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ROLE OF KNOWLEDGE MANAGEMENT IN ACHIEVING FOOD SECURITY AND NUTRITION IN GARISSA COUNTY, KENYA

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Abstract:
Food is a primary need that is basic to all human needs and a fundamental human right (Maxwell, 2001; Ingram, 2011). Improved food security is vital in the alleviation of poverty, promotion of people's health and labor productivity, contributes to the political stability of a country and ensures sustainable development of citizens (FAO, 2011). Food and nutrition security are achieved when adequate food is available, accessed and satisfactorily utilized by all individuals at all times to live a healthy and happy life. Nutrition security goes beyond food security by considering adequate access to essential nutrients, not just calories. Nutritional security means guaranteed constant adequate dietary intake that helps the body to resist and recover from disease. Food insecurity leads to severe health problems for individuals and to the society including malnutrition, obesity, disease and poverty (Hammond & Dube, 2011). Indigenous knowledge refers to the knowledge and know-how unique to a given society or culture which encompasses "*the cultural traditions, values, beliefs and worldviews of local people*" (UNESCO, 2016). The fundamental differences between indigenous and scientific knowledge paradigms are characterized by an old African proverb which states *"when a knowledgeable old person dies, a whole library disappears" (*Naanyu, 2013). The study explored the role of indigenous knowledge in achieving food security and nutrition in Garissa county whose major economic is livestock keeping. The study found out that in the dry season when resources are rare; the pastoralist manage their herd composition in regard to age and sex to preserve herd viability; and splitting up herds during wet and dry season, milk

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preservation is through gourds cleaning, drying and disinfecting for long-term, milk preservation is via spontaneous fermentation or back slopping and drying remain to be the most use approach for raw cereal grains, supported by the addition of ash, minerals or activated charcoal to absorb moisture and oxygen. The study concludes that despite the rich practices, indigenous knowledge is marginalized in favor of high-tech modern knowledge. The agro-pastoralist have no clearly defined channels through which they can share their lived indigenous knowledge, experiences and practice and it is rational and easy for pastoralist to practice indigenous methods of control of pests and diseases learnt over generations. The study recommends that documentation of indigenous knowledge from aging experts for future references, repackage indigenous knowledge towards food security and sustainable pastoral production in communal ranches.

Keywords: food, food security, knowledge management, indigenous knowledge, nutrition security

1. Introduction

Food is a primary need that is basic to all human needs and a fundamental human right (Maxwell, 2001; Ingram, 2011). Improved food security is vital in the alleviation of poverty, promotion of people's health and labor productivity, contributes to the political stability of a country and ensures sustainable development of citizens (FAO, 2011). The Food and Agriculture Organization (FAO) defines Food Security as a "*situation when all people at all times have physical, social and economic access to sufficient, safe and nutritious food to meet their dietary needs for an active and healthy life*" (FAO, 2014; FAO 2009). Food and nutrition security are achieved when adequate food is available, accessed and satisfactorily utilized by all individuals at all times to live a healthy and happy life. This definition implies that nutrition security includes dietary requirements of the consumed food, health care and sanitation in order for one to be able to live a healthy and active life. Traditionally, nutrition security involves the knowledge of the right feeding practices (especially correct infant feeding practices), cooking practices, clean environment, and safe drinking water among others. Nutrition security goes beyond food security by considering adequate access to essential nutrients, not just calories. Nutritional security means guaranteed constant adequate dietary intake that helps the body to resist and recover from disease. Food insecurity leads to severe health problems for individuals and to the society including malnutrition, obesity, disease and poverty (Hammond & Dube, 2011). Nevertheless, ending hunger and achieving food and nutrition security is goal number 2 out of 17 sustainable development goals and one of the BIG 4 AGENDAS of the president.

The Monitoring and Evaluation Harmonization Group of Food Security Partners (FAO, 2013), in their Food Security Learning Framework (FSLF) have estimated that meeting global food security challenges will become increasingly difficult in future as the world's population reaches 9 billion by 2050, and pressures on natural and human

resources intensify. Over 900 million people worldwide remain food insecure despite recent reports by FAO (2014) indicating global hunger reduction. The majorities of food insecure people live in Sub-Saharan Africa and entirely depend on agriculture as their source of livelihood (Burchi & Muro, 2012; FAO, 2014).

A number of studies have been carried out and many solutions proposed towards solving food insecurity in Sub-Saharan Africa. Key among the solutions is the modernization of agriculture by use of modern technologies. It is apparent that rural farmers have failed to adopt modern technologies due to high costs associated with them and increasing levels of poverty. Given the rural context, indigenous knowledge would offer cost-effective solutions for achieving sustainable food security. It is important to acknowledge that indigenous knowledge and innovations are core competences of rural farmers and, any planned interventions ought to build on farmers' experiences and knowledge for better results (Tweheyo, 2018).

Indigenous knowledge is increasingly becoming part of the development agenda. Local initiatives are multiplying and the number of development projects integrating indigenous knowledge is increasing (Gorgestani, 2001; Awuor, 2013). Indigenous knowledge refers to the knowledge and know-how unique to a given society or culture which encompasses "*the cultural traditions, values, beliefs and worldviews of local people*" (UNESCO, 2016). Indigenous knowledge is a tacit knowledge of the local or indigenous people, which is personal, content-specific, and therefore hard to formalize and communicate. It differs from formal scientific knowledge, which is an explicit or codified knowledge that is transmittable in formal, systematic language. Indigenous knowledge is viewed by rural communities as one of the core components that contribute to sustainable and equitable development (Akullo, 2007; Awuor, 2013; Kamwendo & Kamwendo, 2014; Eyong et al., 2007). In traditional societies, the elders' wisdom combines both ecological and social knowledge and offers solution to specific societal problems (Awuor, 2013). Indigenous knowledge is informal, interactive, and integrated in people's livelihoods (Claxton, 2010). The fundamental differences between indigenous and scientific knowledge paradigms are characterized by an old African proverb which states *"when a knowledgeable old person dies, a whole library disappears" (*Naanyu, 2013).

Management of indigenous knowledge is extremely important. Like scientific knowledge, indigenous knowledge needs to be managed so that it is easy to access, retrieve and shared among farmers in a broader geographical area (Lodhi & Mikulecky, 2010; Eseryel, 2014). Knowledge management is about capturing, creating, distilling, sharing and using the expertise; these activities are missing in achieving sustainable food security and nutrition. Appropriate technology, facilitation and other forms of support are required to connect people to process and share the information provided by the different stakeholders (National Government, County Government, Developmental partners and the local people).

ICT can play a major role in improving the availability of indigenous knowledge systems and enhancing its blending with the modern scientific and technical knowledge (Mwantimwa, 2008). ICT such as computers and the Internet can be of great help to

collect, store and retrieve indigenous knowledge for sustainable use (Meja, 2002). The application of ICT is essential to stimulate the flow of indigenous knowledge and incorporation of modern scientific and traditional knowledge. This will enable indigenous communities to protect and exploit their unique cultures and knowledge through digitization (Eseryel, 2014). Indigenous knowledge and techno-blending practices to the local setting can help to improve agriculture production and sustainability of food security. The main use of ICT for promoting indigenous knowledge could be as follows: capture, store and disseminate indigenous knowledge so that it is preserved for the future generation; promote cost-effective dissemination of indigenous knowledge; create easy accessibility of indigenous knowledge information systems; promote integration of indigenous knowledge into formal and non-formal training and education; provide a platform for advocating, improving and exploiting benefits from indigenous knowledge to poor farmers (Rahman, 2000; Nonaka, 1991; Eseryel, 2014).

Garissa County is located in the former Northeastern province of Kenya and is divided into 6 sub Counties namely Garissa, Fafi, Lagdera, Ijara, Balambala, Township and Dadaab. Garissa is a County whose major economy is livestock keeping. The main livestock bred are cattle (Boran), goats (Galla), sheep (black headed Persian) and camel (dromedary one humped) whose main products are meat, milk, hides and skin. Sub-counties like Balambala nad Masalani practice rain-fed agriculture on small scale having Watermelons, mangoes, vegetables, tomatoes, paw paws, bananas, cowpeas, simsim, maize, beans and green grams as the main crops. Garissa County is a dry area. There is virtually no rainfall yearlong in Garissa. The average temperature in Garissa is 29.3. About 362mm of precipitation falls annually. The driest month is July, with 4mm of rain. Most of the precipitation here falls in November, averaging 98mm. Rainfall being the main climatic parameter used in the county is mostly erratic, not well distribute in space and time over the seasons. The rain in the area is becoming more unreliable causing serious draughts whose severity and assorted impacts are on the rise jeopardizing the livelihood sources and food security. The population is becoming more vulnerable and less resilient to climate shocks. In the past, a major drought was normally expected once every 10 years; in the past three decades, major droughts recurred after every three to four years and sometimes after two years (Kaitho et al., 2006). During the dry season, there is a general migration of livestock from the hinterland to areas near River Tana where water is readily available. However, some pastoralists move with their livestock to adjacent counties of Tana River and Lamu in search of pasture.

2. Problem Statement

The Monitoring and Evaluation Harmonization Group of Food Security Partners (FAO, 2013), in their Food Security Learning Framework (FSLF) have estimated that meeting global food security challenges will become increasingly difficult in future as the world's population reaches 9 billion by 2050, and pressures on natural and human resources intensify. Over 900 million people worldwide remain food insecure despite recent reports

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A number of studies have been carried out and many solutions proposed towards solving food insecurity in Sub-Saharan Africa. Key among the solutions is the modernization of agriculture by use of modern technologies. It is apparent that rural farmers have failed to adopt modern technologies due to high costs associated with them and increasing levels of poverty. Given the rural context, indigenous knowledge would offer cost-effective solutions for achieving sustainable food security. It is important to acknowledge that indigenous knowledge and innovations are core competences of rural farmers and, any planned interventions ought to build on farmers' experiences and knowledge for better results (Tweheyo, 2018).

While the contribution of indigenous knowledge is recognized in developed countries, use of indigenous knowledge in developing countries is not strongly emphasized as an alternative to conventional knowledge (Cloete & Idsardi, 2012). People who use indigenous knowledge are associated with poverty, backwardness and superstitions (Awuor, 2013). As a result, traditional food crops are labeled as poor peoples' food by rich consumers. The question that arises is whether indigenous knowledge and traditional food crops are really for poor people and what interventions are needed in order for indigenous knowledge to play a key role in the improvement of household food security in rural communities (Cloete & Idsardi, 2012).

Indigenous knowledge systems have not to a very long extent been captured and stored in a systematic way and are therefore endangered with extinction. The lust for modernity and new technologies are threatening the loss of a great store of knowledge held by native people. A good number of indigenous groups in Africa and elsewhere in the world have suffered from long-term discrimination, inequity and exclusion from planning and execution of development 8 programs and projects. The main reason for Indigenous knowledge not been captured and stored in a systematic way is that it is handed down orally from generation to generation (Naanyu, 2013). The advancement of research on climate change and variability and its impacts on agriculture particularly in dry land areas has played a key role in development of both tactical and strategic means to buffering the impacts associated with extreme climatic conditions. However less emphasis has been laid on indigenous knowledge, skills, experiences and adaptation strategies held by local people as a basis for informing development of sustainable approaches to minimize the risks imposed by climate change and variability (Suri, 2009) on food security and nutrition.

Many households in Garissa County are vulnerable to food and nutrition insecurity that is prerequisite for malnutrition and other related childhood illnesses. Poverty, illiteracy and drought have led to minimal access to essential services to the majority of the inhabitants of the county. Inadequate food at the household and community level because of cyclic drought conditions coupled with long-term degradation of livelihoods and local coping strategies have further weakened the way of

life of residents of the County. The combined effect of the above factors has resulted in chronic levels of acute malnutrition indicating the enormity of both underlying and basic causes of malnutrition (Garissa County Nutrition and Food Security Survey, May 2011 MERCY-USA).

3. Literature Review

Indigenous knowledge, which is also referred to as local knowledge, has been steadily growing interest in the academic world both within the social as well as natural sciences (Awuor, 2013; Kamwendo & Kamwendo, 2014). Scientists and policy makers are becoming aware of the contribution indigenous knowledge (IK) can have to sustainable development and more so to food security (Kilongozi, et al., 2005). Harnessing the indigenous knowledge of local people creates a sense of respect and ownership of interventions designed for addressing the local communities' problems (bottom up approach) and in turn creates positive and sustainable results (Ingram, 2011; Ranganathan, 2004). Indigenous knowledge is now considered one of the cornerstones that can guarantee survival of rural communities especially in food and nutrition security (Awuor, 2013). Therefore, there is no doubt for believing that indigenous knowledge is vital for rural communities' food and nutrition security (FAO, 2014). However, it is apparent that the younger generation underestimates its utility just because of their own limited awareness. It is important to note that indigenous knowledge is a key path-way to rural farmers' transformation and it is potentially a reliable alternative to modern technology especially in the process of achieving food security (Kamwendo & Kamwendo, 2014).

The majority of farming communities in Ghana depend on traditional knowledge systems in production and processing of food (Kumasi, 2011). The Maasai pastoral communities in Kenya have greatly benefited from a range of indigenous knowledge systems in ensuring their animal health, forage plants and range management that have improved their productivity and food security (Kilongozi et al., 2005).

In Kenya, communities have made clay pots for storing drinking water using their indigenous knowledge. These pots keep water cool and clean and as a result, household hygiene has greatly improved because these pots keep water safe from re-contamination and therefore diarrheal diseases are prevented (Boven & Morohashi, 2002). Many Indigenous communities have used indigenous forecasting methods for a long period of time to predict seasonal climatic events (Winnie et al., 2002:22). They observe the cloud, Wind and lightening that likely have their origins in traditional understanding of what contemporary researchers recognize as atmospheric science. Others watch the behavior of livestock, wildlife and the local flora; this is not limited to livestock-keepers only but also the crop producers. Musembi's (2010) work in the Akamba crop producing community in Kenya indicates that the Akamba also have early warning signs of rain and drought. They also observe the pattern of the stars and few days before the onset of rains, domestic animals would refuse to enter their sheds and according to them these stars

formed a particular pattern which showed whether it would rain or not. The location of the stars was also an indicator of the amount of rain and how soon it will rain. This behaviour was interpreted to mean that it had rained heavily and the shed was flooded.

Traditional climate experts use early warning as an indigenous practice in predicting the onset of rainfall, floods and drought. For example, the experts view the horizons-the dark cloud linings that indicate the availability of enough rainfalls that is an important issue as it indicates when to migrate with the livestock to different areas and growing crops. They observed the pattern of seven stars to predict whether it could rain or not. The location of the stars was also an indicator of the amount of rain and the soonest it would rain. Acacia trees e,g, *Acacia nilotica*, *Acacia tortillas* and *Balanites aegyptiaca* produce flowers before it rains. Trees shed their leaves when there will be a dry season or drought. Animal feeding behavior difference when the upcoming will be good or bad. When animal have more relax composure, it gives an indication the rains are around the corner or there will be a good year. The livestock would refuse to get up unless forced to do so. When the animals will be wondering around scavenging for what to eat all the time, stressed/fatigue and restless it is a sign the upcoming seasons will be poor, rains and drought, animal stray away neither sleeping nor sitting within return to the sheds in the evening. The movement of certain birds and the noise they made, warned about the rains or drought sessions.

In addition, some pastoralist groups observe the intestines of slaughtered animals and if their color is red, that was an indication that it would start to rain and in case the color was black, that was an indication there would be a drought or war.

The pastoral communities have relied on their indigenous early warning systems since time immemorial. This knowledge has enabled them to deal with multiple threats and variability and has helped them to survive and effectively use the harsh and highly variable environment. However, many traditional forecasting methods are perceived as becoming less reliable with increasing climate variability. Climate variability has led to recurrent, severe and prolonged droughts). The timing of the rain by pastoral communities is an important issue as it indicates when to migrate with their livestock to different areas. The complications brought by climate change and variability have led to researchers becoming concerned about whether the community uses any indigenous early warning signs to predict the weather variation and whether they are reliable.

While weather variability is the main determinant of food security and nutrition, production systems in Garissa especially in pastoral setting have to adapt to changes that are social in nature or related to market connections and livestock movement laws. Drawing their knowledge from transmitted, inherited traditional wisdom, pastoralists apply these strategies and adapt them to the context to grasp opportunities rapidly and overcome the constraints they encounter. In this way, they constantly develop new strategies, more than simple mobility modifications, by adapting transhumance circuits suited to new contexts and new risks.

4. Risk Reduction Strategies to Enhance Production Systems

Pastoralist farmers have developed a wide range of strategies concerning their production systems. These strategies consist of; selecting and using different species or races or accessing far off of livestock (knowing that indigenous races are the best adapted) to optimize use of various ecological niches, in particular in the dry season when resources are rare; managing herd composition in regard to age and sex to meet the dual challenge of meeting household needs and preserving herd viability; and splitting up herds to avoid the risk of over-grazing and enable migration to locations where they can access better pasture and water resources. The fact of investing in animals is also a risk management strategy because the herd acts as insurance against the risks of drought, illness, theft, etc. Finally, lending "excess" animals to the needy preserves social cohesion and makes up a sort of social security system. Among other strategies, there are also activity diversification (trade, salaried labor, services) and migration of family members (to cities or foreign countries) who can make significant contributions by sending money.

Pests and diseases are two of the greatest threats to the realization of the productive potential of their pastoralist and agro-pastoralist herds. The inadequacy of modern health delivery system for their production enterprises either in human or material resources calls for a look at the alternative means of dealing with the menace of pests and diseases. Pests and diseases control are also carried out according to the traditional beliefs of the herdsmen before and even after the advent of scientific control method.

5. Traditional Food Preservation and Storage

Food preservation makes a significant contribution to food security and food safety in pastoral communities with limited access to external food sources. Traditionally, preservation is achieved through physical, chemical and biological means, such as heating, salting, sugaring, curing, drying, smoking, pickling, cooling, freezing or fermenting with microorganisms. Milk, meat and cereals are the main food products that require preservation from key pathogenic microorganisms. Meat requires fast consumption or preservation as spoilage occurs quickly. Therefore, meat is conserved via drying, salting, curing, cooking, pressing, oil application, and combinations of the above by Somali groups in Garissa. Nyirinyiri, for example, is prepared in a simple process from long, thin strips of meat, which are slightly salted and then air dried for a few days. Its simplicity and effectiveness, paired with the dry climatic conditions of many pastoral zones, make drying an ideal preservation technique, and probably the most widespread. Through these techniques and their various combinations, pastoralists are able to adequately preserve large quantities of meat from a carcass to ensure food security and reduce food waste.

Milk in contrast to meat, is obtained daily from animals. Spoilage is rapid, especially at high temperatures and under poor hygiene conditions. The high energy and

nutrient content of milk provides an ideal substrate for microorganism growth, therefore, preservation is necessary. Traditionally, and more commonly, milk is preserved via spontaneous fermentation or back slopping, a process, which adds a small amount of a previously fermented batch to the fresh milk. This process is further enhanced by combination with drying and even smoking for long-term storage. Fermentation is applied to milk, meat and cereal products worldwide. Milk is also preserved by transformation into butter.

6. Traditional Water Management Approaches

Water management system around rain water catchments especially in the southern part of Garissa County is interesting and worthy replication. The numbers of pans within their geographical area with water impounded are mapped, and the individual owned pans are communally used in turns and desilting using an 'agah dhig' approach is done until water is exhausted. Pans are deeper, desilted and readiness to impound water before the next rainy season. Animals are not allowed to enter the water. A desilting approach before animals arrive, where the owner creates a steep step a few meter away from the water level. The animal will only be able to reach the water and once the animals water, owners collect their animal dung after. Water management committee exist at more permanent water sources in eth north of Garissa, water use is paid for in cash and a water rota exists. The local also have a way of traditional enabling a stranger or pass by with livestock be allowed access water for their livestock. The other recent approach has been migrating personal groups blend into local clan structures as means of protection, semi assimilation. While in that state of imbedding the new arrival will be paying the social support and blood money and count a member. These are traditional models to move across territories and find the required pasture and water for their livestock. In recent times, learning the conflicts caused by the wandering nature of Somali individual household into other territories, joint collective approaches to securing permission by sending scouting elders ahead of moving pastoralist have been used. This enables to get needed access right from their neighboring communities. Agro-pastoralist, who also practice irrigation in farm along the Tana River, have formed into groups to enable them secure the pumping, watering and weeding labor as groups.

7. Disease and Pest Control

Strategies employed include keeping herds containing a mixture of different livestock species as insurance against total loss of livestock in case of drought. The livestock species kept include camels, cattle, sheep, goats, and donkeys, all of which have different forage and water requirements and variable levels of resilience to drought. The camels, cattle, and goats provide milk, which is consumed by the households. The small stock is sold when cash is required to meet other domestic requirements such as to purchase food or to pay school fees. Some other methods include; diversification of livelihood sources;

livestock mobility to track forage and water resources; diversification of herd composition to benefit from the varied drought and disease tolerance, as well as fecundity of diverse livestock species; and sending children to school for formal education as a long term investment expected to pay back through income from employment.

Because of pests, disease and decreased soil nutrients culture measures to control pests and soil fertility are employed. Farmers use traditional pest control such as tillage, compost manure and mulching, strategic planting dates, or crop rotation - which means using a field for planting in different seasons, and not having the crop in the same field for two consecutive seasons,. Farmers put in many hours of manual labor to do weeding and avoid reduced yields. Uncontrolled weed growth reduces crop yield. Some farmers solve this problem by cultivating a smaller area, but this also reduces total yields. They also recycle organic wastes of crop and animal origin and maintenance of long-term fertility of the soil.

Some other practices interrupt an insect pest's life cycle in some way; (i) Inter-cropping (or companion planting) is another cultural control that is usually used because of the benefits from the plant-to-plant interaction, but it can also be utilized for pest control. The more plant species present, the higher the diversity (ii) exclusion - through crop spacing of plants to reduce pests' migration (keeps any form of outbreaks to a few plants.

Animal disease control is done through; avoid places with high infestation of ticks, animals with fed with plants containing a high level of salt, thus the ticks fall off, removal of ticks before leaving the enclosure in the morning, and throw these ticks into a fire burning near the entrance to the enclosure, tick infested areas are avoided, tick eradication by burning the infested pasture is widely used. Animal treatment is done through blessing of herds through – religious healing, mostly done by reading the Quran and practical treatment including herbalism i.e. treatment with parts of plants or other natural products. Other methods include scarification and bloodletting in order to free the animal from spoiled blood and using red-hot plates on animal body to burn disease spot. Indication of this type of therapy is lameness, the rheumatic complex, skin diseases and infectious diseases of the alimentary and respiratory tract. Also through herd management viz: herd dispersion is used to reduce the risk of infecting all animals belonging to one household, choosing animal for breeding was based on the health of the animal, prevention of contact between healthy and ill animals, diseases prevention can cause herdsmen and his herds to move. Lately pastoralist avoids regions where insect or where there are reported disease complications. There are reported and undocumented over-dosage, false applications and wrong treatment.

8. Conclusion

It is perceived in the literature that indigenous knowledge provides cost-effective and sustainable ways of food and nutrition security for rural communities. It is established

that rural community still depend on their traditional practices. Literature further reveals that documentation and management of invaluable indigenous knowledge still deserve a lot of attention as it is at the threat of biotechnology innovations and genetically modified organisms. Besides, it is observed that indigenous knowledge is always marginalized in favor of high-tech modern knowledge. Farmers have no clearly defined channels through which they can share their lived experiences on indigenous knowledge practices. This implies that policy makers simply assume that exotic knowledge, which is also referred to as scientific knowledge, works for everybody including rural poor farmers. However, sufficient evidence from literature shows that this has not been the case (USAID, 2016; Emorut, 2015).

Based on the reviewed literature, it is noted that there are gaps regarding indigenous knowledge information flows between farmers themselves and policy makers. Accessibility and sharing of indigenous knowledge among farmers and food security experts is still inadequate. It is also observed that rural farmers need to be helped by making indigenous knowledge more available and accessible in the process of improving food security. Besides, it is noted that there is dire need for farmers and stakeholders' collaboration for experience and knowledge sharing. It is further noted that interventions are needed to enhance rural households' food security and that these should build on peoples' indigenous knowledge for positive results. In chapter three, the exploratory study conducted with rural farmers and stakeholder presented use of early warning system to predict good and poor rainy seasons, herd breeding, cereals, meat and milk preservations techniques employed to improve access, availability of food at household level. Pest and animal disease treatment through cultural and traditional methods to reduced poor yields. The inadequacy of modern health delivery system for the pastoralist and agro-pastoralist production enterprises either in human or material resources calls for a look at the alternative means of dealing with the menace of pests and diseases promotes the use of indigenous, cultural and traditional knowledge to improve their food and nutrition security. In most cases there is no link between scientific early warning information generated for policy and decision makers and indigenous knowledge, which is detrimental to food and nutrition security in Kenya.

It is rational and easy for pastoralist to practice indigenous methods of control of pests and diseases in their herds since it is a practice handed down from their parents. The frequently practiced indigenous control methods of pests and diseases by pastoralist in Garissa are hygiene, self- diagnosis, use of herbs, and movement from place to place, bush burning and spiritual incantation. Also, pastoralist Somali's age, marital status, contact with extension agents and years of experience influence the decision of herdsmen in the practice of indigenous control method.

8.1 Recommendation

From the foregoing, the paper recommends that efforts be made to integrate indigenous knowledge with modern technology in order to achieve sustainable food security and required food nutrition adequacy in the face of climate change that threats livelihoods of

the people living in Northern Kenya and other ASAL counties in Kenya and Africa. Specifically, it is recommended that;

1) Provide statistical facts on food security and nutrition status for guiding interventions.
2) Traditional knowledge;
    a. Documentation of indigenous knowledge from aging experts and kept for future references
    b. Provide an environment for collaboration, create a platform for knowledge and experience sharing between farmers and stakeholders in the decision-making process.
    c. Incorporate indigenous knowledge in existing modern practices of achieving sustainable food security and Nutrition
    d. Provide a repository for indigenous knowledge and experiences of farmers for other farmers to learn
    e. Support the protection and strengthening of traditional knowledge systems which promote sustainability and the use of experiential knowledge in research and development.
3) Digital technologies;
    a. Promote access to and the use of digital technologies, including for precision agriculture, and foster their appropriate application for sustainable agricultural development
    b. Enable instant communication between farmers and stakeholders on crop and animal disease outbreaks, and provision of feedback to farmer queries for food security improvement.
4) Develop and foster innovation that addresses challenges in achieving sustainable agricultural development in livestock systems, through collaborative and participatory research, transfer of knowledge and capacity building.
5) Repackage indigenous knowledge towards food security and sustainable pastoral production in communal ranches;
6) Diversify economic opportunities for pastoralists; and
7) Boosting of institutions at the local level to help communities maintain access to resources as part of the institutions community outreach engagements.

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