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Review article

Development and promotion of village chickens subgroups to counteract the adverse effects of climate change in Sub Saharan Africa

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ABSTRACT

Smallholder agriculture sector which harbors different village chickens ecotypes/varieties/strains is one of the most susceptible to the adverse effects of climate change due to its low adaptive potentiality. As of now, the sector is facing scores of challenges due to unpredictable environmental consequences of climate change which have impinged on village/indigenous/local/native chicken production systems. The adverse effects associated with climate change which can impact negatively on village chicken production systems being diminished water resources, changes in the rainfall form and abundance, elevated temperature regime, unpredictable seasonal distortion, dwindling of feed resources and prevalence of uncommon diseases and parasites. Therefore, it is assumed that the development and promotion of certain village chicken outstanding subgroups such as the necked necks become critical in sustaining productivity. Village chickens are excellent for their adaptability and tolerant to local diseases and harsh environmental conditions. Structural, functional and feeding behavior of some village chicken strains will play a critical role in enhancing production, reproduction and survival in these adverse conditions. As a result, it is appropriate to develop and promote village chicken subgroups through within population selection. Adaptive management and anticipatory learning approach in village chicken development and promotion is suggested. The

preceding review attempt to explore the likely effect of animal species selection, such as promoting village chickens genetic resources in smallholder rural farming sector in tackling climate change challenges. Strategic development and promotion of village chickens, which target both productivity and adaptability traits will greatly help in improving the welfare of the rural folk through substantiating their resilience.

1. Introduction

Perry et al. (2002) acknowledged that village chickens are diverse and extensively raised animal species worldwide. There are the dominant animal species in the rural communities in Sub Saharan Africa (RLDC, 2010). The known characteristics of village chickens is that they are relatively hardy and survive on limited nutrition (FAO, 2004) as a result, they are prominent in the low input systems (Goromela et al., 2008) with limited resources (Kyarisiima et al., 2004) under smallholder subsistence farming (Mekria and Gezahegn, 2010). In terms of poultry species the village chicken constitutes 70% of the total chicken population in Africa (FAO, 1986) which might have increased in the past decade. Their widespread distribution is a testimony of their adaptability to the adverse environmental conditions and stresses (Halima, 2007). It is indisputable that indigenous chickens contribute significantly in rural economies in most African countries. They have more diverse use and benefits to poor rural households. It can be reasonable to assume that developmental programs which target indigenous chickens are vital in the socio-economic development of various rural communities through improving the household welfare of the poor majority and their ability to adapt to harsh environmental conditions. Due to their potential adaptation to local harsh environment development and promoting of indigenous chickens will enhance resilience of the low input agricultural production systems which are particularly vulnerable to climate variability. A credit can be given for village chickens' ability to tolerate adverse environmental conditions and poor management associated within free range systems without loss of performance (Mtambo, 2000). It is assumed that different animal species due to their morphological, functional and feeding behavior will respond differently to the adverse effects of climate variability. Therefore, the development and promotion of adapted animal species will be critical in sustaining productivity under an increasingly harsh local environment. In this case, disruption factors related to the unpredictability of climate variability are lessened. The component on village chicken genetic improvement programs render a major role in the development and promotion of some varieties of village chickens for commercial purpose in the mainstream animal agriculture. However, this process should take into account social as well as economic factors in their institutional context. At the same time genetically focusing on both productive and adaptive traits to counteract the adverse effects associated with climate change. The preceding review attempt to explore the likely effect of animal species selection, such as promoting indigenous chickens genetic resources in the rural farming sector in tackling climate change challenges.

2. Tangible and intangible benefits of village chickens in resource poor rural communities in Sub Saharan Africa

In Africa most subsistence households own village chickens and their significance in rural communities has already been affirmed (Padhi, 2007; Dolberg, 2003; Alders and Spradbrow, 2000; Mtambo, 2000). It is indisputable that village chickens have been a major source of income for the poor rural communities in addition to provision of nutrition (FAO, 1997; Creevey, 1991). Urbanization and increase in human population in developing countries have been associated with an increased demand for rich protein food sources, while increased income and improved living standards have brought in a huge demand for poultry products (FAO, 2002). Indigenous chicken are known to be a compelling species to use to reduce rural poverty gaps. Globally, capital build up in smallholder farming sector has been associated with rearing village chicken. Village chickens are part of an approach to solve the problem of food insecurity through improving nutrition. Poverty alleviation and hunger diminution among rural communities is possible through raising village chickens because of their short generation interval and minimal feed and health component obligation (Besbes, 2009). According to Mugga (2007), local chickens contribute to the

national food security since they provide the much needed protein to rural communities. The projected increase in animal protein demands and malnutrition in resource poor rural communities will pose a challenge for Sub Saharan Africa, hence the need to promote and develop indigenous chicken due to their short generation interval. Women have been empowered through rearing village chickens, in addition to the provision of the fast growing population with high quality protein and as a source of household income for rural communities. Gueye (2009). The many benefits derived from rearing village chickens, which include nutrition, income generation and customary function becomes critical for resource poor rural communities. Apart from being nutritious, indigenous chicken's products are inexpensive without social or religious customs prohibiting on consumption in rural communities. It is important to acknowledge that village chicken play a major role in rural communities in Sub Saharan Africa, however, less regard has been given to their development and promotion to improve the welfare of the rural household. It is assumed that the development and promotion of village chicken is the answer to the perpetual food insecurity, poverty alleviation and hunger reduction for the betterment of the rural populace. It has been unfortunate that indigenous chicken are ranked modest in the overall contribution to nations economies because of the absence of characterized performance parameters (Mulualem and Tesfahunegny, 2015). This also emanates from the fact that indigenous chicken production parameters are not within desirable levels and can not be used in commercial enterprises. High mortality rates in village chicken have been a major concern aggravated by low weight gain and average number of eggs per hen per year are very modest (Matthewman, 1977). Despite the indigenous chickens' dual purpose and multiple benefits, there does remain an abundant unexploited genetic potential for increased production. They provide employment for family members from which they gain income during the crop off-season periods (Mandal et al., 2006). Village chicken offer other non monetary values to the communities where they are part of the biological approach of controlling crop, cultural ceremonies and celebrations (Veterinary Services Department, 1998; Alders and Spradbrow, 2000). They also have social, cultural and religious importance, and improve growth, mental development, school performances and labor productivity and reduce the likelihood of illness among the small-scale farmers' children through diversification of consumable foods (Martin et al., 2011). Village chicken structure such as red and white color has been associated with socio-cultural and religious ceremonies for adequate rain and crop harvest. On the other hand red and black spotted color are used to celebrate the coming of new year, while white and black spotted protect persons from evil spirits and disasters (Tadelle and Ogle, 2001). Village chicken serve as a scaling-up enterprise to larger livestock species (Dolberg, 2003) and is a tool for poverty alleviation and food security (Gueye, 2009). Rearing village chicken has been cited as an enterprise for the vulnerable groups which constitute women and children, however the output in terms of acquired assets benefit individual household. It is important to note that any developmental projects on village chicken will empower women. Village chicken are mainly reared and owned by women in the rural areas (Faouzi et al., 2002; Mekria and Gezahegn, 2010), no wonder gender is often a major focus in rural development and poultry could be an obvious entry point to reach poor women. Village chicken as a source of savings and income serve bank account which assist in family nutrition and curtail food insecurity (Quisumbing and McClafferty, 2006). Rural communities can derive one other benefit through improved village chicken husbandry practices in terms of manure for use in village gardens. Village chicken rearing is a component of farm diversification and investment. Studies have shown that different **i**ndigenous chicken ecotypes in Ethiopia are capable of improving growth through appropriate feed utilization potentials (Tadelle, 1996). From a strategic point of view, development and promotion of village chicken build capacity for rural communities adaptive potentiality and resilience**.** Village chicken are in harmony with the low input subsistence systems where management is poor. Their ability to tolerate local diseases and survival on low nutritional regime makes them an appropriate candidate for rural communities. For health reasons village chicken are preferred by consumers because they are organically produced and contains low cholesterol and fat. Its chewy and tasty meat are the other parameters which consumers look for in village chicken (Jaturasitha et al., 2008). Village chicken reared under the organic farming systems are said to have chicken quality that is more acceptable (Fanatico et al., 2008), because most consumers have preference for meat produced based on the local management practices.

3. Promoting naked neck village chicken due to their structural adaptation to heat stress changes caused by climate change.

Despite the introduction of the imported chickens village chicken strains due to their numbers and multiple functions play a major role in rural economies as a result, if developed and promoted will become a promising

animal genetic resource in alleviating poverty on the African continent (Bett et al., 2012). In fact, chickens are common in the sub Saharan communities (Faouzi et al., 2002). Development and promotion of village chicken in Africa is falling back despite the multiple functions and socio-economic benefits. It is important that smallholder farmers rear adapted animal species which will survive and breed in local harsh environment. It will be difficult for unadapted animal species to survive and reproduce in such circumstances. This means the attributes that assist animal species survival should be the basis of choice of animals to rear. This is done with the hope that these traits can be imparted into future generations. It is highly likely that the traits that do not assist an individual animal species to survive and breed will slowly disappear. Village chicken apart from being excellent scavengers and hardy, are perfect mothers and have a good brooding instinct despite their unfavorable growth and laying few numbers of eggs of small size (Tadelle, 2003). In addition, they possess natural immunity against local diseases, according to Darwish et al. (2011). The small body size of village chicken is a desirable trait in terms of maintenance requirement in low input systems where feed resources are inadequate. The changes in temperature regime, the menace of new disease and parasites, water scarcity which will influence range productivity, changes in rainfall forms and adequacy are some of the adverse effects of climate change and variability (Scholtz et al., 2012). However, variability in ambient temperature which will impart animal heat stress and nutritional stress resulting in lowered productivity and reproduction are the features that has the profound direct impact on village chicken production. According to Baker (2009) adaptedness as the state of being adapted, the ability of an animal to produce and multiply in a given environment which warrant farmers to select a particular animal species for specific environment. This means animal adaptation is the ability of animal to produce and reproduce in the environment which they are reared. Understanding stand-in factors for adaptation, such as ability to produce and reproduce is paramount in village chicken production. This is because climate change is predicted to have a profound effect on village chicken rearing in smallholder farming sector in Africa.

The naked neck village chicken strains are an ecotype which has been identified as one of the potential type in terms of performance in harsh environment. The dominant feature of the naked neck is the featherless skin on the neck, on the breast and ventral part of the thigh (Khobondo et al., 2014). The morphological structure of limited feather coverage gives it an advantage on thermoregulatory potential under heat stressed environmental conditions. The few characterization studies in different African countries (Nigeria, Botswana, Kenya, Malawi, Sudan Ethiopia) have reported immense morphological variability and different performance levels among village chicken populations (Kingori et al., 2007). This might show that the micro-satellites in village population may be highly polymorphic. Village chicken among the poultry species show the highest rate of genetic variation within population which can facilitate selective breeding. In characterization three major strains have been identified which are the dwarf type, normal and heavy body weight type. Village chicken have immense morphological variation with different colors of feather coverage combined with different types of comb shapes which can be used to identify different strains. The comb shape can be portrayed as rose, pea, walnut, duplex and crest are also found. Plumage coloration is different with strains, but mainly dominated with blackish and brownish colors showing extended and pied colorations. Feather coverage is mainly normal while forms such as Naked neck, frizzle and silkiness appear sporadically are the dominant forms. In this case the morphological adaptation is the key factor in targeting the naked neck strain in harsh environmental conditions associated with climate change. Therefore, information on morphological adaptation becomes critical in the unpredictable production environment, however, dealing with adaptation parameters might be complicated. The comb type has also been implicated in efficient heat regulation where single comb type allows better heat dissipation (Apuno et al., 2011).

Naked neck genes associated with performance in the heat stressed environment have been studied (Apuno et al., 2011; Khobondo et al., 2014). Limited plumage has been associated with heat tolerance (Yaicin et al., 1997). It is known that sensible heat dissipation is associated with the insulation of plumage which is a merit in slow growing chicken (Leeson and Waish, 2004). Siegel (1995) reported that neural, endocrine and immune system are an integral part of heat stress response (Siegel, 1995). The severity of composite stressors will determine the capacity of village chicken to cope with their environment, which relate to their physiological processes. Naked neck genes associated with performance in heat stressed environment are related to structural or morphological marker genes which makes them appropriate candidate for development and promotion in smallholder harsh environmental condition. Naked necks and frizzle plumage expression which has been associated with the incomplete dominant genes Na and F, respectively, are significant in hot climate. Studies on population segregation for necked neck gene (Na) to assess its influence on growth of broilers under heat stress have been carried out (Patra et al., 2002). It was observed that the diminution of plumage in genotypes Na/Na and Na/na in

broilers result in improved heat dissipation, more body weight gain, improved feed conversion efficiency with good carcass quality as compared to normal broilers. Merat (1986) studying the naked neck gene reported that the gene was associated with genotype*environment interaction for laying hens at elevated temperature. In agreement, in a similar study Cahamer et al. (2008) reported that naked neck gene can be targeted to alleviate heat stress in chickens. The results by Chen et al. (2008) indicated that the naked neck gene influenced heat regulatory attributes such as the wattle length, rectal and surface temperature measurements. Due to partial dominance the naked neck gene in its homozygous (Na/Na) and heterozygous (Na/na) state reduces feather coverage by 20% and 40%, respectively (N'dri et al., 2007). It is reasonable to suggest that heat tolerance of chickens can be improved by the Na gene (Horst and Rauen, 1986). The effect of the NA gene's influence is prominent at a high ambient temperature above 30 ^{0}C because it because it regulates the adverse effects of heat stress on growth (Deeb and Cahaner, 2001) in addition to egg production and efficiency attributes (Chen et al., 2004). In the same study naked necks at 35 ^{0}C were able to curtail raised body temperature (Yunis and Cahaner, 1999), while showing similar growth and body weight under different temperature treatment. The naked-neck birds at 35 °C showed only a marginal advantage over their fully feathered counterparts, indicating that 20 to 40% reduction in feather coverage provided only limited tolerance to the heat stress imposed by hot conditions. Studying growth rates and meat yield in broilers Cahaner et al. (1993) and Barua and Howlider (1991), respectively, agreed that naked neck broilers were superior than normally feathered counterparts when reared at a high or moderate ambient temperature. However, Patra et al. (2002) efforts should be made to study the effects of naked neck under cyclic/seasonal tropical climate because most of the studies on performance of naked neck and normally feathered chickens have been undertaken in constant high low ambient temperature.

4. Establishment of appropriate breeding schemes and application of reproductive biotechnologies to promote performance and adaptive traits in village chickens

The African continent is dominated by complex, diverse and risk prone rural livelihoods, and considering this context need chicken breeds that are flexible, dual purpose and resistant to the prevailing environment (Andeson, 2003). Village chicken have for long been neglected in genetic improvement schemes in spite of their multiple benefits to Sub Saharan Africa rural economies. Regrettably, insufficient effort has been directed towards their development and promotion or establishing appropriate breeding schemes for their genetic improvement. However, the recent realization of the potential of village chickens in the resource poor smallholder rural sector in Africa has prompted their current sluggish promotion and development effort. Village chicken is a potential animal genetic resource for the purpose of development of future dual purpose breeds for rural communities. In Africa the village chicken numerically and economically is a predominant poultry species in the rural economies whose potential has not been exploited genetically. In the first world success has been realized in other livestock species in terms of genetic manipulation, what makes it impossible to develop and promote village chicken in their performance and adaptive attributes. Formulation of village chicken breeding goals should take into account both performance and adaptive traits which has been highlighted by Solkner et al. (1998) and Olesen et al. (2000). It is important that development and promotion of village chicken for their performance and adaptability should be accompanied by improved management, feeding and better health cover. It has been acknowledged that genetics influence fitness and adaptability in village chicken, where Baker (2009) has defined adaptedness as the ability of animals to produce and reproduce in a given set of environment. However, adaptation is a complex factor and traits associated with it are lowly heritable. Hill and Zhang (2009) observed that in a stable environment adaptability traits would have reached a selection limit and are expected to respond to selective breeding if there is an environmental shift, resulting in change of fitness and increase in heterozygosity. Promotion and development of village chicken become relevant to smallholder rural farmers accompanied by adaptation strategies which are apt to be localized. With this scenario genetic schemes targeting village chicken in low input systems is paramount. A spectra of traits might be considered in village chicken breeding schemes of which ability to survive on limited feed resources, converting low grade feed resources to meat and eggs and adaptation itself. Village chicken already possess these attributes hence they need just to be included in future breeding schemes to improve on chicken meat and egg production. However, the genetic improvement approach in response to stressed environment is the basis of any future breeding schemes and as a matter of course might differ from the present approach. The complexity of measuring adaptation traits have to be taken into consideration. Sluggish genetic improvement schemes for village chicken through selective breeding have been attempted without being

given maximum effort in Africa (Hossary and Galal, 1995; Msoffe, 2003; Khobondo et al., 2014). Lack of infrastructure has been cited as the major constraint for establishing performance and genetic evaluation schemes. On farm selective breeding might be an alternative approach as the breeding goals should take into account the different low input production systems among regions, uncertainty associated with the future circumstances (Smith, 1984).

The preferred approach selection within village chicken population might be important as a long term strategy (Wolliams et al., 1998). As expected in any breeding population, it should be acknowledged that village chickens have been experiencing dynamic processes of constant genetic change through natural selection and the influence of genetic drift. Genetic change is a process driven by the influence of environmental factors and accelerated through artificial selection. The disadvantage of selection within populations may be time consuming, but the results will be permanent (Padhi, 2016). Selection within population or ecotypes is meant to take advantage of the genetic variability in these populations distributed in every corner of the African continent. The few studies on characterization of village chicken in Nigeria, Botswana, Kenya, Malawi, Sudan, Ethiopia etc. immense genetic variation has been observed in both performance and morphological attributes (Kingori et al., 2007). The genetic differences in these ecotypes have been derived from domestication, farmer selection and breeding methods (Khobondo et al., 2016). Lwelamira et al. (2008) suggested that selection within population might be the appropriate approach to use that will bring success in genetic improvement in village chicken. Within population selection should have a component of animal genetic conservation of chicken ecotypes identified for their adaptability and performance which are prerequisite for sustainable development.

Crossbreeding schemes might be another option of genetic improvement in village chicken. The results are faster, however limited success using crossbreeding has been reported in smallholder animal agriculture. Crossbreeding is a viable option only if a protocol which aim at producing a dual purpose bird is derived with sustained adaptation as a major focus and has an element of local animal genetic resources conservation (Okeno et al., 2013). From a strategic point of view smallholder village chicken production perspective, with the uncertainties of climate change crossbreeding in rural communities pose a risk of genetic dilution in the long term. Hence it can be suggested that breeding schemes should focus on within population selection despite that it is time consuming. It is very difficult to reverse genetic dilution in the long term. Lack of access to adequate breeding exotic stock and infrastructure, aggravated by poor management has been some factors which work against sustainable crossing breeding programs in rural communities. Quddus (2012) and Roschinsky et al. (2015) reported that the favorable outcome of crossbreeding schemes is that output of crossbred chickens must satisfy farmer expectations, which motivates farmers to maintain the scheme. In such circumstances well designed selection scheme might be an alternative approach for the on farm research at the same time avoiding the danger of indiscriminate crossing effects. Crossbreeding notably has been tried in Africa for village chicken has notably been attempted targeted at exploitation of genetic difference between imported chicken breeds and the hardy village chicken. Imported breeds have been crossed with adapted village chicken to give high performance crossbred (Kahi, 2002). The limitation was that the imported chicken breeds were not naturally adapted to the harsh local environmental conditions which compromised the ability to mate. This shows that any crossbreeding program should be implemented with caution (FAO/IAEA, 2009). The threat in establishing sustainable crossbreeding schemes in Africa emanate from the fact that smallholder farmers will need constant replenishing of imported stock, in certain cases crossbreds generated have been poorly adapted to the local harsh environmental conditions or lack of logistic support. Bhuiyan et al. (2005) noted that indiscriminate crossing under poor management regime has pushed some animal genetic resources to the verge of extinction. This is on the backdrop that crossbreeding schemes have been implicated in genetic dilution of Africa animal genetic resources threatening the current conservation effort of these species (Msoffe, 2003; Kosgey, 2004). In an attempt to introduce crossbreeding programs previous studies have shown that upgrading local animal genetic species do not necessarily respond well to problems that experienced under African conditions, hence precaution should be taken in introducing exotic blood in the smallholder farming systems. Apart from the threat of loss of local adapted animal genetic resources, researchers need to be concerned about the trade offs between animal performance and ability of animals to adapt to the local harsh environmental conditions. How crossbreeding achieve its goals has been highly variable and dependent on local conditions (Madalena et al., 2002). In certain cases crossbreds have sometimes failed to cope with the high temperatures, shortage of feed resources and local diseases resulting in compromised performance. Inadequate logistical support and low complementary socio economic support have raised questions about the viability of crossbreeding schemes (Leroy et al., 2016). As compared with pure breeding, crossbreeding

does not produce genetic progress by itself, it relies on hybrid vigor which can be dependent on targeted traits and breed complementarities. The major advantage of selective breeding is that genetic change over time can be derived from comparison of base population and the selected population in addition to comparison of selected indigenous population with imported breeds. Approaches in development and promotion of village chickens might be slightly different from those used in intensive production systems taking into account the low input nature which characterize smallholder farming systems.

Successful use of reproductive biotechnologies (ie artificial insemination, embryo transfer, etc.) and genome studies (ie, marker assisted selection) has been the basis of livestock and poultry genetic improvement in developed countries. Consideration of inclusion of reproductive biotechnology and molecular science to support the development and promotion of village chicken is expected to enhance the process with major potential of increased performance. Use of series of reproductive biotechnologies will assist in quick genetic gains without compromising adaptive quick genetic gain without compromising animal adaptability. It is reasonable to suggest that there is immense same opportunities in the use of reproductive biotechnologies in development of village chickens for the smallholder farming systems. Use of series of reproductive biotechnologies will assist in quick genetic gains without compromising adaptive quick genetic gain without compromising animal adaptability. The approach will enhance the contribution of village to be substantial. Reproductive biotechnologies and molecular genetics are likely to have an impact in the future of development of village chicken. DNA based testing and marker assisted selection for genetic variability evaluation will be applicable in disease resistance studies. The exploration and possible utilization reproductive biotechnologies and molecular genetics in development of village chicken will enhance the tone that was not possible before. However, the use of reproductive biotechnologies and molecular genetics require adequate infrastructure and resources, and trained personnel which is a limitation in Africa. However, an argument may be raised to the effect of cost implication and how local farmers can change their attitude from the present consideration as animals as a status symbol and appreciate the drive for higher productivity which shapes the socio economic agenda. The existing contribution of village chicken in mainstream economies of most African countries is regarded as low. Among the reasons for this scenario is farmers attitude toward animal agriculture and the low genetic performance on economic traits. The viability of village chicken should not be overstated, however their contribution do not fit well in the national value chain. This is one of the major reasons of the sluggish development and promotion of village chickens at national level. However, village chickens remain essential due to their multiple socio economic benefits in addition to their adaptability. It means development and promotion of village chicken will enhance the future reliance on wider use of local animal genetic resources that can produce and reproduce in unfriendly agricultural environment characterized by water stress and scarcity of feed resources. It is important to note that previous attempt on developing village chicken focused on investigating the influence of feeding technologies without considering the genetic makeup of the village chickens. Future village chicken development and promotion strategies should consider a holistic approach where both genetics and improved management practices are sort. Reproductive biotechnologies and molecular genetics have not been used extensively in Africa to improve village chicken performance due to probably the exorbitant cost implications. Application of biotechnologies and molecular genetics have been used extensively high valued animal species resulting in profound impact in increasing animal performance. It is assumed that the same could also apply in the development and promotion of village chicken in Africa. The poultry sector in developed world has advanced to the current stage mainly due to adequate infrastructure and the rapid application of biotechnologies. Lack of appropriate infrastructure and technologies has curtailed the promotion of village chicken in smallholder farming sector. This is in the background that such technologies and appropriate infrastructure are paramount in the drive for successful development and promotion of village chicken. Government and private sponsored research institutions have played a critical ole in technological innovations in the third world. According to Smith (1988) acknowledged that on station breeding centers can act as conduits for the role of technology transfer in animal breeding improvements and developing of production systems. The current trends in application of reproductive technologies and molecular genetics in animal improvement makes reproductive physiology manipulations possible openings up entirely new horizons for increased production even in village chickens genetic resources utilization. The accompaniment of these technologies on base population selection will accelerate performance improvement at the same time retaining the adaptive traits in the context of climate change challenges.

5. Adaptive management approach and anticipatory learning in indigenous chicken genetic improvement for climate change adaptation and resilience in rural communities

It is incontestable that Sub Saharan African region is already experiencing the challenges associated with climate change effects which have presented themselves in the form of frequent calamitous circumstances, such as floods, heat wave, subsiding water resources, unpredictable rainfall patterns and modification in livestock and poultry disease and parasites spectrum due to changes in environmental conditions. The climate change associated challenges in the production environment has notably impacted negatively on village chicken production systems, hence curtailing the intended contribution of village chickens to the rural economies. This calls for new approaches in village chicken development and promotion endeavors. One of such strategies is the use of adaptive management approach and anticipatory learning. Lindblom (1959) and Halbert (1998) defined adaptive management as an incremental learning accumulated knowledge, though gradual bits of information and making marginal adjustment. The approach is gaining increasing recognition for its application in rural populations in coping with complexity under climate change and variability. It has been used successfully in adaptive eco-based natural resource management. With the magnitude of negative effects of climate change and dealing with its consequences which are complex and uncertain, the use of well executed studies with local communities using adaptive management approach has been suggested (Pahl-Wostl, 2007). However, tools for exploration of adaptive learning in stallholders farming sector are limited due to the level of low adaptive potentiality (Tschakert and Dietrich, 2010). The success of development and promotion of village chicken may be dived from the fact that stallholder farmers are slow in adopting new technologies in adapting the current scenario of production systems to the imminent threats of climate change. It is assumed that adoption of adaptive resources management and anticipatory learning approach can assist in smallholder choice of preferred village chicken development and promotion alternatives for resilience-building answers to adverse climate change impacts.

Adaptive resources management and anticipatory learning processes will take into account the accrued smallholder fames knowledge over yeas and perceived village chicken production and eco-based environmental issues, while giving credit for adoption of new technologies in the process interactions that may emerge, as well as imposed scenarios, and subsequently modification of production systems. Rural communities are rich in local knowledge and perspectives based on their subsistence animal production practices which can be incorporated in the development and promotion of village chicken production systems for successful adoption of new technologies. The accrued knowledge can be crucial in the process of monitoring, responding and change management functions targeting at development of an appropriate village chicken stains with special attention to enhancing performance and resilience into rural communities. Alternative ecological based resource management knowledge has been recognized in contribution of to successful biodiversity conservation (Gadgil et al., 1998), rare species (Colding, 1998), protected areas (Johannes, 1998), ecological processes (Alcorn, 1989), and to sustainable resource use in general (Schmink et al., 1992, Berkes, 1999). The impact of unpredictable effects of climate changed on village chicken production makes the adoption of specific animal breeding options complex, which warrant change in the way smallholder farmers respond to potential negative impacts, which may in turn enhance adaptive resources management and anticipatory learning processes. The applicability of adaptive and anticipatory learning was tested by Holling (1978) in resources management based on the concept of learning by doing, where feedback in studies would be crucial in making future decisions. This becomes relevant to the development and promotion village chicken are taking place in inevitable uncertainities of climate change and change management decisions may be controversial. Change in village chicken production practices using adaptive management and anticipatory learning the impacts are apparent in rural communities in responding to the challenges of climatic changes, and facilitating smallholder farmers decision making capabilities and flexibility. Therefore, it is crucial for any change management in village chicken production systems to take into account the complexity and diversity of village chicken production scenarios in Africa. This will build flexible, adaptable and resilient potentiality based on ecological based adaptation. The process becomes precautionary in an attempt to develop and promote village chicken production.

Use of village chicken farmers knowledge systems in development and promotion of production perspectives would not run into the rural community ownership problem which is a limitation in centralized and technically oriented decision making processes. In an attempt to implement intervention the centralized systems have failed to improve the welfare of the world's rural poor. Incorporation of local knowledge systems represent a shift away from the preoccupation with the centralized, technically oriented solutions of past decades, which failed to

improve the prospects of most of the Sub Saharan smallholder farmers. This was due to the fact that solutions did not take cognizance of the local knowledge systems of the marginalized communities. Village chicken development and promotion in resource poor communities in Africa should take advantage of anticipatory learning in an attempts to identify the anticipatory and predictive elements inherent to these communities, and to provide a blended approach based on the anticipatory nature of those elements. Integration of local knowledge systems in the intended development and promotion based on new technologies has the ability to decide possible future village chicken production based on their current understanding and local knowledge, thereby anticipating those situations that might be favorable (or risky) in the development and promotion of village chickens. The adaptive management approach which is participatory in nature giving rural communities the will to determine the favorable pay off of their involvement in development and promotion of village chicken. This can be enshrined in the capacity to participate in the development plans to achieve maximum benefits. Complexity, diversity and risk prone resource poor rural communities in Africa call for the development of village chicken breeds that can produce and reproduce in the harsh environmental conditions associated with climate change. It is indisputable that Africa needs to develop and promote their own appropriate and suitable village chicken breeds under the prevailing climate change challenges.

6. Implications

Sub Saharan Africa should promote and develop village chickens in order to deal with the vagaries of climate change through enhancing adaptation and resilience in rural communities. In the face of both monetary and non monetary benefits of indigenous chicken for the rural population on the African continent their production systems continue to be subsistence with much of the marketing done within local communities. Village chicken production is the main animal husbandry activity in poor rural areas which comes in the form of multiple benefits. It is assumed that the burden of rural smallholder farmers to embrace climatic adaptive strategies in indigenous chicken production depends to a large extent on major socio-economic factors. It is common knowledge that the smallholder farmers have paucity of particular skills, resources and infrastructure to embrace preferred climatic adaptation strategies. Lack of skills, resources and infrastructure are a development that threatens the livelihood of resource poor smallholder farmers through compromising their adaptive capacity. The recognized merit of village chicken is that they are in harmony with the low input production systems. Their ability to easily produce and reproduce in local harsh environmental condition is a sign of adaptability hence the need for smallholder farmers to choose what type of animal species to raise. The species structural, behavioral and functional adaptation traits becomes critical because these can be imparted to future generation.

Selective breeding programs in village chickens should target both performance and adaptive traits taking advantage of their wider genetic base. There is need to take cognizance of the fact that there is need to conserve local animal genetic resources from genetic erosion by avoiding indiscriminate crossbreeding. It is assumed that selection procedures accompanied by recent genomic biotechnology greater strides can be achieved in improving productive and adaptability traits in indigenous chicken. There are immense prospects for genetic improvement through selection for productive and adaptive traits in village chickens. Selection procedure can take advantage of the fact that there is a lot of genetic variability within village chicken population having not being characterized in terms of performance. This is mainly due to environmental and genetic constraints with It is indispensable that precise and dependable estimates of different genetic parameters for productive and adaptability traits of indigenous chicken population should be estimated. This would be crucial for implementation of appropriate breeding plans or schemes in genetic improvement. Indigenous chicken are endowed with highly desirable characters like adaptability to harsh conditions and resistance to diseases. Therefore, an objective evaluation of performance of indigenous chicken with special emphasis on performance traits and adaptability to harsh environments is essential.

Genetic variability within population is immense in village chickens, which is a precursor of appropriate selection programs for genetic improvement and conservation. Village chicken genetic improvement programs should focus on within population selection rather than crossbreeding with imported chicken breeds. Appropriate designed selection schemes should be implemented to avoid the danger of genetic dilution. Crossbreeding has been used to upgrade indigenous chicken taking advantage of breed complementarity. Specifically, specialized exotic chicken breeds have been crossed with indigenous chicken breeds to combine the high productivity of the former with adaptive attributes of the latter. Imported chicken breeds employed in crossbreeding are not naturally

adapted to most harsh local environmental conditions, hence large scale crossbreeding needs proper planning and be implemented with caution. Crossbreeding programs if not properly planned and implemented is a menace to the ongoing worldwide effort to conserve the indigenous genetic resources.The indigenous chicken genetic resources should focus on engaging alternative approaches for genetic improvement of indigenous chickens. As a result, adoption of genetic improvement through selection within indigenous chickens strains could be a valuable scheme. However, it is imperative that dependable estimates of different genetic parameters for performance traits should be availed without compromising adaptability traits of indigenous chicken. Direct and correlated response should also be predicted for different traits due to selection. Deriving phenotypic and genetic parameters of productive traits will afford standard procedure for selection plan in order to improve meat and egg production in local chicken. Farmers are more interested in the development of dual-purpose indigenous chicken strains disregarding the usual productivity traits such as fast growth rate which might be secondary. Selection within indigenous chicken populations has an advantage of maintaining the indigenous chicken unique adaptability traits which are critical considering the harsh environmental condition caused by climate change. In addition selection within village chicken population avoids genetic erosion and dilution and enhance indigenous chicken genetic resource conservation. If information on genetic distances between the different strains (eco-types) can be precisely ascertained through biotechnologies, this can be used in selection schemes for improvement of indigenous chicken production systems while accompanied by improved management. It is suffice to suggest that indigenous chicken genetic improvement programs should take into account socio economic and institutional environments without losing focus on the need to develop both productive and adaptive traits in the face of the challenges associated with climate change. The larger part of the Sub Saharan Africa population dwell in rural areas (villages), where the village chicken is dominant, it is reasonably to suggest that promotion and development of indigenous chickens would have a profound positive impact on food security attainment, and malnutrition, poverty and hunger reduction in these communities. This can only be achieved through appreciation of their elegance as a reliable food and economic resource through structuring their production and marketing to enhance their commercialization in the mainstream agriculture sector. In terms of funding, it has been unfortunate that the private sector has been not forthcoming in supporting long-term investments in untested chicken strains genetic improvement programs. However, it is unforeseeable private sector engagement in promotion and development of a genetic improvement program of indigenous chickens once that ecotypes has been shown to have a market value.

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