



## Status of Farm Animal Genetic Resources of Jammu and Kashmir - A Review

Mubashir Ali Rather\*<sup>1</sup>, S. Shanaz<sup>2</sup>, N. A. Ganai<sup>3</sup> and Ambreen Hamadani<sup>4</sup>

<sup>1</sup>VAS, Department of Sheep Husbandry, Jammu & Kashmir, INDIA

<sup>2</sup>Associate Professor cum Senior Scientist, Division of Animal Genetics and Breeding, Faculty of Veterinary Sciences & Animal Husbandry, SKUAST (K), Shuhama, Alusteng, Srinagar, Jammu & Kashmir, INDIA

<sup>3</sup>Director, Planning and Monitoring, SKUAST (K), Shuhama, Alusteng, Srinagar, Jammu & Kashmir, INDIA

<sup>4</sup>PhD Scholar, Division of Animal Genetics and Breeding, Faculty of Veterinary Sciences & Animal Husbandry, SKUAST (K), Shuhama, Alusteng, Srinagar, Jammu & Kashmir, INDIA

\*Corresponding Author: [mubashir.70011@gmail.com](mailto:mubashir.70011@gmail.com)

**How to cite this paper:** Rather, M., Shanaz, S., Ganai, N., & Hamadani, A. (2020). Status of Farm Animal Genetic Resources of Jammu and Kashmir - A Review. *International Journal of Livestock Research*, 10(4), 27. doi: <http://dx.doi.org/10.5455/ijlr.20200201065851>

**Received** : Feb 01, 2020  
**Accepted** : Mar 22, 2020  
**Published** : Apr 30, 2020

Copyright © Rather *et al.*, 2020

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0). <http://creativecommons.org/licenses/by/4.0/>



### Abstract

*The livestock sector is one of the most dynamic fields of human activity in Jammu and Kashmir (J&K). It is very important in the welfare of the rural population and employs a major section of the labor force. It contributes livelihood to a large proportion of small and marginal farmers and landless laborers. Jammu and Kashmir is ideal for the rearing of livestock owing to favorable agro-climatic and geophysical conditions, rich alpine pastures and hosts of other natural endowments. Nature has bestowed this area with high mountains to low hills and vast meadows providing enormous scope and excellent atmosphere for livestock rearing. The J&K is rich in the native germplasm in terms of sheep, goat, cattle, camel, yak, and poultry. The farm animal genetic resources (FAnGR) of J&K are the backbone of the agrarian economy through the production of milk, meat, manure, eggs, pelts, fibers, hides, and germplasm for research and development of new breeds and strains. The FAnGR also withstands the pressure of change, possesses unique traits (fiber fineness in Kashmir Merino and Changthangi goat) and ability to work in hypoxic conditions (yak, double-humped camel and Zanaskari horse). However, due to crossing with exotic germplasm, species hybridization and availability of alternate livelihood activities, there has been a dilution of pure native FAnGR. Therefore, some efforts need to be applied at ground level through programs and schemes to improve the productivity of the precious native vast biodiversity for conservation.*

**Keywords:** Biodiversity, Conservation, Crossbreeding, FAnGR, Germplasm

## Introduction

All animals that are of any economic, scientific and cultural importance to humankind in terms of food, agriculture production for the present or the future comprises farm animal genetic resources (FAnGR). The farm animal genetic resources consist of cattle, buffaloes, goat, sheep, swine, equines, camel and poultry. The animal genetic resources are very crucial component of biodiversity and play a vital role in ensuring food security and maintaining genetic diversity. The livestock contributes greatly to the agrarian economy of Jammu and Kashmir. Livestock rearing is the core activity of rural masses in the J&K and plays a vital role in socio-economic upliftment of weaker sections of the society *viz*; Bakerwals, Gujjars, Chopans, Gaddies and Changpas. The Gujjars and Bakerwals have adopted the livestock rearing as their primary occupation from times immemorial and prefer to migrate in search of pastures to feed their livestock (Anonymous, 2004). Animal genetic resources in addition to meat, milk, of eggs, skins, hides, fiber, wool, draught power, manure etc. also provide genetic material for research and germplasm for the development of new breeds and strains. It is well-known that the livestock rearing provides nutritional security and insurance to the farmer during periods of crisis due to crop failure. In addition a rich source of nitrogen, phosphorus and potash present in the droppings/dung of livestock improves the soil fertility. The AnGR represent a repository of allelic arrangements, rare or absent in the selected breeds and they can also be effectively associated to typical products helping farmers manage and protect the environment. However, for numerous reasons, animal genetic resources of J &K are diminishing from last decade or two. This review therefore, explores the states of animal genetic resources in Jammu and Kashmir and conservation thereof.

## Farm Animal Genetic Resources of Jammu and Kashmir

The state of Jammu and Kashmir is ideally suited for livestock rearing owing to favorable agro-climatic and geo-physical conditions, rich alpine pastures and host of other natural endowments. Nature has bequeathed J&K with high mountains to low peaks and vast meadows providing enormous scope and excellent atmosphere for livestock rearing (Rather *et al.* 2019a). The farm animal biodiversity in the J&K follows closely the geographical diversity. J&K is a rich repository all the major species of farm animals *viz.* cattle, buffalo, sheep, goat, horse and poultry and some unique domestic animal genetic resources including yak and Bactrian camel. This diversity is additionally reflected by the number of breeds and the variations within and among them (Ganai *et al.* 2016). Details about farm animal genetic resources (FAnGR) of J&K and population dynamics are given in Table 1 and 2, respectively.

**Table 1:** The of farm animal genetic resources of Jammu and Kashmir

Species	List of registered breeds	Main uses/important trait
Cattle	Gurezi	1. Adaptation traits
	Local Kashmiri	2. Diseases resistant
	Ladakhi Hill Type	3. Easy to manage
Buffalo	--	Milk and milk products
Sheep	Bakerwal	1. Carpet wool
	Gaddi,	2. Adaptation traits
	Poonchi,	3. Diseases resistant
	Gurezi,	4. Easy to manage
	Karnah	
	Malluk	
	Purgi	
	Changthagi Changluk	
	Kashmir Merino	Apparel wool
Goat	Changthangi	1. Show excellent mutton traits 2. Disease resistance 3. Ability to thrive in harsh condition.
	Malra	Non-pashmina and disease resistant goat
	Bakerwal	Biggest breed of goat in J&K
Horse	Zanskari	Adapted to the hypoxic conditions of high altitudes of Ladakh
Yak	--	Milk and draught ability in hypoxic conditions

Camel	Double-humped	Adapted to cold desert climatic conditions Survive a temperature of -20 <sup>0</sup> c
Poultry	Kashmir favorolla	Meat and eggs
Goose	Kashmir Anz	Meat, eggs, pet and feather
Duck	--	Meat

**Table 2:** Population Dynamics of livestock of J&K in thousands

Species	2003	2007	2012	2019
Cattle	3084	3443	3015	2533
Buffaloes	1039	1050	788.9	691
Sheep	3411	4127	3420	3248
Goat	2055	2068	1813	1730
Pig	2	1	0.878	1.43
Horse	172	167	144	6.3
Mules	40	42	NA	1.7
Donkeys	24	24	17	0.96
Camel	103	NA	150	466
Yak	47	62	54	26.22
Mithun	24	0.02	0.0057	26 no's
Poultry	5568	6683	6360	7366
Total excluding poultry	9899	10987	9200	8319

Source: Livestock Census 2003, 2007, 2012 and 2019 (Anonymous, 2019)

### Risk Status of FAnGR of J&K

To decide when a breed is at risk, much will hinge on the local situations of the breed, extent of crossbreeding, management system, and utility of breed and rate of decline under local agro climatic conditions. The danger status of a breed can be estimated by the size of breeding stock, which can be articulated by the number of breeding females, the sex ratio, the number of breeding males, the proportion of females bred to males of the same breed, the trend in population size and effective population size under a particular production system. A working rule is that when population size approaches 5,000 breeding females (a total population of about 10,000 animals) the survival risk of the breed should be studied, and appropriate measures would be needed for its conservation. It is suggested that whenever the total number of animals falls below 10,000 one must start preserving semen and embryos (Bhatia and Arora, 2005). The condition may altogether be different where not even initial surveys have been conducted on breeds and the breeding policies are framed generally on population estimates based on census reports of species. Therefore, Nivsarkar (1994) and Acharya (1999) recommended an action plan for determination of risk status and conservation of breeds/strains under Indian conditions. The risk status under Indian conditions presented in Table 3 (Nivsarkar, 1994; Acharya, 1999) and accordingly the risk status of FAnGR was found and is presented in Table 4.

**Table 3:** Risk status under Indian conditions

S.No	Population	Risk status
1	50,000 with no serious declining trend.	Can be considered a normal population.
2	30,000 to 50,000 animals with constant declining trend.	insecure category
3	15,000-30,000	vulnerable
4	8000-1500	Endangered
5	< 8,000	Critical and needs immediate conservation

**Table 4:** Risk Status of Farm Animal Genetic Resources of Jammu and Kashmir, Reasons and Possible intervention

Species	N	Breeds	Population	Risk status	Reasons
Cattle	1	Gurezi Hill Type	NA	Population not available	Not documented, Crossbreeding with Jersey and HF
	2	Local Kashmiri	NA	Population not available	
	3	Ladakhi Hill Type	NA	Population not available	
Buffalo	0			Not documented	
Sheep	1	Bakerwal	24575	Vulnerable	•Indiscriminate crossbreeding •uncontrolled amalgamation with migratory
	2	Gaddi	92194	Normal, decreasing	

				population	
	3	Poonchi	2643	Critical	flocks • Lack of breeding policies and strategies • Conservation not included in breeding policy • Shrinking of grazing areas
	4	Gurezi	17207	Vulnerable	
	5	Karnah	2946	Critical	
	6	Malluk	26328	Insecure	
	7	Purgi	NA	Not documented	
	8	Changthagi	65115	Normal, however decreasing population	
	9	Kashmir Merino	> 11 Lakhs		
Goat	1	Changthangi	196179	Normal population	Pasture degradation, availability of alternate livelihood activities
	2	Malra	NA	Not documented	Not documented
	3	Bakerwal	NA	Not documented	Not documented
Horse	1	Zanskari	26221	Insecure	Construction of roads Breeding with non-descript horses
Yak	0	--	26221	Insecure	•Species hybridization with cattle •indiscriminate slaughtering for meat •Availability of alternate livelihood activities
Camel	1	Double-humped	211	Critical	Construction of roads Closure of silk route 1951
Poultry	1	Kashmir Favorolla	NA	Population not available	Availability of eggs and broiler meat
Goose	1	Kashmir Anz	NA	Population not available	
Duck	0	--	NA	Not documented	Not documented
Dog	1	Bakerwal dog		Population not available	Not documented

### Reasons for the decline of FAnGR of J&K:

If concrete steps are not taken, the native FAnGR may be lost forever. The important reasons behind loss or dilution of native breeds are as under:

- i. Use of non-adapted exotic germplasm through indiscriminate crossbreeding which has often arisen through improper recommendation and biased and misleading comparisons between the native breed and crossbreed population. The Kashmir Valley breed has been lost completely and the other genetic resources of J&K are getting endangered too.
- ii. Uncontrolled intermixing with nondescript animals eg. sheep breeds and Zanskari horse.
- iii. Conservation has not been included in the breeding policy until recently.
- iv. Species hybridization e.g. yak is crossed with cattle.
- v. Construction of new roads and closure of old routes like silk route in 1951.
- vi. Pasture degradation, shrinking of grazing areas and availability of alternate livelihood activities.
- vii. Availability of commercial animal products everywhere. Kashmir Favorolla, Kashmir Anz and duck has gone into eclipse due to the easy availability of broiler meat and eggs in the Valley.
- viii. Genetic potential of native FAnGR of J&K has not been harvested fully due to the lack of organized breeding programs and lack of basic requirement for genetic improvement (i.e. date recording which is either non-existent or poorly recoded). The selection process in sheep breeding programs is not based on performance evaluation. But, on following formula:  $B.V = BW + GFW * 10$ . Where B.V is breeding value of dam or sire, BW is body weight at onset of breeding season and GFW is last greasy fleece weight. The Department of Sheep Husbandry should adopt modern techniques and algorithms for the selection of animals of high genetic merit.
- ix. It is advisable to have an animal breeder and geneticist to serve the purpose.
- x. Non-availability or non-existence of livestock database management systems for real time decision making, policy planning and evaluation.

### Importance of Animal Genetic Resources of J&K

- xi. The native farm animal genetic resources of J&K are the backbone of any agrarian economy. They provide milk, meat, eggs, fibers, pelts, hides, manure, draught power, genetic material for research and germplasm for the development new breeds and strains.

- xii. The farm animal genetic resources of J&K are a source of revenue for poor rural communities, insurance against future changes in production system and opportunities to meet future demands. Therefore, losing them will have deleterious effects on their fragile economy and livelihood of poor rural communities.
- xiii. These also help to withstand the pressure of change in production circumstances.
- xiv. These are adapted to harsh environmental conditions and possess unique traits. Eg fiber fineness in Changthangi goat is the best in the world.
- xv. Due to their high adaptation to the agroclimatic conditions, they possess traits like disease resistance & heat and cold.
- xvi. The farm animal genetic resources of J&K are easy to manage on low input methods in terms of feed fodder, housing, and health care and these convert low quality feeds/ fodder in animal products (meat, milk, egg etc) efficiently.
- xvii. The native farm animal genetic resources of J&K have draught ability to work in challenging environmental conditions viz yak, double humped camel and Zanaskari horse work in hypoxic conditions.
- xviii. They provide genetic material for crossbreeding and for the development of new and improved breeds.
- xix. They are important to preserve the cultural & historical values, sustain the inheritance value of livestock and fulfill the rights of an existing genetic resource to continue to exist (Ganai *et al.* 2016)

### Cattle Genetic Resources of J&K

In Jammu and Kashmir, there are 2533 thousand cattle heads. The decrease in local cattle population may be associated to urbanization, expansion of crossbreeding programmes for increasing milk yield per cow per day and change in life style. However, field surveys suggest the existence of hill type cattle in Kashmir valley (places not yet covered by the crossbreeding programmes), eg. Gurez (Ganai *et al.* 2016) and Ladakh. These hill type cattle are well adapted to the local conditions, resistant to diseases and are able to thrive on low quality and quantity of feed. Hill type cattle are cylindrical and highly adapted to cold climate. Their average daily milk yield ranges from 1.0 to 4.5 kg per day.

### Sheep Genetic Resources of J&K

The State stands fifth in India with respect to the sheep population, with a percentage share of 18.59 (Anonymous, 2014). Among the registered breeds of sheep in the country; J&K contributes 6, viz. Changthangi, Bhakarwal, Gurez, Gaddi, Karnah and Poonchi. Many other breeds as Malluk, Purgi etc. have not been registered yet (Table 4). The native sheep breeds are known for disease resistance, sturdiness, and presence of fecundity gene. The Gaddi breed is used as a means of transport in the high terrains. Besides Gaddi, the Bhakarwali breed is also hardy and sturdy, proving to be the best climber on the mountains despite of its bulky size (Kour *et al.* 2018). Bhakarwal is a migratory sheep found in Rajori and Poonch districts of Jammu along with Poonchi breed, Malluk and Purgi are the unregistered breeds of Ladakh whereas Changthangi is a registered breed of cold arid regions i.e Leh and Kargil. Malluk and Changluk produce good quality wool for cloth or carpet industry (Shergojry *et al.*, 2017).

Kashmir Merino is a synthetic breed (not yet registered) which was developed around 1960 at Sheep Breeding and Research farm Reasi, Jammu by crossing native ewes viz; Gaddi, Poonchi, and Bakerwal with Australian Merino Rams and F<sub>1</sub> ewes so produced were bred to Delain rams (imported from U.S.A). Inter-se mating of F<sub>2</sub> was done and continued till a breed (Kashmir Merino) with stable and uniform characters was evolved. The breed is found in every nook and corner of Kashmir Valley (Rather *et al.* 2019a). Kashmir Merino and Rambouillet, the fine Wool breeds, are used for the upgradation of local sheep. All native sheep genetic resources are constantly being crossed with Kashmir Merino and Rambouillet, the fine wool breeds, in Kashmir and Jammu, respectively for fine wool. Cross-breeding is being practiced without giving any regard to conservation of native breeds. With continued crossbreeding and negligence, we may lose this precious native germplasm. The performance traits and distribution of sheep breeds of J&K are presented in Table 5 and 6.

**Table 5:** Performance traits of sheep breeds of J&K

Breed	Native Tract	BW (kg)	WW	6-MW	12-MW (kg)	18MW	Reference
Gaddi	Kistwar and Baderwah	1.8	9		17	26.59±1.90	Anonymous. (2004)
Poonchi	Poonch & Rajori districts of J & K						

Bakerwal	Migratory		3.18± 0.17	13.46± 2.88		33.00± 2.88	29 to 36	Anonymous. (2004)
Gurez	Gurez tehsil in Northern Kashmir	Male	2.54±0.02	8.73±0.08	21.28±0.25	28.60±0.28		Ganai et al. 2010
		Female	2.47±0.01	8.70±0.05	21.54±0.19	28.59±0.19		
Karnah	Karnah in north Kashmir							Anonymous. (2004)
Changthangi	Changthang region of Ladakh							Anonymous. (2004)
Kashmir Merino	Kashmir valley		3.35±0.01	19.54±0.05	19.54±0.05	23.44±0.06	32.47±0.49	Rather, 2019; Rather et al. 2019a; Rather <i>et al.</i> 2019b.

**Table 6:** Wool traits of sheep genetic resources of J&K

Trait/Breed	GFY	Crimps per inch	FD (μ)	SL (cm)	Medullation %	Clean wool yield	Reference
Gaddi	0.817		28.52±0.07	10.15	25.80±0.33		Qureshi et al. 2013
Poonchi	1.92±0.116		27.93±0.584	7.89±0.673	8.89±1.052	71.08±2.11	Qureshi et al. 2013
		8.67±0.18	24.99±0.13	3.82±0.07	2.22±0.19	63.14±0.23	Taggar et al (2018)
Bakerwal	1-1.5		36-38μ	6-8 cm	25		
Gure	Male GFY-1	311.12±15.41		4.96±0.11			Ganai et al. 2010
	GFY-2	450.31±12.56					
	GFY-3	31.96±10.96					
	Female GFY-1	289.55±9.21		4.62±0.14			
	GFY-2	458.31±9.10					
	GFY-3	528.75±7.29					
Karnah	1.00 - 1.250		22-25	9.36			
Changthangi	1.5						
Kashmir Merino	1.77±0.03, 0.82 ± 0.03		20.880.07	3.47±0.10	Nil	--	Rather et al. 2019
	0.80 ± 0.02	4.35± 0.02	20.33 ± 0.05	3.86 ± 0.14			
			20.04 ± 0.002 4.03	4.03 ± 0.02	0.10 ± 0.001	67.19± 0.02	Baba et al. (2020)

### Goat Genetic Resources of J&K

Changthangi, Malra and Bakerwal are important goat genetic resources of Jammu and Kashmir. Nomadic tribes Gujjars and Bakerwals maintain the Bhakerwal. The animals display disease resistance, ability to thrive in harsh condition and excellent mutton confirmation are important traits of the goat (Ganai. *et al.* 2016). Bakerwal goat is tall with huge structure when compared to other goat breeds of J&K. Bakerwal goat retains good feed conversion and reproductive efficiency. Malra is a non-pashmina goat of Ladakh. Changthangi is a medium sized goat, yield finest quality of under coat hair called cashmere or pashmina (12.72μ) besides good quality meat (chevon). The pashmina is harvested once a year, generally in June/July, either by shearing or by combing. Average production is 214 g (68 - 500 g). Dwindling and degrading pastures coupled with limitations of fodder, lack of sufficient veterinary care and apathy to assisted reproductive technologies have been the major constraints. The potential of raising Changthangi in Ladakh remains under exploited. Horns of Changthangi are large turning outward, upward and inward forming a semicircular ring. The average live weight of buck is 20 and doe is 20 kg; average birth weight is 2.1 kg. Kidding takes place once a year, normally single; the average age at first kidding is 20 months. Documentation and characterization of Bakerwal and Malra goats and characterization and evaluation of Changthangi goat is highly recommended. Goat breeding farms need to be established by the department of sheep Husbandry in respective breeding tracts of these breeds. The farms need to be maintained on same lines as for sheep genetic resources for conservation and sustained management of goat breeds of J&K.

### Yak

The semi-domestic Yak (*Bos grunniens*) is a multi-use animal best known for its hardiness and is resistant to extreme cold climate and hypoxic conditions. The yak, commonly known as “*the ships of the plateau*” or ‘*ship of snow*’ is

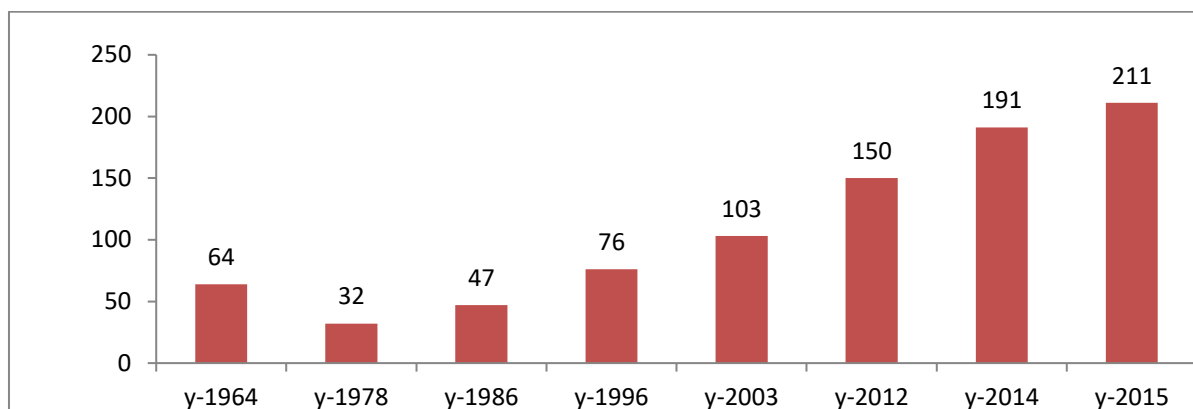
found in Kargil, Leh and Guraz. Yaks do not thrive at lower altitude & begin to suffer from heat exhaustion at 15 °C and above. Yak when hybridized to cattle exhibit great degree of heterosis. Yak-cattle hybrids (dzo and dzomo) in the recent times have found immense popularity due to their better survival in the hypoxic conditions. Dzo are preferred for ploughing because they are much harder than the local bulls or the cattle-jersey bulls and the female yak (Dzomo) are better milch animals, producing nutritionally enriched milk (having 7–12 per cent fat and 5 -6 per cent protein) as compared to the local cow. Besides having a good dressing percentage of 40-45 percent, the yaks also produce undercoat of fine diameter (400g/year) (Shergojry *et al.* 2017). The yak flourishes at an altitude of 2,500 to 6,000 meters above sea level. Besides being of cultural importance, the yak serves as a financial asset providing source of livelihood for the highlanders living in difficult terrains. The animal not only proves to be an excellent pack and transport animal for the snow bound passes, but also offers economic security to the owners in terms of milk, hide, meat, fuel and manure (Gupta *et al.* 2011). Documentation and improvement of yak by adopting the technologies, which are already in vogue for cattle and buffalo improvement is highly recommended.

### Zanskari Horse

Horse (*Equus caballus*) is a significant equine species, which has played an important role in the human civilization. Horses are still an integral part of the Indian army, security forces, police and numerous socio-cultural activities (Singh *et al.* 2002). Livestock census from 2003 to 2019 revealed a discernible decrease in pony and horse population in J&K. Zanskari horse Laddakh (Behl *et al.* 2006) and is one among six discrete and hardy breeds of horses of country along with and Marwari, Kathiawari, Spite, Manipuri and Bhutia (Singh *et al.* 2002). Since, their height at wither is between 125 and 127 cm, hence this breed was clubbed under the category of pony breeds (Gupta *et al.* 2010). Only 9702 number of Zanskari horses were reported in 2013 (Anonymous, 2020). The decrease in population of Zanskari horses is attributed to crossing with non-descript horses and construction of roads. It is a medium in size, well-built mountain horse. The Zanskari horses are known for their ability to work, run adequately and carry loads at high altitude, hypoxic and challenging conditions of Ladakh. In line with national policy, the Department of Animal Husbandry has created corpus fund of Rs. 200 lakhs in year 2010-11 for Leh hand Kargil under annual plan to conserve double humped camel and Zanskari horse. Four breeding farms have been established two in Kargi district (Bodhkhurboo, Zanskar Padum) and two in Leh distirict ( Chuchuot and Nobra), with the primary objective of preserving and producing good quality breeding animals for distribution to field organizations . Zanskari Equine Breeding Farm for Zanskari horse has started functioning in the year 2001-02 with the introduction of four mares and one stallion. The capacity of these breeding farms need to be enhanced and managed under Open Nucleus Breeding Scheme (ONBS) to avoided inbreeding.

### Camel

The Bactrian camel (*Camelus bactrianus*) is a large, even-toed ungulate native to the steppes of Central Asia. They are mostly found in cold deserts of China, Mongolia, Iran, Afghanistan, Pakistan and Kazakhstan. A small population of *C. bactrianus* also exists in the Nubra valley of Ladakh region. It was introduced as a draught animal in Ladakh by travellers in the 19th century. However, after closure of the silk route in 1950, only a few Bactrian camels were left behind with the local traders in the Nubra valley. Presently the bactrian camel has critical population of 211 animals. Bactrian camels move at about 5 km/hr, produce 5 kg of hair/year, 600 lt of milk /year and 250 kg of dung / year (Shergojry *et al.* 2017). These Bactrian camels hold historic importance of Central Asian trade capable of carrying 1 quintal, working 6-8 hours daily (Angchok *et al.* 2012). The animal displays tolerance to high levels of salt and sugar in the body, making it an appreciable animal model for Blood pressure and Diabetes (Ganai *et al.* 2016). The Bactrian camel is adopted to harsh cold climatic conditions and can remain without food and water for days together. The IUCN has declared the camel critically endangered since 1998, yet no serious measures have been adopted to conserve this species (Makhdoomi *et al.* 2013). The population of bactrian camel over last few years is presented in Figure 1. Complete registration of the bactrian camel, protection of community grazing areas, promotion of camel-based tourism and small cottage industry for camel products will ensure conservation of this treasurable genetic resource is very important.



**Figure 1:** Trend in Camel Population

## Poultry

Among the poultry breeds of J&K, only Kahmir Favorolla and Kashmir Anz have been registered. The indigenous chicken; the 'Kahmir Favorolla' is highly variable and found in all districts of Kashmir valley. It is extremely adaptable to cold climate of mountainous terrains of Kashmir under backyard system of rearing. With the progress of the poultry industry in the country, and the availability of the egg and the birds in every nook and corner, the local bird seems to have gone in eclipse (Ganai *et al.* 2016). Disease resistant and feathered comb is a distinctiveness of this breed. The average adult weight of male and female bird is  $1.72 \pm 0.04$  kg  $1.5 \pm 0.02$  kg, respectively. The average egg weight of this bird is  $46.06 \pm 0.48$  g. The best way to protect this bird is to make it economically viable for egg and meat production under low input backyard production system. Kashmir Anz is the registered breed of geese of India. These are cinnamon or white in color, reared for meat, eggs, feathers, or as a hobby in areas located around the water bodies. Kashmir Anz geese are hardy, disease resistant and excellent foragers, requiring minimum inputs for rearing and management (Hamadani *et al.* 2020).

## Strategies and Efforts Needed for Conservation at Ground Level

Conservation ensures that the farm animal diversity is being maintained for contribution to food production, agricultural production and productivity through strategic planning, and policies for future purposes. The loss of AnGR and in particular native breed means the loss of unique genes/gene combinations associated with adaptability and utilization of low-quality feeds. The native breeds are also a source of genetic material for research purposes. Further crossbreds fail to exploit their genetic worth and production level goes down after F1 stage, so to produce F1 we need native breeds to harvest hybrid vigor. Native breeds also supplying germplasm for the improvement of cross breeds. Effective conservation of genetic resources is possible only if the FAnGR are recognized and documented adequately, and there is a full participation towards conservation efforts of communities keeping the animals, scientists and authorities concerned like Development Authorities, Universities, Animal and Sheep Husbandry Departments. The first and most important step for efficient conservation policy for animal genetic resources is the proper characterization (phenotypic and molecular) to assess within and between breed diversity, followed by documentation and proper management. Therefore, the authors recommend the following strategies for conservation and sustained management of FAnGR of J&K. All native undocumented breeds should be characterized and studied for performance evaluation on priority basis. The native FAnGR can be made self-sustainable through selection and breeding. The use of modern breeding techniques (ranking of sires and BLUP) and biotechnological tools (MOET and embryo transfer technology) can be utilized to develop highly productive livestock populations, which can sustain the modern economic pressures. However, for modern breeding techniques, reliable and accurate data is needed. Therefore, the data recording system at all farms should be uniform and digital. The data management in the farms should be done with the help of ICT based Management Information Systems and modern breeding tools to warrant reliable and accurate data recording and analysis. The crossbreeding should be restricted to non-descript populations only. The pastures and grasslands need to be improved and protected. All the encroached grasslands, pastures, and meadows should be protected from illegal encroachments. All sheep breeds should be kept at Government Sheep Breeding Farms in respective niche area for genetic improvement and conservation under open nucleus breeding system (ONBS) for bidirectional gene flow. Therefore, all sheep breeding farms must have a dual mandate genetic improvement of crossbred germplasm and genetic improvement and

conservation of native germplasm. Kashmir Favorella and Kashmir Anz should be improved by selective breeding for meat and eggs to make them economically viable. The crossed animals need to be improved through inter-se mating with stabilized exotic inheritance levels of 52-62.5% for semi-intensive and 62-75% for intensive production systems as increasing exotic blood to higher levels deteriorates the adaptability traits. The crossbreeding ought to be only practiced for non-descript populations and purebred native breeds should be preserved for future to harvest heterosis and for breed development of new breeds. Progressive farmers' flocks need to be linked with nucleus government breeding farms to allow the transfer of elite animals to and from the nucleus. The Department of Sheep Husbandry should boost farmers to adopt systematic feeding and breeding practices. Education, incentives, subsidies on feed and fodders should be provided to the farmers for rearing of native breeds. State Agricultural Universities should act as nodal agencies to conserve all FAnGR of J&K. Gurezi hill cattle and local Kashmiri breed should be characterized and studied for performance evaluation and selected for genetic improvement. Malra, bakerwal, purgi, Malluk etc need to be characterized on same lines. Some possible interventions for the conservation of AnGR are given in Table 7.

**Table 7:** Possible intervention to conserve FAnGR of J&K

Species	Breeds	Possible intervention
Cattle	Gurezi Hill Type	<ul style="list-style-type: none"> <li>Breed characterization</li> </ul>
	Local Kashmiri	
	Ladakhi Hill Type	
Buffalo		<ul style="list-style-type: none"> <li>Breed characterization</li> </ul>
Sheep	Bakerwal	<ul style="list-style-type: none"> <li>Halt cross breeding in respective breeding tracts</li> <li>Establish breeding farms in the respective ecological niche for its genetic improvement</li> <li>In-situ conservation at Government Sheep Breeding Farms in respective niche</li> <li>Selection for pure breeding under ONBS</li> <li>Molecular characterization for diversity</li> </ul>
	Gaddi,	
	Poonchi,	
	Gurezi,	
	Karnah	
	Malluk	
	Purgi	
	Changthagi,	
Kashmir Merino	<ul style="list-style-type: none"> <li>Registration and documentation</li> </ul>	
Goat	Changthangi	<ul style="list-style-type: none"> <li>Performance evaluation</li> </ul>
	Malra	<ul style="list-style-type: none"> <li>Breed characterization, performance evaluation and registration</li> </ul>
	Bakerwal	
Horse	Zanskari	<ul style="list-style-type: none"> <li>Capacity of Zanskari breeding farms need to be enhanced</li> </ul>
Yak	--	<ul style="list-style-type: none"> <li>Establishment of Yak breeding far under ONBS for pure breeding</li> <li>Characterization</li> </ul>
Camel	Double-humped	<ul style="list-style-type: none"> <li>Camel-based tourism and small cottage industry for camel products in its breeding tract.</li> </ul>
Poultry	Kashmir Favorolla	<ul style="list-style-type: none"> <li>Make it economically viable for egg and meat production</li> </ul>
Goose	Kashmir Anz	<ul style="list-style-type: none"> <li>Make it economically viable meat production.</li> </ul>
Duck	--	<ul style="list-style-type: none"> <li>Breed characterization</li> </ul>
Dog	Bakerwal dog	<ol style="list-style-type: none"> <li>Breed characterization</li> </ol>

## Conclusion

J&K possesses rich Animal Biodiversity. These unique native breeds provide a livelihood to the locals and are also a part of the fragile ecosystem of the region. Therefore, their conservation is the need of the hour, which can be achieved through concentrated efforts. Some efforts need to be applied at ground level through programs and schemes to improve the productivity of the precious native vast biodiversity for conservation.

## Conflict of Interests

There is no conflict of interest.

## Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

## References

1. Acharya, R. M. (1999). Management and conservation of livestock genetic resources. *Indian Journal of Animal Genetics and Breeding*, 21(1-2), 7-19.
2. Angchok, D. & Stobdan, T. (2012). Double- humped camels of Ladakh: stranded between the stakeholders. *Current Science*. 102 (12).
3. Anonymous. (2004). Directorate of Sheep Husbandry Kashmir division, Government of Jammu and Kashmir. <http://jksheephusbandrykashmir.net/sheep.html>.
4. Anonymous. (2019). Government of India. 20<sup>th</sup> All India Livestock Census. Department of animal Husbandry, Dairy & Fisheries, Ministry of Agriculture, Government of India.
5. Baba, M. Baba, A., Ahanger, S. A., Hamadani, A, Rather, M. A., & Shah, M.M. (2020) *Tropical Animal Health and Production* DOI 10.1007/s11250-020-02238-1
6. Behl, R., Behl, J., Gupta, N., Gupta, S. C., Ahlawat, S. P. S., Ragnekar, M. & Ahmed, Z. (2006). Genetic characterization of Zanskari breed of horse. *Journal of Genetics*, 85 (3), 199-203
7. Bhatia, S. & Arora, R. (2005). Biodiversity and Conservation of Indian Sheep Genetic Resources - An Overview - *Asian-Aust. Journal of Animal Science*. 18(10), 1387-1402.
8. Ganai, N.A., Bhat. Z.A. & Shiekh. F.A. (2016). Policy planning for conservation and sustainable use of farm animal genetic resources in J&K. National Symposium on Policy Planning for Livelihood Security through Domestic Animal Biodiversity & XIII Annual Convention of Society for Conservation of Domestic Animal Biodiversity. *Compendium*. 2. 84-94
9. Ganai, T.A.S., Misra, S.S. & Sheikh, F.D. (2010). Gurez-a threatened sheep breed of Kashmir. *Indian Journal of Animal Sciences*, 80(8).806-808.
10. Gupta, A. K., Pal, Y. & Tandon, S. N. (2010). Zanskari Pony. Monograph 1.National Research Centre on Equines, Hisar
11. Gupta, S.C., Tundup, T., Gupta, N. & Kumar, P. (2011). Livestock Wealth of the Ladakh: A Cold Arid Region in India. Retrieved. Doi:10.1017/S101423390000 0766 on 11-8-2018.
12. Hamadani, H., Khan, A.A. & Banday, M.T. (2020). Kashmir Anz geese breed. *World's Poultry Science Journal*, 76(1). Doi:10.1080/00439339.2020.1711293
13. Kour, G., Singh, A., Kumar, P., & Kumar, D. (2018). An Overview of Diversified Animal Genetic Resources in the Indian State of Jammu and Kashmir, *International Journal of Current Microbiology and Applied Sciences*, 7(10), 3113–3121.
14. Makhdoomi, D., Gazi, M., Nabi, S. & Ahmed, S. (2013). Morphometric Studies on Adult Double Humped Camel of Ladakh, India. *Emirates Journal of Food and Agriculture*, 25(7); 544-548.
15. Nivsarkar, A. E. (1994). Small ruminants and an action plan for conservation in India. In: Domestic Animal Diversity. (Ed. R. Sahai and R. K. Vijh). SBI Publications, Karnal, India. pp. 49- 57.
16. Qureshi. M. A., Khan. S. A., Shafique. M., Sabir. N & Ahmed. G. (2013). Influence of genetic and non-genetic factors on quantity and quality of wool from sheep reared at Rawalakot Azad Jammu & Kashmir. *Journal of Animal and Plant Science*, 21(10), 1007-1012
17. Rather, M., Shanaz, S., Ganai, N., Baba, M., Hamadani, A., Ahmad, M., & Ahmad, T. (2019b). Genetic, Phenotypic and Environmental Trends for Production and Reproduction Traits in Kashmir Merino Sheep. *International Journal of Livestock Research*, 9(12), 73-78. doi: 10.5455/ijlr.20190510100655
18. Rather, M.A. (2019). Genetic evaluation of Kashmir Merino Sheep at organized farms. (M.V.Sc. thesis. Division of Animal Genetics and Breeding Faculty of Veterinary Science & Animal Husbandry, Sher-e-Kashmir University of Agricultural Sciences & Technology of Kashmir)
19. Rather, M.A., Shanaz, S., Ganai, N.A., Bukhari, S., Hamadani, A., Khan, N.N., Yousuf, S., Baba, A., Raja, T.A. & Khan, H.M. (2019a). Genetic Evaluation of Wool Traits of Kashmir Merino Sheep in Organized Farms. *Small Ruminant Research*, 177 (2019), 14–17.
20. Shergojry, S.A., Akhoun, Z.A., Mubarak, T. & Namgyal, D. (2017). Socio-economic Impact of Livestock in Tribal Areas of Leh. *Journal of Krishi Vigyan*, 6(1), 187-190.
21. Singh. M. K., Yadav .M. P & Mehta. N. T. (2002). Breed characteristics of Marwari and Kathiawari horses. *Indian Journal Animal Sciences*, 72 (4), 319-323.
22. Taggar, R. K., Chakraborty, D., Kumar, D., Vohra, V., & Tantia, M. S. (2018). Wool characteristics of poonchi sheep. *International Journal of Fauna and Biological Studies*, 2018; 5(2): 133-135

\*\*\*\*\*