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Review article

Focus on status and prospects of conservation and sustainable use of indigenous livestock genetic resources in Zimbabwe

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A R T I C L E   I N F O

A B S T R A C T

This is a review paper that looks at the current status and prospects of conservation of indigenous livestock genetic resources in Zimbabwe. Indigenous livestock genetic resource conservation and sustainable use can contribute to reduced vulnerability, increased food security and accelerated economic growth in rural areas of Zimbabwe. There is a consensus that global animal genetic resources diversity is under pressure. The existence of threat to animal genetic resources is accepted, even though debate remains about the severity of genetic erosion. Local effort on improvement and conservation of indigenous cattle are described and challenges highlighted. The need to invest in indigenous livestock research and human resource development to support livestock conservation to accrue maximum benefit is acknowledged. Strategy on livestock conservation should be instrumental in ensuring the survival of indigenous livestock genetic resources, while making superior animals available to smallholder farming sector. Unknowingly some of our indigenous livestock genetic resources may be classified as insecure or vulnerable but not however endangered as such. Natural disasters have resulted in loss of valuable indigenous genetic resources, breeding tracts and mixing of genetic characteristics of various genetic grouping. Indigenous livestock genetic conservation should encompass changes in value and attitude of smallholder livestock producers from the present consideration for number of

stock as status symbol to more important objectives of higher productivity and socioeconomic benefits that are business oriented. The review paper therefore, concludes that in the planning and implementation of indigenous livestock conservation interventions to increase livestock production, smallholder livestock farming sector approach is proposed, placing the household as focal point of livestock conservation. Small scale farmers approach should become increasingly important and can have a tremendous influence on achieving the primary objective which should be the conservation of indigenous livestock genetic resources   one of the most vital resources in rural economy.

1. Introduction

Conservation can be defined as the management of human use of animal genetic resources to yield the greatest sustainable benefit for the current and to maintain the potential for future generation (Wollny, 1995). Indigenous livestock genetic resources are numerically and economically very important and promising genetic resources, however their conservation and sustainable use have lagged behind in Zimbabwe. For many years the performance of indigenous livestock of Africa was regarded as inferior in spite of the fact that Africa is richly endowed with a large number of indigenous livestock (Scholtz, 2012), however the increased demand for livestock products locally has open up economic opportunities for indigenous livestock production. There is evidence that indigenous livestock make a vital contribution to food security and smallholder household livelihoods (Homann et al., 2007) and has significant potential to alleviate poverty in smallholder farming sector (Agrisystems, 2000). Food security becomes increasingly vulnerable because of high livestock genetic erosion caused by lack of implementation of adequate conservation measures. Livestock sector is valued as one of the main global drivers of agriculture as well as one of the sectors having enormous potential for poverty reduction (FAO 2006; Holmann et al. 2005). Zimbabwe has experienced economic diversification over the years but continues to depend greatly on agriculture hence conservation and use of indigenous livestock genetic resources should be considered as a major component of rural development. There is a strong correlation between poverty and a high degree of genetic diversity in livestock (Blench, 2005). The loss of animal genetic resources should be viewed with concern as their play an important socio-economic role in terms of supporting current and future livelihoods as well as profits (Hiemstra et al., 2006).

Livestock conservation in general is not easily justifiable economically,   however, Smith (1984) expressing economic justification of conservation and preservation of genetic resources calculated the product of value expressing the used proportions of genes of the genetic resources and relative profit in economic efficiency. Hence, there is need to implement conservation and sustainable use of indigenous livestock genetic resources to derive maximum benefit. Conservation and sustainable use of indigenous livestock genetic resources is essential due to their potentiality for multipurpose use, disease tolerance and low maintenance requirements. The future of animal production will rely on a wide use of indigenous livestock genetic resources that can survive and produce under harsh semi arid conditions of Zimbabwe. There is global concern about the potential long term consequences of loss of domestic animal diversity and the need for conservation of animal genetic resources which are prerequisites for food security and the future agricultural innovations (CBD, 1992)..The review attempt to highlight the need to conservation indigenous livestock genetic resources while obtaining maximum benefit from local livestock.

2. The role of traditional livestock husbandry in indigenous animal genetic resource conservation

The traditionally smallholder livestock sector, which include the communal and resettlement areas, are considered as predominantly subsistence. However, a recent sector (small scale commercial) has emerged as a

result of land reform, in which income and nutrition are main reasons for keeping livestock. There is a symbiotic relationship between the farmer and livestock in both communal and resettlement farming sector, with animals being kept for as long as possible in order to provide primary and intermediate products and services (Agrisystems, 2000). The livestock farming in communal (homestead) and resettlement areas income generation is very much secondary. The major functions on livestock keeping are to meet nutritional needs, storing of wealth, providing security, social and cultural functions (Homann et al 2007). Meat though normally considered as a primary product, is only used to obtain the salvage value of the animal at the end of its useful life, especially for cattle, sheep and goats (Sibanda, 1999). The uses of livestock tend to differ according to agro-ecological regions, and the potential for cropping to supplement livestock production.

The traditional livestock production continues to remain in a state of crisis, major production constraints are associated with management and husbandry, disease*nutrition complex and the seasonality of feed, especially in the communal grazing system. Livestock indices are very low and mortality excessively high. The communal national livestock census in 2003 estimated at 3,944,830; 435,905; 2992,204; 118,795 and 11,111, 923 for cattle, sheep, goats, pigs and poultry, respectively (Hagreveas, 2004). No data on donkeys were available.

The off take of livestock in smallholder livestock sector is low, for beef it has been estimated at 1-3% (Sibabnda, 1999). Reasons for low off take have been many, which include multiple use of livestock and poor animal husbandry. It is important to note that livestock in smallholder sector are not differentiated by breeds or strains. The management of grazing lands in communal and resettlement areas is considerably poor leading to low livestock productivity and hence low off take. The low resource base and complex ownership patterns makes selling of animals difficult. The price of indigenous species livestock has been unfavorable in the both formal and informal markets. The middlemen have taken advantage of the drought situation to buy cattle, sheep and goats for a song. The formal markets have tended to down grade the indigenous livestock carcasses hence low prices. With the above scenario, it may be suffice to assume that there will be less changes in livestock population in communal and resettlement areas because of the low off take. The population dynamics may be static which may enhance species composition for a long time if the effects of drought is not considered. However, the effects of drought in the communal and resettlement livestock sector have accelerated livestock mortality. The past two decade the rainfall patterns in Zimbabwe have changed, characterized by intermittent droughts. The poor management have also worsened the situation which is already desperate. All these factors have negatively affected the livestock populations hence the need to verify the existing population before a catastrophe. Drought has affected mostly the southern parts of the country which is characterized by marginal rainfall. Farmers have been forced to offload livestock through sales. This has resulted in significant reduction in livestock populations in certain parts of the country. The reduction in large livestock is of major concern because of their generation interval. It will take at least three years to produce an animal from conception to slaughter in cattle. Cattle production is a long term process, creating additional difficulties in the smallholder livestock sector. After a disaster cattle numbers may take many years to recover. Floods in 2000 reduced cattle population from 57,000 to approximately 23,000 in the southern parts of Zimbabwe. Intervention through restocking only recovered 50% of the original numbers (Perry et al 2003). The effects of drought may be felt long after the actual event. Its common knowledge that drought can reduce livestock population substantially, although the numbers may not be verified because no current livestock census has been done. If the environmental effects such as drought and sporadic floods could outweigh the ability to conserve indigenous livestock, the country may be heading for a disaster for some of the livestock species. Hagreaveas et al., (2004) conducted a study funded by FAO to examine the effects of drought on livestock population in Zimbabwe in order to help design relief and recovery interventions. It was concluded that the effects of drought on reduction of livestock is real and should not be underestimated.

The communal areas before the land reform were over populated, which meant land area for both cropping and livestock grazing was reduced. The increased pressure on land had forced communal farmers to reduce the land available for grazing of livestock, and this may have natural affected livestock population in specific areas. Keeping of large ruminant animals was never an option for most smallholder farmers. Majority of farmers preferred the keeping of small stock to compensate for small land holdings due to human population pressure. The land reform program has led to large scale shifting of both human and livestock. The impact of this shifting need to be determined in terms of livestock population distribution and dynamics. The assumption is that land size could have influenced the indigenous livestock population dynamics in favor of small stock. Conditions unfavorable for human population growth will negatively affect the livestock species diversification assuming other factors are constant.

Agricultural development has become hostile to indigenous livestock diversification. Smallholder livestock sector has been forced to adopt new methods of livestock production in which breeders in public sector are interested in having access to exotic high productive breeding material. Regarding their own indigenous livestock awareness of potential benefit is not adequate locally. The maintenance of traditional livestock agriculture systems as part of indigenous livestock conservation and sustainable utilization strategy may be a starting point for future programs.

Previously long term livestock improvement and conservation programs where executed on station, invariably included management techniques which were not used in traditional livestock systems such as routine disease control, restricted breeding season, planted forages and fencing. As a result conclusions were not relevant to smallholder farming sector that harbors most of the livestock genetic resources populations. Smallholder farmers would want to see more use of their own local indigenous livestock with this understanding local farmers will continue to maintain the local breeds/strain because they have something to offer. This recognition of value of indigenous livestock will assist to develop acceptable long term livestock conservation strategies. Evaluation of indigenous livestock genetic resources which target the immediate commercial use will have high rate of adoption in the smallholder livestock sector. Improvement in marketing of animal products from local livestock and provision of incentives for keeping local animal genetic resources should be considered when formulating animal conservation policies.

It is important to note that in an attempt to choose a smallholder based livestock conservation strategy a few problems may be encountered. The majority of traditional livestock farmers can not read and write, this may complicate the livestock conservation efforts. The inability to interpret information coming from documented research may cause some confusion. Participation of smallholder livestock sector in indigenous genetic resource conservation is highly desirable but ways and means of achieving success is a surmountable task and need s proper planning.

3. Efforts on indigenous cattle genetic improvement through selection, multiplication, dissemination and conservation

3.1. Tuli

In 1942, while working in the lowveld regions of Southern Zimbabwe, Mr Len   Harvey   noticed that there appeared to be a distinct type of yellow Sanga cattle amongst the ordinary mixed native cattle. These seemed better adapted to the harsh local conditions and were superior to other stock. As a result of these observation the government then decided to purchase some of these cattle to see if they could be improved and breed true to type. In 1946 a Nguni herd was established at Tsholotsho sub-station and a Tuli herd was established at Tuli sub-station as part of a national program to conserve the indigenous cattle resources of the country (Ward, 1978). Approximately 180 breeding females of the breed were maintained in single sired mating groups. With closure of the substations in 1978, the Tuli conservation herds were subsequently moved to Matopos Research Station in 1979 and as expected, adapted well to its new environment. The development and management of the herds were described by Brownlee (1977).

 The commercial cattle farmers soon realized the potential of the breed and for many years breeding stock was sold to them. The formation of the Tuli Breed Society took place in 1961. The breed was soon to be found thriving in Zimbabwe and now in South Africa. It is unfortunate that the drive for indigenous cattle conservation which started in the 1940's has failed to live up to its expectations. On the other hand the potential of the Tuli cattle are now recognized by South Africa cattle breeders and through previous numerous imports they have established active, ever increasing breeding populations in South Africa. The recent development that has led the increase in international interest in Tuli cattle breed is the discovery, through research at Clay Center in Nesbraska, USA that the Tuli produces meat of exceptional high quality. In trial of several breeds the Tuli had the most juicy meat and was second to the Angus for marbling.

3.2. Nguni

 In 1946 a Nguni herd was also established at Tsholotsho sub-station as part of a national program to conserve the indigenous cattle resources of the country (Ward, 1978). With closure of the substation in 1978, the Nguni conservation herd was subsequently moved to Matopos Research Station in 1979 and as expected, adapted

well to its new environment. Matopos Research Station was holding 140 breeding cows herd that had been closed herd since its inception (Khombe, 1994). Proposal had been made to increase the herd at Matopos Research Station or establish another conservation herd at different site (Beffa and Ncube, 1994). The management and selection procedures were supposed to be similar with to the Tuli herd. The biggest government herds were kept at Matopos Research Station and Grasslands Research Station, these have over the years dwindled.

3.3. Mashona

Makoholi Experiment Station was holding the largest government herd of Mashona breed that was registered with the Mashona Breed Society. In 1990 Mashona Breeding Scheme, a joint venture between Mashona Breeders Association and Apex Corporation was established. The breed society released the limitation in terms of selection within herds because of small herd size. The scheme was trying to broaden the genetic base of the breed through buying in and progeny testing (Khombe, 1994). The screening program was supposed to secure high merit individual to create a nucleus herd.

There is a real case for involvement of research institutions and universities in indigenous livestock conservation and sustainable use. The institutions should maintain pure bred indigenous livestock populations as control and for research purposes. Management, nutrition and selection within populations should be carried out to provide information on superior males for use by local farmers The economic crisis has resulted in high staff turnover in government institutions, loss of expertise and insufficient operating budgets has severely hampered the ability to conserve and utilize the indigenous cattle herds. There is no longer any proper performance recording of these cattle breeds in all the research stations. The existence of the breed societies has not been spared with the economic melt down. The recording cattle schemes have been discontinued because they were donor funded. The withdraw of donors most of the donor funded cattle schemes collapsed because the central government could not continue funding them.

A counter argument on these on station improvement programs is that data from research stations will be collected from fewer animals, maintained under systems considerably different from what obtained for bulk of the smallholder population. Close adaptation of local cattle to their habitat which is the smallholder farming sector suggest that on farmer research too could have been another viable option.

4. Importation of livestock and indiscriminate crossing causing genetic erosion

In the last century many livestock development programs have sought to improve the productivity of indigenous livestock, in terms of increasing the output of marketable products such as meat and milk, by promoting the extensive use of exotic germplasm in crossbreeding (Rege, 1999). The importation of exotic breeds or strains and other social and economic pressure have exposed locally adapted indigenous livestock to the risk of potential loss of this valuable livestock genetic group (Rege and Gibson, 2003). Obvious the need to improve livestock production in developing world has threatened unimproved indigenous livestock populations in Africa. Indigenous livestock which are adapted to the local conditions are endangered through livestock substitution and lack of appropriate livestock development programs. Gradual importation of animals in many developing countries is driving smallholder out of business or creating pressure to increase output, often through the use of different breeds or crossbred animals. The knowledge of about the adaptive properties of indigenous livestock and their competitiveness versus exotic livestock is still limited. This has resulted in high performance livestock genetic resources are replacing indigenous populations which have a broad genetic base suitable for diverse use in harsh semi arid conditions. Systematic livestock importation and indiscriminate crossing have contributed to the genetic dilution and erosion of indigenous livestock species. Indiscrimate crossing of exotic breeds /strains has been the order of the day in communal areas, with the Braham cattle breed having taken a center stage despite limited grazing. If this process is not arrested the population of indigenous cattle will be reduced to unacceptable proportions. The detrimental effects of wide spread crossing with exotic breeds/strains of livestock not adapted to the harsh semi arid environment has been experienced in some rural areas where numbers of local animals species have dwindled. There are more crossbreds than the pure local breeds especially in cattle.

Constraints to productivity should be identified for indigenous livestock and intervention sort which are not likely to be importation and crossbreeding of local livestock with imported breeds. These intervention should take into account the production environment which is harsh and feed resources are scarce. More detailed information and extensive documentation on performance parameters of our indigenous livestock should be considered to

improve productivity. This could give us a basis of the direction of genetic improvement and conservation of indigenous livestock genetic resources.

Causes of genetic erosion in indigenous livestock genetic resources may be influenced by changes from traditional agriculture to modern techniques of agriculture. As a result of decline in economic viability of traditional livestock production system the indigenous livestock genetic resources are threatened , while others are replaced through crossbreeding. The reduction in populations species of indigenous livestock would be a loss to an invaluable heritage. The country need for future If the country looses the our local livestock diversity the future of livestock agriculture could be threatened. The up keep of our local livestock genetic resources serves as an insurance, providing the resources needed to meet the unforeseeable future challenges such as new livestock diseases, parasites and environmental changes due to global warming. Indigenous livestock possessing high gene frequencies for adaptation would play a particular important role in future animal production systems in Zimbabwe

5. Infrastructural and technological elements necessary to support indigenous livestock conservation and sustainable use

Conservation of livestock genetic resources in the developed world has advanced to the current stage mainly due to the presence of adequate and appropriate infrastructure. In addition to the advancement in infrastructure, application of new technologies has complemented the livestock conservation efforts. In contrast, infrastructure for national livestock conservation programs are lacking in Zimbabwe. However, the need for such facilities is paramount for successful conservation programs. State sponsored research institutions should be part of the drive for technological innovation and indigenous livestock genetic resources conservation. On station breeding units may provide the centers for rapid distribution of superior indigenous genotypes through improved technologies, which as Smith (1988) states, are area model for the role of sophisticated technology in improving indigenous breeds and developing production systems.

The results of new developments in reproductive physiology which makes various manipulations possible opens up entirely new horizons for indigenous livestock genetic resources conservation. New technology can achieve immediate improvement through selection of foundation livestock populations and attain faster and more effective performance improvement rates in indigenous livestock genetic resources. Multiple ovulation schemes offer effective options to maintain and improve indigenous livestock if well functioning infrastructure and capital are provided The introduction of biotechnological derived conservation techniques such as semen, embryo and gene banks and maintenance of live populations would be ideal but unrealistic under the current constraints of developing countries.

 Existing research facilities fall short far short of what is required for livestock improvement and conservation. Most facilities have lived up to their life span and are dilapidated which warrant massive reconstruction. This makes these institutions inappropriate as they are confined to small livestock populations and have discontinued past efforts due to large personnel turnover. Establishment of links with private sector for livestock conservation programs has been unsuccessful because of inability to economically justify the benefit on the part of the state. The use of new approaches in livestock conservation and sustainable use of indigenous livestock in Zimbabwe, remain a theoretical possibility considering the lack of appropriate facilities, the extent of inadequate human resource development and expertise. The absence of formal marketing facilities for goats such as auctions has contributed to the persistence of comparatively widespread of household consumption of goat meat and sprouting of informal markets.

6. Human resource development to support indigenous livestock genetic resource conservation

Training focusing on aspect of indigenous livestock genetic resources, their evaluation and utilization should become an integrated part of education of livestock production specialists. The integration of indigenous livestock genetic resource training into the curricula of animal production is lacking at tertiary level. Most lecturers and trainers are not well versed on issues of livestock conservation. This has created information gaps on indigenous livestock genetic resources conservation and use. Time is now ripe for systematic and planned courses on livestock conservation at tertiary level. Zimbabwe should take advantage of the Global Strategy for Management of Farm Animal Genetic Resources which provides a technical and operational framework for assisting countries

with conservation and sustainable use of their animal genetic resources. The previously trained personnel of animal genetic resource conservation have since left the government sponsored institutions which makes it difficult to direct livestock conservation policies. There is need to train new young scientist in livestock conservation programs. The discontinued conservation programs require to be resuscitated for the benefit of future generations. If the animal conservation specialist is to effectively tackle the thorny issue of maintaining the livestock genetic resources in smallholder livestock sector, he must either be a broadly trained professional with knowledge of sociology, economics, land use planning and integrated rural development as well as animal science. It has been noted that animal scientists has to date been trained essentially to meet the demands of the developed livestock sector, and has little, if any, exposure to the demands and challenges in the traditional livestock sector. This aspect need possibly need to be addressed at university level and should be a prerequisite to working in extension services.

7. Population growth and livestock product demand

A typical impact of urbanization is ever more rapid increase for demand for livestock products. This is visible in the markets the presence of imported chicken products. The incentive to keep local chickens has suddenly dropped. Consumption of chicken meat has sharply risen partly because of expansion of population in the urban areas. Sometimes new demands for certain species products can provide a counterweight demand for other products. Due to improper marketing system for goats, their population has been believed to be on an increase. Livestock products in future will constitutes an important part of agricultural activity contributing substantially to household and food security as a result of rise in human population numbers, urbanization and economic development.

8. Final comments

The important issue which need to be addressed in dealing with indigenous livestock genetic resources conservation is how can the country halt the further erosion of indigenous livestock genetic resources and promote their sustainable utilization. Definitely, the starting point is the establishment of a new and accurate baseline data on indigenous livestock genetic resources which is fundamental for sound planning and development of proposed conservation and sustainable use programs. This process could be carried out in tandem with the identification and analysis of how other regional programs may influence our local livestock genetic resources. Conservation strategy which put emphasis on empowering the smallholder farming sector and their practices, will significantly promote rural development. Combining livestock conservation and economic viability through greater productivity in indigenous livestock genetic resources may be the solution to engage the private sector. Intensification on station population selection concurrently run with the conservation of major indigenous animal species populations within the smallholder sector will retain the complex of livestock traits and characters from generation to generation.

Despite the vast land areas occupied by most livestock research stations the capacity to effectively run livestock conservation population is insufficient. Most of the personnel manning the research stations have no idea of animal breeding and conservation issues which can be applied to local genetic animal conservation. Animal nutrition has been the major priority in most of these research stations . No attempt has be made to gather information on different local livestock species distribution. Lack of policy support in this regard has made conservation a non event.

Animal population dynamics has changes the past decade due to human relocation under the land reform program. Supporting the traditional agriculture and their livestock will ensure their survival until their value have been recognized. The value placed on the local animal genetic resources will enhance the conservation of the livestock species. The local farmers should recognize the importance of the local animal genetic resource before effective conservation. The conservation on the part of the local farmers should hold the sense of responsibility and social value in their communities. This only works if the farmers become the central part of the conservation strategy. Promoting smallholder livestock conservation strategy does not mean that local animals are more productive or efficient but it ensures what the animals may offer and what they can produce.

Massive restocking for cattle should be done to counter act the negative effects of drought on cattle population. Non governmental organization should not be allowed to encourage crossbreeding were proper

planning has not been put in place to avoid indiscriminate crossing. Selection of outstanding animals within indigenous livestock populations may accelerate conservation and sustainable use indigenous livestock genetic resources.

Technologies such as artificial insemination which has enjoyed vast use in commercial dairy sector could be have effective use in conservation and sustainable use of indigenous livestock genetic resources. Outstanding indigenous cattle bulls semen can be used in communal established insemination centers in smallholder farming sector to maintain the local species diversity. The loss of local cattle breeds should be taken as an indicator off or general loss of livestock genetic resources in Zimbabwe The status of livestock genetic resource is poorly understood and loss of genetic diversity through natural disasters and indiscriminate crossing of local breeds/strains has not been reported and difficult to quantify.

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