Journal of Applied and Advanced Research, 2019: 4(1) 47–53
http://dx.doi.org/10.21839/jaar.2019.v4i1.265
ISSN 2519-9412 / © 2019 Phoenix Research Publishers

Review Article – Agriculture

Sheep genetic resource conservation experience in Turkey and future prospects in Ethiopia: A Review

Zeleke Tesema[1,3]*, Abiy Shenkute[2,3]
[1]*Sirinka Agricultural Research Center, P O Box, 74, Woldia, Ethiopia*
[2]*Debre Tabor University, P O Box, 272, Debre Tabor, Ethiopia*
[3]*Bahir Dar University, PO Box, 79, Bahir Dar, Ethiopia*

(Received: 17-12-2018; Accepted 24-01-2019; Published Online 24-02-2019)
*Corresponding author (E-mail: zeleke.t2007@gmail.com)

Abstract

Conservation of native animal genetic resource is vital to maintain genetic diversity sustainably and to cope with the future challenging climate change. Thus, the aim of this paper was to review the experience of sheep conservation practice in Turkey and future prospects in Ethiopia. In turkey, fifteen sheep types are extinct and other native sheep population decreased by 47% due to an unplanned crossbreeding program. For these reasons, sheep genetic resource ex-situ in vivo conservation project started in 1995 with three sheep breeds. The animal breeding law regarding registration of new breed and conservation of animal genetic resources was enacted in 2001 in Turkey. In-situ conservation subsidies of sheep breeds near to extinction have been continued since 2005. Following these events, in vitro conservation of germplasm of 13 sheep breeds have been initiated in 2007 and two gene banks have been established and thereby sperm, embryo, cell, and DNA of from each sheep breed conserved in the gene bank. Although they were successful in both in-situ and ex-situ conservations with some limitations, in-situ conserved sheep breeds had better productivity than ex-situ in vivo conserved sheep in Turkey. In the case of Ethiopia, in-situ conservation will be compatible with the existing infrastructure. Through balancing the genetic gain and inbreeding level, it is possible to integrate the existing community-based genetic improvement programs (with in breed selection) with sustainable in-situ conservation of native sheep genetic resources in Ethiopia.

Keywords: Crossbreeding, ex-situ conservation, in-situ conservation, genetic erosion

Introduction

The sheep population in Turkey was approximately 23 million in 2010. About 18% of meat and 6% of milk was produced from sheep. Despite their contribution, there has been a 47% decrease in the sheep population in Turkey during to the last 20 years and still declining (Turkstat, 2010, as cited by Sezenler *et al*., 2014). In Turkey, 35 sheep types are listed by the Domestic Animal Diversity Information System of the Food and Agriculture Organization and 15 of these are given as extinct (DAD-IS, 2010, as cited by Sezenler *et al*., 2014). Most livestock breeds worldwide are threatened by the loss of genetic resources (FAO, 2007). There are a number of factors which causes risk of loss and threaten domestic animal diversity. For example; in the developed countries, the

for the high input and output needs of industrial agriculture (FAO, 2013). Due to the effect of this trend many indigenous breeds have lost their function (unique quality) and disappeared (FAO, 2013). For example; Kıvırcık is one of the most commonly used sheep breeds which constitute 6 - 7% of the total sheep population in Turkey (Kaymakç *et al*., 2001). Although the breed is multipurpose, it has higher wool and meat quality than the other local sheep breeds (Kaymakç *et al*., 2001). Despite its numerically large population and important breed, uncontrolled crossbreeding pressure threatens the existence of purebred Kıvırcık populations (Yilmaz *et al*., 2003; Oner *et al*., 2014). Between 1980 and 2000 47.4% of sheep have been lost (Oskam *et al.,* 2005).

To solve the problem of genetic dilution and erosion, conservation of inhabitant sheep genetic resources was initiated in 1995 in Turkey (Goncagul, 2001). There are two types of conservation strategies: conserving animals in their environment or habitat (in-situ) and without their habitat (ex-situ). The ex-situ can be further classified into ex-situ in vivo conservation and ex-situ in vitro conservation (FAO, 2013). However, ex-situ in vivo conservation was started in 1995 (Goncagul, 2001) and in situ and ex-situ in vitro conservation was followed after some years in Turkey by farmers and non-governmental organizations in order to conserve their sheep genetic resources. Therefore, adopting the experience of Turkey in sheep conservation will be a good lesson for our country Ethiopia. Thus, the aim of this paper was to review the experience of sheep conservation practice in Turkey and

Genetic erosion and measures taken in Turkey

Sheep population trend and previous genetic improvement efforts

Sheep population of Turkey increases at increasing rate up to 1980 and decreasing at increasing rate starting from 1980 to 1995 (Figure 1). Associated to the loss in numbers, there has been a reduction in the genetic resource with the result that at least three local sheep breeds of Turkish become extinct and several others breeds are also decreased in numbers (limited geographic distribution) that they are considered to be endangered and at possible risk of extinction in the future (Yilmaz *et al*., 2013).

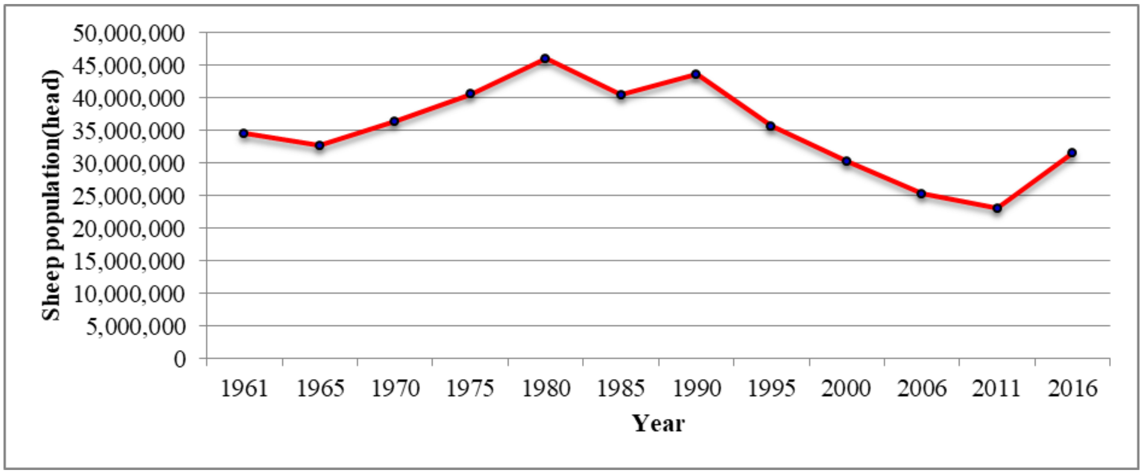

Figure 1. Sheep population trends of Turkey from 1961 to 2016 (Source: FAOSTAT, 2016)

The product which expected from sheep industry also decreased with the sheep population. Government and universities was tried to improve the performance of their local breeds through crossbreeding with highly productive exotic breeds starting from 1928. However, the success of the crossbreeding program was negligible (Yilmaz *et al*., 2013). After more than eighty years of effort, there is little evidence of improvement in the sheep industry (Yilmaz *et al*., 2013). Thus, crossbreeding programmes terminated due to a variety of reasons including unorganized programmes serving the interests of individual scientists rather than the industry as a whole, susceptibility of crossbreeds to disease, poor adapted nature of the crossbreds to local conditions, inadequate financial support and lack of eagerness by farmers to make use of the new genetic material (Yilmaz *et al*., 2013). Now, the government is understands the impact loss of this important aspect of biodiversity and has established programmes for conservation of several native breeds to ensure that the local gene pool is preserved and can thus continue to contribute to biodiversity and sustainable livestock production.

Conservation priority of Turkey sheep breeds

The ex-situ invivo conservation program in 1995 was started without prioritization of native sheep breeds based on their contribution to genetic diversity and non-genetic factors. In order to fill the gap prioritization was conducted later in 2012.

Contribution to genetic diversity

In order to evaluate the contribution breeds to genetic diversity based on genetic data, four different approaches were used; these are allelic richness, Weitzman approach, Metapopulation, and kinship score set approach. Based on allelic richness Ivesin, Hemin, Karayaka and Sakiz; based on Weitzman approach Sakiz, Karagul, and Ivesi (Awassi); with respect to Meta population consideration Sakiz, Kivircik, Karayaka, and Ivesi; and in the kinship score set approach Ivesi, Sakiz, Gokceada were the breeds that were suggested to have priority (Acan, 2012). Generally, Ivesi, Sakiz, Karayaka, Kivircik, Hemin, and Akkaraman would be important breeds to cover total genetic diversity including allelic richness, distinctness, and products of different evolutionary histories, different geographies and perhaps different environmental adaptations (Acan, 2012).

Utilities of the Turkish Sheep Breeds

To be successful in the conservation program, in addition to genetic diversity, the extinction risks, adaptability of the breeds, possession of unique traits of economic and socio-cultural importance should also be considered (Ruane, 2000; Gandini and Villa, 2003). The contribution of the breed to the genetic diversity, the risk of extinction of the breed, and conservation value of the breed are three components for the evaluation of the utility of the breeds (Acan, 2012). According to the report of Acan (2012) the extinction risks were standardized to fit in the range between 0.1 and 0.9. The breeds that had extinction risks above average were Daglic, Herik, Kivircik, Karagul, and Sakiz. The same author states that the main reason for the high risk is the already small population sizes, the small area of distribution, extensive hybridization and most importantly the low esteem of the farmers for the breed (Acan, 2012). Nevertheless, it could be argued that better performing breeds (İvesi, Morkaraman), or breeds with high adaptability to the marginal environment (Gökçeada, Karayaka, Hemşin) have lower risks of extinctions (Acan, 2012).

As part of the prioritization process of the breeds, their relative merits in terms of the economic values of the breeds, the adaptive values of the breeds and the socio-cultural importance of the breeds were considered. Acan (2012) tested three scenarios. When meat production was twice as important as milk production, Norduz, Akkaraman, and Sakiz were the selected breeds (Acan, 2012). When milk production was considered as important as meat production, Norduz, Akkaraman and Sakiz ranked as the top prioritized breeds (Acan, 2012). On the other hand, when adaptive and socio-cultural values had the same weights with the production values, Norduz, Hemşin, and Akkaraman sheep breeds are top three breeds (Acan, 2012). Based on utilities of the breeds; Akkaraman, Sakiz, Norduz, Hemsin, and Ivesin have high priorities for conservation (Acan, 2012).

In-situ and ex-situ in vivo conservation of sheep breeds

Indigenous breeds can be reared with extensive management conditions and with low-quality feed resources. These breeds have special qualities and are very well adapted to their original breeding conditions of the poor environment in which they are able to live and reproduce (Koncagül *et al*., 2011). Since climate change associated with heat stress, quantity, and quality of feed resources, spatial and temporal distribution of diseases the existing conditions of feed and health-related situations can be change in the future due to climate change. Different breeds had a different response for such type of events of climate change. Thus, maintaining the existing variation through conservation will provide the ability to adapt to the possible situations resulted from climate change. Conservation could be applied for endangered breeds and breeds that are not being utilized efficiently (Barker, 2001). Conservation aims of farm animal genetic resources range from avoiding extinction, maintaining genetic diversity, ecological or socio-economic values of breeds, to providing the right conditions for their evolution within an evolving production system (Gandini *et al*., 2004).

Animal genetic resource conservation project started in vivo conservation program in 1995 with three sheep breeds (Golceada, Sakiz and Turkish Merino) and other livestock species (Goncagul, 2001). Consequentially, the animal breeding law which contains two articles regarding registration of new breed and conservation of animal genetic resources was enacted on 21 March 2001 (Goncagul, 2001). After ten years, in-situ conservation subsidies of farm animals including cattle, sheep, goats, bee, water buffalo breeds possess extinction risks has been continued in their original habitat since 2005 (Koncagül *et al*., 2011). So as, to support the in-situ conservation of breeds, farmers, expansion areas and project coordinators were determined, and the projects were created for each breed accordingly. In this context, incentive payment was allowed to 236 breeders for the purpose of conservation of the total of 3131 heads (20 breeds and 5822 bee colonies) in 18 sites (Koncagül *et al*., 2011). About ten native sheep breeds including not endangered breeds were conserved in their habitat and some of them out of their habitat in different parts of Turkey (Table 1). Based on this review Kivircik, Karayaka and Sakiz sheep breeds were conserved both in their habitat and out of their habitat. This type of practice is important and could be a good lesson for other countries.

Table 1. In-situ and ex-situ in vivo conservation of Turkey sheep breeds

Breed	Purpose	Status	Popn. Conserved	Conserved by
Norduz	Good growth rates and good quantity of milk	Endangered	200	Group of 11 farmers
White Karaman	Meat type with poor milk production and moderate coarse wool	Not endangered	24 m and 22 f	International Bahri Dagdas Agricultural Research Institute
Hemin	Meat, fair amount of milk and moderate clip of coarse wool	Endangered	200	One farmer in Ardanuc County of Artvin Province
Herik	Meat type but produces coarse wool	Endangered	200	Three farmers in its home tract in Amasya Province
Daglic	Coarse wool and meat type	Severely at risk	200	Three farmers in Bolvadin County in Afyon Province
Cine Capari	Resistant to disease, meat, milk and coarse carpet wool	Nearly extinct	120	Two farmers in Aydin Province
Karakul	Meat, milk and skin	High risk	200	Two farmers in Tokat Province
Kivircik	Meat, milk and coarse wool type		286 (15m and 271f)	Marmara Agricultural Research Institute (MARI)
Kivircik	Meat, milk and coarse wool type	Not endangered	120f and 4-6m/year	Bandirma Sheep Research Station
Kivircik	Meat, milk and coarse wool type	Not endangered	200	Farmer in Kirklareli
Karayaka	Meat, wool and milk	-	94 (18m and 76f)	Marmara Agricultural Research Institute (MARI)
Karayaka	Meat, wool and milk	-	200	Farmer in Gokceada and Canakkale
Sakiz	Coarse wool, milk and meat	Critically at risk	130 (35m and 95f)	Marmara Agricultural Research Institute (MARI)
Sakiz	Coarse wool, milk and meat	Critically at risk	113	Four farmers in Cesme in Izmir Province
Golceada	Milk and meat	Not endangered	-	Bandırma Sheep Research Station

Source: Anon., 2009; Ertugrul *et al*., 2009; Yilmaz *et al*., 2013; Sezenler *et al*., 2014

Ex-situ in vitro conservation of genetic materials of Turkey sheep breeds

Ex situ in vitro conservation (cryopreservation) is the collection and deep freezing of semen, ova, embryos, and tissues which may be used for future breeding or regenerating animals(FAO, 2013). Conserving genetic diversity by keeping live animals outside their production (ex situ in vivo) not always will be able to guarantee the maintenance of the genetic diversity of a breed (FAO, 2013). That means live animal conservation will prone to diseases, drought, and other threats. Therefore, it is important that in vivo conservation be integrated with cryopreservation of germplasm (ex situ *in vitro* conservation). In other words, long-term in situ in vivo conservation programs may benefit from a germplasm repository (FAO, 2013).

In Turkey, ex-situ in vitro conservation of indigenous sheep germplasm was initiated in 2007 by the project named, In vitro Conservation and Preliminary Molecular Identification of Some Turkish Domesticated Animal Genetic Resources -I. Two gene banks have been established in Lalahan HMAE and TUBITAK Marmara Research Institute (Koncagul *et al*., 2011) and germplasm from 13 sheep breeds (Herik, Karayaka, Karakul, Gokceada, Morkaraman, Kivircik, Akkaraman, Ivesi, Daglic, Hemsin, Cine Capari, Sakiz, and Norduz) have been conserved.

Comparative performance sheep under in-situ conservation and ex-situ conservation

Growth performance of lamb

According to Sezenler *et al*. (2014a) the least square

Table 2. Ex-situ in vitro conservation of genetic material from Turkey sheep

Sheep Breeds	Institute and conserved genetic material					
	GMBE			LALAHAN LCRI		
	DNA	Cell	Embryo	Sperm	DNA	Cell
Karayaka	49 indv. (2940 µg)	63 indv. 630 vials	136 Embryo	25 animals 663 straws	49 indv. (2940 µg)	63 indv. 630 vials
Herik	49 indv. (2940 µg)	48 indv. 480 vials	51 Embryo	18 animals 596 straws	49 indv. (2940 µg)	48 indv. 480 vials
Imbroz	50 indv. (3000 µg)	49 indv. 490 vials	102 Embryo	23 animals 781 straws	50 indv. (3000 µg	49 indv. 490 vials
Karagul	50 indv. (3000 µg)	48 indv. 480 vials	86 Embryo	22 animals 1494 straws	50 indv. (3000 µg)	48 indv. 480 vials
Red Karaman	50 indv. (3000 µg)	44 indv. 440 vials	173 embryo	13 animals 556 straws	50 indv. (3000 µg)	44 indv. 440 vials
White Karaman	50 indv. (3000 µg)	47 indv. 470 vials	65 Embryo	23 animals 704 straws	50 indv. (3000 µg)	47 indv. 470 vials
Chios	49 indv. (2940 µg)	47 indv. 470 vials	27 Embryo	13 animals 1213 straws	49 indv. (2940 µg)	47 indv. 470 vials
Kivircik	45 indv. (2700 µg)	43 indv. 430 vials	185 Embryo	21animals 656 straws	45 indv. (2700 µg)	43 indv. 430 vials
Ivesi	51 indv. (3060 µg)	51 indv. 510 vials	59 Embryo	23 animals 681 straws	51 indv. (3060 µg)	51 indv. 510 vials
Daglic	50 indv. (3000 µg)	49 indv. 490 vials	9 Embryo	20 animals 670 straws	50 indv. (3000 µg)	49 indv. 490 vials
Cine Capari	49 indv. (2940 µg)	49 indv. 490 vials	40 Embryo	22 animals 748 straws	49 indv. (2940 µg)	49 indv. 490 vials
Hemsin	48 indv. (2880 µg)	48 indv. 480 vials	81 Embryo	19 animals 1013 straws	48 indv. (2880 µg)	48 indv. 480 vials
Norduz	54 indv. (3240 µg)	48 indv. 480 vials	40 Embryo	23 animals 805 straws	54 indv. (3240 µg)	48 indv. 480 vials
Southern Karaman	57 indv. (3420 µg)	20 indv. 200 vials	-	-	57 indv. (3420 µg)	20 indv. 200 vials

Source: www.turkhaygen.gov.tr.

Table 3. Growth performance of in situ and ex situ in vivo conserved sheep

Breed	Conservation type	Bwt	Wwt	ADG	SMwt	Ywt	References
Kivircik	In situ	4.2	25.4	234	-	-	Sezenler *et al.* (2014a)
Kivircik	Ex situ invivo	3.7	24.9	234.3	-	-	Sezenler *et al.* (2014a
Kivircik	In situ on station	3.64	31.0	271	32.87	39.01	Sezenler *et al.* (2014b)
Sakiz	In situ on station	3.91	25.4	257	26.95	30.95	Sezenler *et al.* (2014b)
Imroz	In situ on station	3.28	23.6	202	24.15	30.27	Sezenler *et al.* (2014b)
Kivircik	Ex situ invivo	4.1	28	-	-	-	Yilmaz *et al.* (2003)
Imroz	Ex situ invivo	3.3	18.8	-	-	-	Yilmaz *et al.* (2003)

means of the birth weight, the weaning weight (three month weight) and the post-weaning daily live weight gain of the in situ conserved Kivircik lambs were 4.2 kg, 25.4 kg and 234 g/day respectively. For ex-situ conserved lambs the values were 3.7 kg, 24.9 kg, and 234.3 g/day respectively. This demonstrates the ex-situ conserved lambs had lower growth performance than the in-situ conserved lambs. The difference could results from the management conditions of the lambs and the feeding level of ewes before or after lambing and also the quality of pasture. Moreover, ex-situ conserved flock was conserved out of their habitat (variation of climatic variables, variation in feed availability and quality), this may have is own influence on them.

In the other study Sezenler *et al.* (2014b) reported that, the birth weights were 3.64, 3.91 and 3.28 kg, the weaning weights were 31.01, 25.44 and 23.67 kg, the sixth month live weights were 32.87, 26.95 and 24.15 kg, yearling weights were 39.01, 30.95 and 30.27 kg, the average daily weight gains were 271, 257 and 202 g/day in Kivircik, Sakiz and Gökçeada (Imroz) lambs conserved in their habitat under on station, respectively. The birth weight of Kivircik lambs was lower than the report of Sezenler et al. (2014a). Whereas the weaning weight was lower than the report of Sezenler *et al.* (2014a) for the same breed conserved in-situ and ex-situ in vivo. According to Yilmaz *et al*. (2003), the birth and weaning weights of ex situ conserved Kivircik lambs were significantly ($P<0.05$) higher than those of Imroz lambs (4.1±0.1 Vs 3.3±0.1 kg for birth weight and 28.0±0.6 Vs 19.8 kg for weaning weight). Generally, growth performance of lambs under in situ conservation was higher than ex-situ conserved lambs.

Survival rate of lambs

The survival of lambs up to weaning is imperative for profitability in sheep breeding program. The overall mean lamb survival rates of the in-situ conserved lambs were 96.4% with a range from 93.5% to 99.5%, and the value ranged from 81.8% to 95.0% with an overall mean of 90.0% for the ex-situ conserved lambs (Sezenler *et al*., 2014a). This implies that in-situ conserved lambs had higher survival up to weaning than ex situ conserved lambs. The same author states that, the high lamb survival rate of the in-situ enterprise shows that the enterprise employs effective methods of lamb breeding, feeding, and management until the weaning period. On the other hand, in the ex-situ flock, the insufficient quality of the pastures affects the milk yield efficiency of the ewe, which thereby indirectly influences the survival rate of the lambs.

The survival rate of ex-situ in vivo conserved Kivircik and Imroz lamb up to weaning age were 97.9% and 96.4% respectively (Yilmaz *et al*., 2003). The survival rates until weaning of the Imroz and Kivircik lambs were high and similar. This result could be taken as a sign of the effective adaptation of these breeds to the environmental conditions of the Marmara Region and the Institute.

Reproductive performance of ewes

The average lambing rate, multiple birth rate, fecundity and litter size of in-situ conserved flocks were 83.9%, 27.1%, 1.1 and 1.31 respectively. For ex-situ conserved flock lambing rate, multiple birth rate, fecundity and litter size were 74.7%, 27.4%, 1.0 and 1.3 respectively (Sezenler *et al*., 2014a). The in-situ conserved flocks had higher lambing rate and multiple birth rates than the ex- situ conserved flock. However, in both flocks the average number of litter size at birth and fecundity was approximately the same (P > 0.05). The average lambing rate in ex-situ and in-situ flocks were 74.7% and 83.9% respectively which was statistically significant (Sezenler *et al*., 2014a). According to the same author, the difference exhibited might be due to the way the ex- situ enterprise manages the mating (natural or hand mating), the overall management and feeding of the flock and the poor condition of the pastures. Possibly, the fact that the flock is kept at the research station in conjunction with other flocks may imply that the flock size is larger and therefore more difficult to manage efficiently.

Average first oestrus live weights for these breeds were found to be 37.93, 33.35 and 29.75 kg, respectively. The highest first oestrus live weight was observed in Kıvırcık breed and this was followed by Sakız and Gökçeada sheep breeds (Sezenler *et al*., 2014b). The first oestrus age for the Kıvırcık, Sakız and Gökçeada breeds were found to be 315.13, 320.35 and 337.37 days, respectively, and the breeds that showed oestrus earlier displayed the same order as well. The oestrus lengths were determined as 30.99, 25.85 and 20.28 hours for the Kıvırcık, Sakız and Gökçeada breeds, respectively (Sezenler *et al*., 2014b).

Future prospect in Ethiopia

What information we have regarding to conservation?

Sheep production is a major component of the livestock sector in Ethiopia owing to the large population of 30.70 million head (CSA, 2016/ 17) and the diverse genetic resources (Gizaw 2008). At the smallholder level, sheep are the major source of food security serving a diverse function including cash income, savings, fertilizer, socio-cultural functions, and fiber. Sheep are particularly important for the pastoralist/agro-pastoralist and for farmers in the subalpine highlands where crop production is unreliable. Sheep are also important foreign currency earners accounting for 34% of the live animal exports (Gizaw *et al*., 2013).

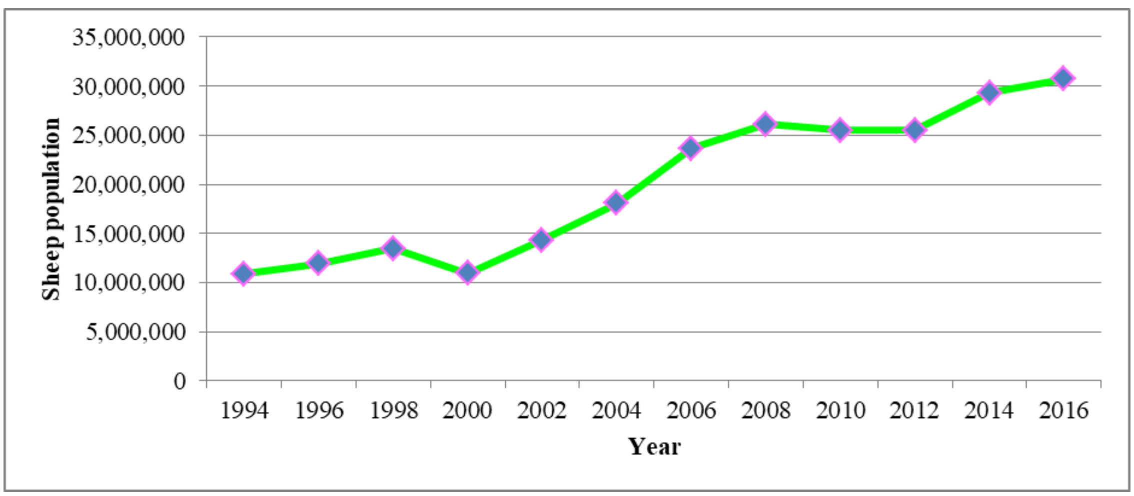

Figure 2. Ethiopian sheep population trend (source: FAOSTAT, 2016)

Despite of their contribution threat status of most of the sheep breeds were not safe according to Gizaw *et al*. (2008), which is alarming for action in terms of conservation of native sheep breeds compatible with the existing production system.

Identification, classification, and description of sheep genetic resources began in the 1970's, Fat-tailed (Arsi-Bale sheep), thin-tailed (Horro sheep) and coarse-woolled sheep (Menz and Tikur sheep) (Abegaz and Gizaw, 2015). Following this identification, phenotypic characterizations of indigenous breeds were conducted at the district level by many MSc students and researchers in different parts of the country. Characterization includes on-station and on-farm performance evaluation, the character of the production system and genetic parameter estimation for few sheep breeds (Menz, Horro, Awassi, Afar, and BHS). Moreover, national morphological and molecular characterization identified 14 sheep breeds and conservation priority was identified by Gizaw *et al.* (2008). Based on their total utility (combining their threat status, current merits and contributions to genetic diversity) the highest five priority

Table 4. Relative conservation priorities for Ethiopian sheep breeds

Breed	Contribution to diversity[1]	Extinction probability[2]	Average breed merit[3]	Total utility[4]	Conservation priority
Farta	0.0000	0.50	0.27	0.27	10
Menz	0.0000	0.40	0.40	0.40	4
Sekota	0.0000	0.10	0.23	0.23	13
Simien	0.4355	0.30	0.33	0.60	1
Tikur	0.0000	0.30	0.33	0.33	8
Wollo	0.0000	0.50	0.33	0.33	7
Afar	0.1291	0.05	0.40	0.41	3
BHS	0.0000	0.10	0.40	0.40	5
Adilo	0.0000	0.40	0.17	0.17	14
Arsi-Bale	0.0000	0.10	0.27	0.27	12
Horro	0.0000	0.20	0.27	0.27	11
Bonga	0.1774	0.40	0.20	0.34	6
Gumz	0.1170	0.90	0.23	0.44	2
Washera	0.0696	0.10	0.27	0.28	9

Source: Gizaw *et al*. (2018)

breeds were Simien, Gumz, Afar, Menz, and BHS in ranking order but had no consequences on the national genetic resources conservation program (Abegaz and Gizaw, 2015). These all synthesized information will be used as preliminary information (base) for future tasks as characterization and identifying utility is the first step of the ladder of the conservation program.

The way forward?

In Ethiopia, different exotic breeds are imported starting in 1944 when Merino sheep were introduced from Italy by an American aid organization (Getachew *et al*., 2016). Following Merino sheep Romney, Corriedale, Hampshire, and Rambouillet were introduced from Kenya in 1967. Recently, Awassi were introduced from Israel in 1980 and Dorper sheep from South Africa in 1980s to Jijiga and in 2007 by Ethiopian Sheep and Goat Productivity Improvement Program (Awgichew and Gipson, 2009). Therefore, Ethiopia exercises sheep crossbreeding program for about 74 years due to believing of low productivity of indigenous sheep breeds. However, except Awassi and Dorper sheep the contribution of other exotic breeds was not well-defined (we can say no contribution at all). This type of unplanned and unstructured crossbreeding program causes genetic erosion. With a similar indiscriminate crossbreeding program, Turkey lost three native breeds totally and many of the other sheep breeds are endangered and extinct. Therefore, delineating crossbreeding areas and controlling breed introduction should be considered as critical steps to reduce the risk of genetic dilution due to indiscriminate crossbreeding. Crossbreeding might focus on sheep populations along the roads, near towns and cities, near market places and buffer zones between two geographically separated areas as those populations are mixed and non-descript (Getachew *et al*., 2016). Therefore, the existing crossbreeding should be organized in this way so as to maintain the existing genetic diversity.

Before facing the challenge of genetic erosion like Turkey, it is paramount to conserve our highly adaptive indigenous sheep breeds. Although it is at infancy stage community-based breeding program was started for some sheep breeds/ populations such as Bonga, Horo, Menze, Doyogena, Atsibi, Gumz, and Farta sheep. This community-based breeding program is important for genetic improvement and in-situ conservation simultaneously. This simultaneous advantage will be realized only when the genetic gain and inbreeding level within the flock is balanced. That means the selection program should be implemented moderately and the genetic variation within sheep breed must be maintained. By considering this principle, in-situ conservation should be implemented for other sheep breeds their threat status is not safe (Afar, BHS, and Semien sheep breeds).

Genetic material conservation is the other important technique which used to conserve parts of animals for a long period of time. Now a day's in case of Ethiopia semen collection from ram is possible and conducted around Debire Birhan from Menze ram by MSc students. Thus, conservation of semen will be possible as the storage does not need advanced technologies. However, conservation of other genetic materials such as ova, embryo, DNA, and cell will be difficult as they need sophisticated technologies to change to a living organism.

Conclusions

Conservation of native animal genetic resource is paramount to maintain genetic diversity sustainably and to cope with the future challenging climate change. However, native sheep population and diversity is reduced due to unplanned crossbreeding program in Turkey. Although they lose some breeds before initiating conservation program, in-situ, ex-situ *in vivo* and in vitro conservation methods are implemented in Turkey. Combining in-situ conservation with ex-situ *in vitro* conservation is ideal for sustainability of conservation program as learned from Turkey. However, in the case of Ethiopia in-situ conservation will be compatible with the existing production system, infrastructure, and technology. Strengthening inventory, monitoring and balancing genetic gain and inbreeding level is used for integrating existing community-based genetic improvement programs with sustainable in-situ conservation of Ethiopian native sheep genetic resources.

References

Abegaz, S., and Gizaw, S. (2015). Small ruminant research and development in Ethiopia. EIAR/ATA/ICARDA Workshop on small ruminant breeding programs in Ethiopia Debre Birhan, 17-18 December, 2015.

Acan, S.C. (2012). Genetic diversity of sheep breeds focusing on conservation research in Turkey. PhD thesis, School of Natural And Applied Sciences, Middle East Technical

University, Turkey.

Anon. (2009). Catalogue of Turkish Farm Animal Genetic Resources. General Directorate of Aricultural Research, Ministry of Agriculture and Rural Affairs, Ankara.

Awgichew, K., and Gipson, A. (2009). Overview of Genotype Program Activities Proceedings of mid-term conference of the Ethiopian Sheep and Goat Productivity Improvement Program, Achievement, Challenge and Sustainability. March 13-14, 2009, Hawassa, Ethiopia. pp. 40-52.

Barker, J.S.F. (2001). Conservation and management of genetic diversity: a domestic animal perspective. *Canadian Journal of Forest Research,* 31, 588–595.

CSA. (2016/17). Agricultural sample survey. Report on livestock and livestock characteristics. The Federal Democratic republic of Ethiopia, Central Statistical Agency (CSA). Private Peasant Holdings. Statistical Bulletin 585, Addis Ababa, Ethiopia.

DAD-IS. (2010). Domestic Animal Diversity Information System (DAD-IS). Food and Agriculture Organization of the United Nations. Retrieved from http://www.fao.org/dadis/.

Ertugrul, M., Dellal, G., Soysal, I.M., Elmaci, C., Akin, O., Arat, S., Baritci, I., Pehlivan, E., and Yilmaz, O. (2009). Conservation of Turkish native sheep breeds. *Journal of the Agricultural Faculty of Uludag University*, 23, 97–119.

FAO. (2007). State of Food and Agriculture, FAO Agriculture Series No. 38. Rome.

FAO. (2013). In vivo conservation of animal genetic resources. FAO Animal Production and Health Guidelines. No. 14. Rome.

FAOSTAT. 2016. Food and agricultural organization of the United Nations, statistical division. http://faostat3.fao.org/browse/Q/QA/E. Retrieved on 8 September 2018.

Gandini, G.C., and Villa, E. (2003). Analysis of the cultural value of local livestock breeds: a methodology. *Journal of Animal Breeding and Genetics,* 120, 1-11.

Gandini, G.C., Ollivier, L., Danell, B., Distl, O., Georgoudis, A., Groeneveld, E., Martyniuk, E., van Arendonk J.A.M., and Woolliams J. A. (2004). Criteria to assess the degree of endangerment of livestock breeds in Europe, *Livestock Production Science,* 91, 173–182.

Getachew, T., Haile A.,Wurzinger, M.., Rischkowsky, M., Gizaw, S., Abebe, A., and Sölkner, J. (2016). Review of sheep crossbreeding based on exotic sires and among indigenous breeds in the tropics: An Ethiopian perspective. *African Journal of Agricultural Research*, 11(11), 901-911.

Gizaw, S., Komen, H., Windig, J.J., Hanotte, O., and Van Arendonk, J.A.M. (2008). Conservation priorities for Ethiopian sheep breeds combining threat status, breed merits and contributions to genetic diversity. *Genetics Selection Evolution,* 40, 433–447.

Gizaw, S., Abegaz, S., Rischkowsky, B., Haile, A., Mwai, A.O. and Dessie, T. (2013). *Review of sheep research and development projects in Ethiopia*. Nairobi, Kenya: International Livestock Research Institute (ILRI).

Goncagul, T. (2001). Farm animal diversity in Turkey: OECD expert meeting on Agri-Biodiversity indicators, Zurich, Swizerland, 5-8 November 2001.

Kaymakç, M., Oğuz, I., Ün, C., Bilgen, G., and Taşkın, T. (2001). Basic characteristics of some Turkish indigenous sheep breeds. *Pakistan Journal of Biological Sciences,* 4, 916-919.

Koncagül, S., Demiralp, C., Aksümer, N., Akın, A. O., and Mehmet, E. (2011). *Domestic animal genetic resources in Turke (1st Ed).* Ankara, Turkey.

Öner, Y., Üstüner, H., Orman, A., Yılmaz, O., and Yılmaz, A. (2014). Genetic diversity of Kıvırcık sheep breed reared in different regions and its relationship with othersheep breeds in Turkey. *Italian Journal of Animal Science*, 13, 33- 82.

Oskam, A., Longworth, N., and Vilchez, I. M. (2005). In: Burrell, A. M., Oskam, A. J. (eds) Turkey in the European Union – Implications for Agriculture, Food and Structural Policy, Cambridge, 217-250.

Ruane, J. (2000). A Framework for Prioritizing Domestic Animal Breeds for Conservation Purposes at the National Level: a Norwegian Case Study. *Conservation Biology*, 14, 1385-1393.

Sezenler, T., Ceyhan, A., Yildirir, M., and Erdogan, I. (2014a). The comparison of some reproduction traits and lambs growth performance of ex situ and in situ conserved Kivircik sheep. *Small Ruminant Research*, 117, 109–118.

Sezenler, T., Köycü, E., Yaman, Y., Ceyhan, A., Küçükkebapç M., and Yüksel, M. A. (2014b). Reproductive and Growth Characteristics during the First Age of Kıvırcık, Sakız and Gökçeada Indigenous Sheep Breeds. *Turkish Journal of Agriculture - Food Science and Technology*, 2(3), 106-111.

Turkstat. (2010). Animal database. Retrived from http://www.turkstat.gov.tr/Start.do.

Yilmaz, O., Cengiz, F., Ertugrul, M., and Wilson, R. T. (2013). The domestic livestock resources of Turkey: sheep breeds and cross-breeds and their conservation status. *Animal Genetic Resources*, 52, 147–163.