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Domestic Animal Biodiversity in Ethiopia and its Threats and Opportunities with Emphasis to Changing Climate: An Overview

Habtamu Lemma
Wolaita Sodo University, P.O.Box 128, Wolaita Sodo, Ethiopia.
E-mail: nurhabta@yahoo.com

Abstract
Ethiopia has long been recognized as a center of diversity for domestic animal genetic resources which is vital component of agro-biodiversity. Ethiopia is the major livestock country in Africa and enjoys considerable livestock resources both in terms of number and diversity. The level of economic gains made from agro-biodiversity depends mainly on the existing indigenous crop/plant and livestock diversity, and on the practices and knowledge of the local farmers. To these communities, losses in agro-biodiversity (more serious in livestock) mean less option in their production systems and hence reduced overall welfare and food security. Climate change is likely to become the dominant direct driver of biodiversity loss. Feed shortage and disease burden exacerbated by climate change. Livestock production in already marginal ecosystems in Ethiopia is severely affected by climate change induced disasters. Sheko cattle, the only taurine breed in East Africa and with Trypanotolerant traits appears to be highly threatened. More efforts of livestock genetic characterization are needed to broaden the range of indigenous genetic resources and options available to livestock keepers seeking to adapt to climate change. The information systems and community-based animal genetic resources conservation researched by such stakeholders as ILRI and maintaining pure indigenous breeds in government breeding Ranches and research centers are positive experiences. The ratification of the Convention on Biological Diversity and the Interlaken Declaration, and some policy issues are also opportunities towards cost-effective way of conservation and utilization of existing/indigenous animal genetic resources which ensures food security and sustainable agriculture. Therefore, this paper is aimed at discussing current state of knowledge on livestock biodiversity and some potential adaptation and biodiversity conservation options to reduce the consequences of climate change.
Keywords: Adaptation efforts, Climate change, Conservation, Livestock biodiversity, Policy issues

1. Introduction

Biological diversity is the variability of life on earth. The most obvious aspect of biodiversity is genetic in the form of different breeds and forms within species. This genetic diversity or variability is due to molecular diversity in the process of molecular or biochemical metabolic reactions. The diversity in the gene provides the basis of molecular variability and the phenotypic variations between breeds and species. The genetic diversity has resulted due to the process of evolution over thousands of years during wild and domesticated stages and for the efforts made by man to meet the market demand, in present day context. This leads to domestication of some species of animals having desirable characteristics for mankind. However, man has domesticated about 40 species for his use like milk, meat, eggs, fiber, hide/skin, fuel, manure and draught power, etc. Biodiversity is a valuable asset for every country (Singh, 2006).

Genetic variation is essential; without it there is no possibility of sustained genetic improvement. And while relatively few breeds and biological types may best fit today's environments and market conditions, genetic diversity is critical if populations are to adapt to changing environments and markets in the future (Bourdon, 2000).

Ethiopia has long been recognized as a center of diversity for domestic animal genetic resource which is vital component of agro-biodiversity. It appears that the country has served as a gateway to genetic material from Asia to Africa and its diverse ecology gave rise to further diversification and thus contributed to develop the huge genotypes the country host today. So far, there are about 32 cattle, 7 sheep, 13 goats, 10 chicken breeds (DAGR-IS, 2007), 4 camels, 4 donkeys, 2 horses, 2 mules and 6 honeybee races (IBCR,2005) are identified in the country. The domestic animal population is estimated to be 47.5 million cattle, 26.1 million sheep, 21.7 million goat, 1 million camel, 39.6 million chickens, 1.8 million horses, 0.4 million mules and 5.6 million donkeys (CSA,2009). Livestock holdings represent a living bank (saving) for both highland farmers and pastoralists. Livestock serve as insurance against crop failure and as a source of food. They also play a critical role in agricultural intensification processes by providing

draft power, manure and fuel. Economically, the livestock sector accounts for 16% of the national and 27-30% of the agricultural GDPs, and 13% of the country's export earning (MoARD, 2007). This level of economic gains made from agro-biodiversity depends mainly on the existing indigenous crop/plant and livestock diversity, and on the practices and knowledge of the local farmers. To the communities, losses in agro-biodiversity mean less option in their production systems and hence reduced overall welfare and food security. Climate change is likely to become the dominant direct driver of biodiversity loss (www.cbd.int/climate). There is widespread consensus that existing biodiversity (crop and livestock genetic resources) will be critically important to help croppers and livestock keepers adapt to a changing climate. Livestock production in already marginal ecosystems in Ethiopia is severely affected by climate change induced disasters (Kassaye, 2010). IFPRI (2012) predicts that, without adaptation, the impact of climate change on agriculture and food security will be high. However, lack of information can be a barrier to better climatic change adaptation and improve our understanding of the climate change-biodiversity relationship.

There have been various research information and positive approaches pertaining to livestock biodiversity and its threats and opportunities in Africa and developing region; however, a collation of information (studies and experiences) remain limited in Ethiopia. Therefore, this paper gives an overview of current knowledge about livestock biodiversity and some potential options of climate adaptations and biodiversity conservation in Ethiopian context. Implications for further investigation and interventions to promote sustainable use and conservation of the local farm animal genetic resources (FAnGR) are highlighted.

2. Livestock origin and production systems

The existence of the large livestock diversity in Ethiopia is due, in large part, to its geographical location near the historical entry point of many livestock populations from Asia, its diverse topographic and climatic conditions, the huge livestock population size and the wide range in production systems. Ethiopia (specifically the Abyssinian highlands) is considered the 'melting pot' of farm animal genetic resources (Rege, 1999). Livestock are kept almost throughout Ethiopia under diverse farming system conditions. Livestock production systems are determined by climate, types of crops grown, livestock species reared, and their economic importance to the producer. The main livestock production systems are crop-livestock mixed production system, pastoral and agro pastoral production systems and intensive urban and peri-urban production systems (Azage Tegegne and Zinash Shileshi, 2004).

3. Threats to FAnGR

According to Pilling (2010), different threats to AnGRs including disasters and emergencies, disease epidemics and control measures, inappropriate breeding management, strategies and policies, changing production system and livelihoods, and cross-cutting threats.

Climate change has the potential to drive gradual changes in production systems (e.g. affecting the availability of feed resources), to cause more frequent climatic disasters, and to increase the exposure of breed populations to unfamiliar epidemic diseases. Other cross-cutting threats include lack of awareness of the significance of AnGR among decision-makers and lack of consultation with livestock keepers and other relevant stakeholders (FAO, 2009a), both of which contribute to many threats arise because of policy and management decisions.

In Ethiopia, indiscriminate breeding, disease, feed shortage and agro-chemicals are some causes of threats to maintenance of animal genetic diversity (IBCR,http://www.ibc.gov.et/biodiveristy/conservation). Feed shortage and disease burden exacerbated by climate change. Livestock health problems such as the high prevalence of Trypanosomiasis in the lowlands are among the challenges that affect livestock fertility.

At the moment Sheko cattle, the only taurine breed in East Africa appears to be highly threatened as a result of interbreeding although it is widely known to have economically important traits such as Trypanotolerance and good dairy character for use in the Trypanosomosis infested parts of Ethiopia (Workineh *et al.,* 2004, Stein et al.,2011). The Fogera (Gebeyehu et al., 2003), Begait, Irob, Ogaden, Afar, and Borena cattle breeds (Workineh et al.,2004), Sinnar donkey breed, and Afar sheep breed are also facing various degrees of threat (IBCR,http://www.ibc.gov.et/biodiveristy/conservation).

The genetic characterization of indigenous animal genetic resources in tropical livestock systems is far behind that of major crops. More efforts of livestock genetic characterization are needed to broaden the range of indigenous genetic resources and options available to livestock keepers seeking to adapt to climate change (Thornton et al., 2011). In addition, characterization (phenotypic and genotypic) is the first step in conservation work.

4. Opportunities

Trypanotolerant traits of Sheko (Workineh et al., 2004; Stein et al., 2011) and Nuer/Abigar cattle breeds and the

drought tolerance characters of camel and donkeys need mentioning. One of the country's vital natural resources, biodiversity, is very much the reflection of the historical climate. There is widespread consensus that existing crop and livestock genetic resources will be critically important to help croppers and livestock keepers adapt to a changing climate**.**

The information systems (DAGR-IS,2007, DAD-IS,2010) and community-based animal genetic resources conservation(Nigatu et al.,2004) researched by such stakeholders as ILRI (International Livestock Research Institute) and maintaining pure indigenous breeds in government breeding Ranches (Cattle, Sheep and Goats) and research centers (IBC,2004) are positive experiences/steps.

The ratification of the Convention on Biological Diversity led by FAO (CBD, 2006, 2008a,b) and the Interlaken Declaration, and the some policy issues by IBCR (Institute of Biodiversity Conservation and Research), and plan by EPA (Environment Protection Authority)- CRGE (Climate Resilient Green Economy) are also opportunities/advantages.

The global plan of action was adopted through the Interlaken Declaration of AnGRs, in which governments affirmed their commitment to its implementation (FAO, 2007e). As of June 1998, the mandate of the IBC has been expanded not only to plant genetic resources but also to animal and microbial genetic resources (National Policy on Biodiversity conservation and Research). CRGE also advocates preserving biodiversity. The establishment of biotechnological laboratory of Holeta can be a beginning to advance molecular characterization in exploring and protecting agricultural genetic resources.

5. Conservation and utilization of animal genetic resources

Biodiversity forms the basis of life on earth. The Convention on Biological Diversity, adopted at the United Nations Conference on Environment and Development held in Rio de Janeiro in 1992, states that the contracting Parties are 'conscious of the intrinsic value of biological diversity' and conscious also of the importance biological diversity for evolution and for maintaining life sustaining systems of the biosphere.' The Parties affirm that 'the conservation of biological diversity is a common concern of human kind' and that they are 'aware that conservation and sustainable use of biological diversity is critical importance for meeting the food, health and other needs of the growing world population' (Ajmone-Marsan and The GLOBALDIV Consortium, 2010). In September 2007 at Interlaken, Switzerland, country delegates from all over the world adopted a global plan of action for conserving indigenous farm animal genetic resources (FAO, 2007).At this meeting, the notion emerged that livestock diversity is decreasing at an accelerated pace, with many breeds being lost throughout the world. Furthermore, populations are poorly characterized in developing countries, where local livestock diversity represents a unique resource for productivity and local breeding programs and also provides a major pathway out of poverty. Conservation of genetic diversity is now universally accepted as being vital for sustainable management of these resources. It can be accomplished by in situ preservation of endangered and valuable breeds, selection programs that will restore genetic diversity in industrial breeds, or the Cryo-conservation of gametes, embryos and somatic cells of the existing gene pool (Ajmone-Marsan and The GLOBALDIV Consortium, 2010). In addition, utilization of farm animal genetic resources is the use and development of animal genetic resources for the production of food and agriculture.

The conservation and sustainable use of genetic diversity are essential to meet a number of challenges facing humanity, from coping with the predicted climate changes to achieving food security despite still growing world population (Pautasso, 2011).

The use in production systems of AnGRs that already possess high levels of adaptive fitness to the environments concerned, and the deployment of sound genetic principles, will facilitate sustainable development of the AnGRs and the sustainable intensification of the production systems themselves. The wise use of AnGRs includes a broad mix of ongoing activities that must be well planned and executed for success, and compounded over time, hence with high value. It requires careful definition of breeding objectives, and the planning, establishment and maintenance of effective and efficient animal recording and breeding strategies (ILRI, 2006).

Conservation of Farm animal genetic resources (FAnGR) refers to all human activities including strategies, plans, polices, and actions undertaken to ensure that the diversity of FAnGR is maintained to contribute to food and agricultural production and productivity, now and in the future (ILRI, 2006). For example, Indigenous breeds of sheep and goats may produce less milk or meat than improved breeds. But they usually fulfill a wider range of functions for their owners and are much easier to manage. Many marginal areas can be exploited only by locally

adapted breeds or species. For example, camels are the only livestock in areas with less than 50 mm of rainfall. If these animals die out, it will no longer be possible to use large areas of arid lands to produce food. Additionally, the genetic diversity they embody enables breeders to respond to changes in production, marketing and the natural environment. The adaptation of different species and breeds to a broad range of environments provides the necessary variability that offers opportunities to meet the increased future demands for food and provide flexibility to respond to changing markets and needs. However, currently, there is a threat of loss of genetic diversity in livestock populations to the extent that some breeds may be approaching extinction. This calls for strong conservation activity which is important, among others, in maintaining genetic diversity to meet the needs of current and future utilization; providing options for adaptation to changing environmental conditions; and preserving cultural and historical values (Gibson et al., 2006). The first step in conservation is to know which breed to conserve (characterization). Basically, conservation is categorized into *ex situ* and *in situ* conservation. The combined use of live animals and frozen semen appears to be the best strategy. For instance, a pure breeding strategy is necessary for breed conservation and it may be accompanied by a well organized community based breeding program supported by a nucleus herd of purebred Sheko animals (Stein, 2011). Conserving the Ethiopian Boran in Borana lowlands of Ethiopia will secure the future use of the Borana genetic material at very little costs per animal (Kerstin, 2006).

Priority should be given to breeds that have reached critical or endangered status, genetically diverse stocks, breeds with unique characteristics and Stocks with high overall economic merit. Some researches in Ethiopia like analysis of genetic diversity and conservation priorities for six north Ethiopian cattle breeds (Zerabruk et al.,2007) and Ethiopian sheep breeds (Gizaw et al.,2008) can also provide valuable information on conservation program.

According to Workneh et al., (2004), there are encouraging developments from FAO (DAD-IS) and ILRI (DAGRIS) as part of their global research programs for characterization, documentation and conservation of Farm animal genetic resources. Potential candidate institutions in Ethiopia for characterization and conservation are MOA (Ministry of Agriculture), IBCR, EIAR (Ethiopian Institute of Agricultural Research) and Academic institutions

Governments are sufficiently concerned about the erosion of livestock breeds to issue a Global Plan of Action (Strategic Priority 6) for Animal Genetic Resources (FAO 2007a). This contains recommendations on monitoring the loss of breeds, their sustainable use and development, their conservation, and policies, institutions and capacity building to manage animal genetic resources.

Supporting livestock keepers to add value to their traditional breeds also contributes to achieving two of the eight Millennium Development Goals (Goal 1 and 7) (UNDP, 2000). The Convention on Biological Diversity (Article 8 and 10) obliges governments to support traditional lifestyles, biological diversity and cultural practices – of which local breeds and species are an integral part (CBD, 1992).

6. Conclusion

There is widespread consensus that existing biodiversity (crop and livestock genetic resources) will be critically important to help croppers and livestock keepers adapt to a changing climate, esp. in fragile areas. In this regard, sustainable and cost-effective ways of conservation and utilization of local farm animal genetic resources need to be implemented to enhance the wise management of AnGN as a means to promote/improve food/livelihood security in a changing climate. These can be included in the following remarks:

- Organizing community based AnGR in-situ conservation programs;
- Integrating Indigenous Knowledge (IK) and practices of local communities keeping animals into conservation strategy;
- developing and using indigenous breeds in government ranches and research centers;
- Establishing Gene Bank for Cryo-preservation of adapted animal germplasm (gametes, embryos..) from endangered breeds (e.g. Sheko and Borena) to backup maintenance of live animals. In this regard, the experiences of countries- Benin, Brazil, China, India and Kenya (FAO, 2009c) can be taken into consideration;
- Characterization studies should be carried out to assess the performance and special qualities of local animal breeds and determine animal genetic resource diversity;
- Placing National Animal breeding policy that take into account the need to maintain genetic diversity; For instance, indigenous cattle need not be overlooked as they have ability to live on less feed and feeds of

lower quality than crossbred cattle and thus to produce some milk or meat where the latter cannot strive (Maule, 1990);

- Promoting integration of AnGR management issues into the planning of adaptation and mitigation measures (Pilling, 2010). Species and breeds that are well adapted to effects of climate change (diseases and feed supply problems) may become more widely used (Hoffmann, 2010). Changes in livestock practices and institutional policy changes, for instance, establishing participatory livestock early warning systems- as in the case of IFAD- supported interventions (IFAD,2009) and ILRI pilot livestock insurance schemes (Hess, 2006; Thornton et al.,2011) in pastoral areas of Ethiopia- could benefit adaptation efforts. Pastoralists have diversified the livetock species by raising drought resistant animals such as Camel and goats (Kassye, 2010). In addition, enhancing rangeland productivity under an environment of a declining resource base (e.g. use of traditional range enclosure in the Borena rangelands of southern Ethiopia involving semi-private grazing lands used for seasonal gazing by calves and sick/weak animals and particularly to address among others unavailability of pasture during dry seasons for milking animals around sedentary homesteads) (MacOpiyo et al., 2008). However, the capacity of local communities to adapt to climate change and mitigate its impact will also depend on their socioeconomic and environmental conditions, and on the resources they have available (IFAD, 2009).

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