketing by farmers in Kilifi , Kajiado and Nakuru counties

County	Farmers.	No. of Cows			Production per day	Value added product	Market
		Non lactating	Lactating	Total			
Kilifi	18	315	150	465	1470	Package milk, Yoghurt, Mala	Milk vendors
Kajiado	22	585	247	832	371	No value addition	Nearby town
Nakuru	32	5384	1422	6806	22,480	Packaged milk, yogurt, mala	KCC, Brookside, vendors
Total	72	6284	1819	8103	24,321		

3.4 Water Source and Milking of the Animals

Majority of the farmers sourced the water for domestic and livestock use from bore holes (54) whereas others especially in Kilifi County used tap (piped) water (8), river water (4) and harvested rain water (1). The study also established that some farmers used the sample place or site for milking and spraying (25). However, majority of the farmers (47) used different places for milking and spraying (Table 4). Further, more than half of the farmers used

mechanical method for milking (43 farmers) whereas automated milking machines were employed by few farmers (29). Methods of grazing employed by the farmers included zero grazing (10), free range (31) and fenced pastures (41).

3.5 Milk Production, Value added Product and Marketing

In Kilifi County eighteen farmers were sampled with an average herd of 33.21 per farmer (465 cattle) of which 32.26% (150) were lactating

1470 litres. In Kajiado county eleven (22) farmers sample had a total of 832 cattle of which only 29.69% (247) were lactating 371 litres. In Kilifi, value addition is carried by KALRO, Pwani University, Buzeki Dairy (formerly Kilifi Plantation) and Mambui farm. Majority of the large scale farms in Nakuru County carry out value addition while in Kajiado there were no farms that carried out value addition to their milk (Table 5).

4. DISCUSSION

The most common brands of acaricides used by farmers in Kilifi, Kajiado and Nakuru counties to control ticks and tick borne diseases are Triatix, Duodip and Steladone. The methods of applying the acaricides include mechanical or hand spraying, pour-on method, dipping, spray race with majority of the farmers spraying their animals once a week. The acaricides residues after spraying were managed through drainage into the soil, pit, use of a septic tank and pressure pump. In Kajiado County, it was observed that there were no public cattle dips managed by either the county or central government. All the cattle dips in Nakuru County were owned by private, large-scale farmers. The survey gathered that there was an effort by the Kilifi County government to boost livestock production through rehabilitation of the cattle dips. The local livestock farmers had initially rejected the idea of paying KSh. 10 per cow as dipping charges put in place in order to sustain maintenance of the cattle dips and this led to the collapse of almost all the cattle dips in Kilifi County. The dips that are functional operate on weekly basis managed by private individuals. Interviews with the farm managers revealed that full replacement is very expensive and thus they top up their dip wash. The KALRO-Mtwapa and Mariakani regional livestock investigation laboratories used to carry out acaricides analysis to establish concentration of the chemicals present and their sensitivity to the pests. However, due to collapse of the equipment used in the chemistry and biochemistry laboratory, they no longer carry out acaricides analysis but only carry out livestock disease diagnosis and surveillance. This has led to farmers relying on the use of chemicals from the local Agro-vet shops to control ticks and other pests. Although the county provides extension services for capacity building and dissemination of information to support crop and livestock production and productivity, the farmers claim that these services are not available.

The water used by the farmers come from Tap (Piped), Harvested rain water, Rivers, Community Dams and Bore holes. Majority of the farmers (54) used bore hole as water sources for their animals. Many parts of the selected Counties (Kilifi, Kajiado and Nakuru) lack piped (tap) water. In Nakuru and Kajiado counties, there is no tap water in the interior and remote areas where the farmers are located. Therefore, the households use river water and bore hole water. However, in Kilifi County, Malindi Water and Sewerage Company (MAWASCO) and Kilifi Mariakani Water and Sewerage Company (KIMAWASCO) provide tap water from water treatment plant at Baricho in Langobaya harvesting the water from Galana River. However, the source can sustain the population and therefore, the households rely majorly in dams and rainwater tapped from roof houses. The county Government in conjunction with the central government has collaboration with United Nation Food Programme (UNFP), World Vision, Plan International, Japan International Corporation Agency (JICA) among other Non-Governmental Organization (NGO) to improve livelihood in the county through promoting livestock production by providing quality water. Majority of the water sources may suffer from water salinity and seawater intrusion. The same water is used to water the livestock in the area. Due to farmers spraying their cattles to remove ticks, these chemicals are washed by the run offs and collected in the dams where they find their way into the body of human beings and livestock. Further, the pesticides used to control pest from the crops they grow end up in the river. Commercialized livestock farming is evident in Nakuru County with majority of large-scale farmers using automated milking machines in specialized milking shades. In Kilifi and Kajiado counties, farmers surveyed were found to milk their animals manually. Further, the study reveals that conventional grazing; zero-grazing, free range and fenced pastures are the livestock raring systems in the three counties. Smallholder farmers were the majority in Kilifi, while high intensity dairy farming was practiced in Nakuru. The study also observed that zero grazing is predominant for milk production under commercial mixed-farming system practiced intensively in Nakuru County and a few farmers in Kilifi county and Kajiado County. The main areas where milk production is under this system are Ongata Rongai, Kiserian, Bulbul and Matasia in Kajiado County and Kilifi town and Malindi in Kilifi County. Small-scale agro pastoral milk production exists in the southern parts of Kajiado

County namely Kimana, Oloitokitok, Ilasit and Rombo through pastoral free-range system.

The study established that Nakuru County was leading in terms of livestock keeping and milk production with a total herd of 6806 cattles of which 1422 were lactating about 22, 480 litres of milk. Although Kajiado had a higher number of cattle herd (832) compared to Kilifi (465), the production of milk in Kajiado was low (371 litres) compared to Kilifi (1470 litres). This is attributed to the fact that Kajiado is predominated by pastoral communities where the animals are majorly kept for beef production. However, with changing trends there has been a shift of the livestock industry changing from dairy production to beef production due to collapse of most of the dairy industries countrywide. The remaining functional dairy industries that buy milk for value addition in Nakuru County are Brookside Dairy Ltd, Kenya Cooperative Creameries (KCC) and a few large scale farms that carry value addition of their milk produce. In Kilifi, Mtwapa KALRO, Pwani University and Buzeki farm carry out value addition of the milk produced. However, there is no constant identified buyer in Kilifi County who can buy milk from the small holder farmers a factor that has contributed to reduction in milk production.

The dry conditions experienced in the country have probably resulted into the low milk production. For instance, Kajiado County produces an average of 30,241,491 litres of milk per year valued at KES 907,244,730 [21]. In the current study, the milk production stands at 133,600 litres, 529,200 litres and 8,092,800 litres in Kajiado, Kilifi and Nakuru counties respectively. Although only a few farmers (22 in Kajiado, 18 in Kilifi and 32 in Nakuru) were involved in the study, this trend can possibly reflect a reduction of milk production in the entire country. Furthermore, the number of farmers involved in milk production predominantly resides in the rural areas of the three counties a finding that corresponds with the survey report by ASDSP [18]. Women and youth are particularly important in the value chain engaging in milking, and selling. There is no value addition of the milk produced by the farmers in Kajiado county the farmers in Kajiado county. However, value addition of produced milk in Kilifi and Nakuru counties. Some of the large scale dairy farms in Kilifi County (Mambrui farm, Buzeki (Kilifi Plantation) Dairy, Pwani University and KALRO-Mtwapa) and Nakuru County (Egerton University, Kabarak University Farm, ABMA Farm) package

fresh milk and process yogurt and Mala. The small-scale farmer sell their milk to vendors and consumers in major towns such as Kitengela (Kajiado County), Kilifi, Mtwapa and Malindi (Kilifi County), Nakuru and Naivasha (Nakuru county).

Through the observations made from the study, both private and public small-scale service providers for animal feeds and veterinary services in Kajiado, Kilifi and Nakuru counties exist. However, farmers complained of a lack of agricultural extension services such as artificial insemination and disease surveillance system. Further, to support on-farm production of milk, service providers supplying ploughing services, labor (e.g. for milking, pasture management and hay-harvesting) and spraying services are crucial. Although these service providers used to exist, currently they were not available. The collapse of livestock based infrastructure lead to the redundancy of cooperatives especially in Kilifi County that used to offer milk cooling services and transportation of the milk to the major markets around the country's coastal region. The cooperatives also used to carry out value addition services leading to availability of many brands of fermented milk 'mala' and yoghurt in the market. Currently few brands of milk related products exist beside the role of Kenya Dairy Board as the main marketer of milk and milk products is not felt.

In Kajiado County there is a shift towards migration in search of pasture to settled livestock farming. Previously, the pastoralists would migrate with the entire livestock including lactating livestock. However, attitudes of the community are also changing where the lactating herds are for domestic consumption and additional income that has significant contribution to domestic food security and family income [26]. Further, the study observed that there are initiatives by KALRO to improve breed productivity by having crosses of the predominant Zebu cows with the more productive Borana cow that produces more milk per animal. The dominant breed, Zebu is also currently being upgraded with the dual-purpose Sahiwal breed and improved Borana breed for beef production. Milk production in exotic cattle is three times higher than in cross breed cattle [18], indicating that livestock improvement programs have the potential of increasing productivity in Kajiado County.

Kilifi County is semi intensive in terms of livestock rearing with a few medium sized large

scale farms that included KALRO-Mtwapa, Kilifi Plantation, Pwani University, Mambui, Mjanaheri and Marekebuni farms. Mambui farm had a herd of more than 100 cattle. Through observations, the breeds kept in Kilifi County were Friesian, Ayshire, Brown Swiss, Fleckvier, Sahiwal, Jersey and some crossbreeds of the Boran. However, they are owned by small-scale farmers each with a maximum herd of five animals. Literature search reveals that Kilifi County has a total of 11 cattle ranches, 6 owned by groups, 2 owned by the Agricultural Development Corporation (ADC), 2 owned by private companies and 1 owned by an individual developer. One group ranch is dormant while the rest are active. Giriama Company and Kilifi Company are private ranches; Biryra, Ndigiria/Mapotea, Mnangoni, Dola, Chakama, Kiski and Weru are group ranches while Galana and Kulalu are ADC ranches. The livestock are kept for milk and beef production with carrying capacity of each of the ranch estimated at 3 livestock per hectare in dairy zones and 0.25 livestock per hectare in the rangelands. Worldwide, livestock keeping has been known to contribute to increase household income significantly and therefore contributing towards poverty reduction. About 52% of the household cash income among peasant farmers in Kilifi County comes from cattle keeping.

5. CONCLUSION

In conclusion, this is the first report on the status of dairy farming in Kenya, a case study of three counties (Kilifi, Kajiado and Nakuru) done after the collapse of many livestock base infrastructure and dairy industries. The study recommends a more detailed survey on the same issue focusing on a larger farming population within the selected counties and eventually countrywide to provide a true reflection of livestock production in Kenya. Probably as a result of sea water intrusion along the coastal line, chemical analysis of the surface and underground water is recommended to ascertain the suitability of the water source for agricultural, livestock and domestic purposes in these three and other counties countrywide. Furthermore, due to free range system being the predominant grazing method, acaricides residues may have accumulated in the water sources causing a public health problem. Therefore, analysis of acaricides of all classes that are used by the livestock farmers is recommended so as to establish which types leach into the soil and eventually contaminating ground water. Poor usage of these acaricides could be detrimental in the long run since it can lead to acaricides

resistance. The county governments in conjunction with the national government in collaboration with the already existing collaborations of NGOs should come up with strategies to revive the livestock based infrastructure and streamline the use of acaricides especially for small holder farmers. With a robust and vibrant dairy industry a lot of households depending on it for livelihoods will be greatly empowered economically.

CONSENT

As per international standard or university standard, Participants' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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