



Identification and Morphological Characterization of Mahakaushali Goat Population in Seoni, Chhindwara and Balaghat Districts Region of Madhya Pradesh

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ABSTRACT

Background: The study on morphometric characters on Mahakaushali goat population were conducted in Mahakaushal region of Madhya Pradesh at Seoni, Chhindwara and Balaghat districts. This is a region of central India. Mahakaushal region is lies on upper or eastern reaches of Narmada River Valley at Madhya Pradesh state. The present research work was conducted under the project sanctioned by Science and Engineering Research Board, Department of Science and Technology, New Delhi, India.

Methods: Identification and morphometric characterization of local goat population known as "Mahakaushali goat" at Mahakaushal region of Madhya Pradesh was carried out in accordance to the standard protocol of NBAGR, Karnal (Haryana). The information of morphological traits i.e. body coat colour, skin colour, horn shape, horn colour etc. were considered. The information's were collected during the survey of the native goat in the Mahakaushal region of Madhya Pradesh.

Result: The geographic distribution of 'Mahakaushali goat' population was at Seoni, Chhindwara and Balaghat districts at Mahakaushal region of Madhya Pradesh. It was observed that the animals of goat population were having white, black, light brown and mixed colour variants of body coat and skin colour. All animals in the Mahakaushali goat have medium-sized drooping (Vertical) pendulous ears. This is the peculiar characteristics of the goat. The tail has small to medium-sized hairs along its whole length, the thickness of the tail is about average and its orientation is in the upward direction. The survey was the first attempt to study the morphometric characteristics of Mahakaushali goat at Seoni, Chhindwara and Balaghat districts of Mahakaushal region at Madhya Pradesh state.

Key words: Breed, Mahakaushali goat, Morphometric characterization, Population.

INTRODUCTION

In India, the goat species is very much known for their various utility in the different agro-climatic zones. Goat plays an important role in rural agrarian economy. Diverse goat population with their varied ecology, production systems and communities are found in India. In the small ruminant species in India, goat species is in largest population. Overall population rank of the goat species is second largest in livestock category. This species is significantly contributing to the production of milk after cattle and buffaloes (Sodhi, 2016).

India has large genetic resources with 39 registered breeds (NABGR, 2024), there are several goat populations variants in different part of the country are found that have not yet been identified, recorded, or classified as breeds. As per 20th Livestock Census, out of 148.88 million goats, more than 60% of them are yet to be characterized (Livestock Census 2019, Government of India). In order to register/document indigenous animal genetic resources and identify new breeds, the ICAR-National Bureau of Animal Genetic Resources (NBAGR) launched the "Mission towards Zero Non-descript Animal Genetic resource of India" program in 2021. More than half of the goat population is yet unidentified (Sharma *et al.*, 2020). The valuable genetic diversity for breeding programmes will preserve

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with the help of identification and characterization of distinct germplasm in a particular region. Goat farming serves as a good source of livelihood for rural farmers when we compare it with other domestic livestock and it has been recognized as an integral part of traditional farming systems (Dubey, 2017; Patel *et al.*, 2023). Unfortunately, the researchers haven't focused much on characterizing the goat population in Mahakaushali region of Madhya Pradesh.

In Madhya Pradesh (11.06 million goats), there are many goat populations found in different zones, which need systematic characterization, evaluation and documentation. Once these populations are characterized and evaluated, that could be registered as separate breed. Proper phenotypic and genetic characterization would further help agencies related with livestock development to take up suitable breeding strategy/program for the improvement of native stock for future genetic conservation. To support animal biodiversity in marginal areas, survey on native goat population/breeds with special emphasis on their role as a tool of sustainability and adding value to the local economy is required to be conducted. The utilization of local breeds, disease resistance, forage self-sufficiency, forage quality, milk quality, typical and/or traditional goods, environmental labeling and direct sales are the primary characteristics of the economic element. Mahakaushal, a region of central India, lies in the upper or eastern reaches of the Narmada River valley in the Indian state of Madhya Pradesh. Jabalpur, Dindori, Mandla, Narsingpur, Seoni, Chhindwara, Katni and Bhalaghat districts are included in Mahakaushal region. Jabalpur is the largest city in the region. The Latitude and longitude of Mahakaushal region are 23°08'60.00"N and 79°55'58.80"E (Fig 1). Some unique and distinct livestock populations are found in this region of Madhya Pradesh. There is a need to characterize the different populations. In order to develop the breed descriptor for Mahakaushali goat population (required for breed documentation), the current study is necessary.

The present investigation specifically targets the native goat population distributed in the Seoni, Chhindwara and Balaghat districts of the Madhya Pradesh. This is the study of population identification and morphometric traits in the Mahakaushali goat of Mahakaushal region of Madhya Pradesh. The present study targeted population of goat is the one of the lesser-known population, which is present in a good number at targeted studied area. This goat population in targeted area is known for its local names *i.e.* Mahakaushali goat, Gourani, Atty, Cabri, Desi, Seveni, etc. The name Mahakaushali goat of these population is derived from the region 'Mahakaushal' where they exist. The purest form of Mahakaushali goat is found in the continuous tract of Seoni, Chhindwara and Balaghat districts of Madhya Pradesh. In views of above, the present study was undertaken with the objectives of identification and morphometric characterization of the goat in Seoni, Chhindwara and Balaghat district region of Madhya Pradesh.

The current study was conducted by the Department of Animal Genetics and Breeding, College of Veterinary Science and Animal Husbandry, Rewa, as part of project study funded by the Science and Engineering Research Board, Department of Science and Technology, New Delhi, India. The project title was "Study on phenotypic characterization, biometry and management of local goat population in the Madhya Pradesh districts of Seoni, Chhindwara and Balaghat" (Project file no. EEQ/2021/000486).

MATERIALS AND METHODS

Native tract and climatic condition

The Mahakaushal area of central India is located in the Indian state of Madhya Pradesh in the upper or eastern parts of the Narmada River valley. Jabalpur is the largest city in the region. Cities and districts of the region include Jabalpur, Dindori, Mandla, Narsingpur, Seoni, Chhindwara, Katni and Bhalaghat. Unique and distinct goat population was found in Seoni, Chhindwara and Balaghat district region of Madhya Pradesh. The present study was targeted Seoni, Chhindwara and Balaghat districts of Mahakaushal region of Madhya Pradesh for the morphometric characterization of nondescript goat population. The mean minimum temperature was found 21.38°C, 21.04°C, 21.79°C, respectively in Seoni, Chhindwara and Balaghat, districts. The mean maximum temperature was 32.32°C, 31.19°C, 33.9°C, respectively in Seoni, Chhindwara and Balaghat districts. The average precipitation was 178.8 mm, 143.72 mm and 137.85 mm, respectively in Seoni, Chhindwara and Balaghat districts. The humidity was 50.0 per cent, 49.38 per cent and 50.67 per cent, respectively in Seoni, Chhindwara and Balaghat districts. The height from mean sea level was 612 m, 675 m and 288 m, respectively, Seoni, Chhindwara and Balaghat districts. The geographical area (Sq. Km.) is 8758 sq. km. 11815 sq. km. and 9245 sq. km. respectively, in Seoni, Chhindwara and Balaghat districts.

Animal material

The present study was conducted in Seoni, Chhindwara and Balaghat districts of the Mahakaushal region of Madhya Pradesh. A total of 3320 goat animals (2307 females and 1013 males) from 'Mahakaushali goat' were studied. The questionnaires developed by ICAR-National Bureau of Animal Genetic Resources, Karnal were used in survey and data collection for study of population identification and morphological traits.

Morphometric characteristics

The morphological traits such as the colour of coat, skin, muzzle, eyelid, hooves and horns were studied. Shape

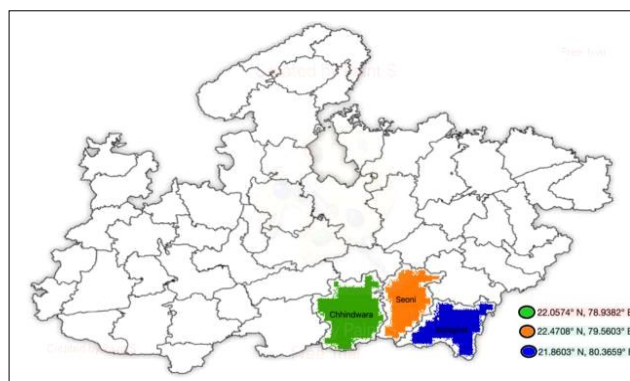


Fig 1: Targeted districts geography and location with latitude and longitude at Mahakaushal region of Madhya Pradesh.

and orientation of horn, ears, forehead, body and udder shape, teat shape and size etc. were included in the study. The morphometric traits were studied as per standard protocol of ICAR-National Bureau of Animal Genetic Resources, Karnal (NBAGR, 2024).

RESULTS AND DISCUSSION

The per cent values of different morphological traits of animals in 'Mahakaushali goat' population at Mahakaushal region have been shown in Table 1. As per the study of

phenotypic traits, Mahakaushali goat is not close to the other documented goat breeds. This was the first study on present studied goat population at Mahakaushal region of Madhya Pradesh.

Coat colour and skin colour

The study revealed that the body coat and skin colour in population varied from white to black, light brown to mixed colour. The body coat colour of the goat in the targeted region under study ranged from white (18.0 per cent), black (17.65 per cent), light brown (24.71 per cent) to Mixed colour

Table 1: The morphometric characteristics of the goat population of Seoni, Chhindwara and Balaghat district of Mahakaushal region of Madhya Pradesh.

Morphometric trait	Colour variant types	Total number	Percentage
Coat colour	White	660	18.00
	Black	647	17.65
	Light brown	906	24.71
	Mixed colour	1453	39.63
Skin colour	White	1746	47.63
	Black	288	7.86
	Light brown	1632	44.52
Muzzle colour	Black	2295	62.60
	Light black	1056	28.81
	White	315	8.59
Eyelid colour	Black	830	22.64
	Light black	2677	73.02
	White	159	4.34
Hooves colour	Black	626	17.08
	Light black	3011	82.13
	White	29	0.79
Horn colour	Black	666	18.17
	Light black	3000	81.83
Horn shape	Straight	2966	80.91
	Curve	700	19.09
Horn orientation	Upward	3053	83.28
	Backward	613	16.72
Horn size	Small	3220	87.83
	Medium	442	12.06
	Large	4	0.11
Forehead	Straight	2656	72.44
	Convex	815	22.23
	Concave	195	5.31
Udder shape	Trough	1489	85.62
	Round	136	7.82
	Pendulous	13	0.75
	Bowl	101	5.81
Teat shape	Cylindrical	90	5.18
	Funnel	7	0.40
	Pear	1604	92.24
	Round	38	2.19
Teat tip	Pointed	1513	87.00
	Round	226	13.00
Milk vein	Not prominent	1736	99.83
	Prominent	3	0.17

(39.63 per cent). The skin colour was white (47.63 per cent), black (7.86 per cent) and light brown (44.52 per cent) (Fig 2). Some animals were having medium hairy skin but majority of cases less hair skin was observed. Similarities observed in coat colour of different goat might be due to breeds share some level of common ancestry and common environmental effects. In contrast to the present study, Sharma *et al.* (2005) reported brown and white coat with black spots in Barbari goat, Verma *et al.* (2006) reported brown coat colour with light and dark patches in Sirohi goat and Sharma *et al.* (2006) reported black coat colour in Beetal goat. In accordance to present study, Similar to present study, the majority of Rohilkhandi goats (>90%) were small, black animals. Goats from Kumaoni and Garhwali were small animals, 60-80% of which had bodies colored tan or brown (Singh *et al.*, 2019). In accordance to present study andaman local goat coat colour pattern varied from black, brown and mixed black and white. The predominant coat colour was black (90%) with admixture of black, brown and white (10%). In accordance to the present study, Kumar *et al.* (2024) found black, brown coat colour, gray skin colour in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh. In accordance to present study, Ganjam goat breed was found in black, brown, blackish brown and brownish black coat colour (Verma *et al.*, 2015).

Muzzle colour

The colours of muzzle varied from black, light black and white in population. Black colour muzzle was the most common in goat population. The observed colours of muzzles were black (62.60 per cent), light black (28.81 per cent) and white (8.59 per cent) (Fig 3). Black colour muzzle was the most common in goat population. In accordance to present study, black and brown colour of muzzle were found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024). Similarly in Ganjam goat muzzle was found in grayish black colour (Verma *et al.*, 2015).

Eye lid colour

The common eyelid colours observed were black, light black and white in goat population. The most common eye lid colours observed were black (22.64 per cent), light black (73.02 per cent) and white (4.34 per cent) (Fig 4). In accordance to present study, light or dark black colour eye lid was found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024). Similarly in Ganjam goat eyelashes was found in grayish black colour (Verma *et al.*, 2015). Ears are medium sized and drooping.



Fig 2: Male goat, Female goat and group of male and female in Mahakaushali goat population.



Fig 3: Muzzle colour of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.

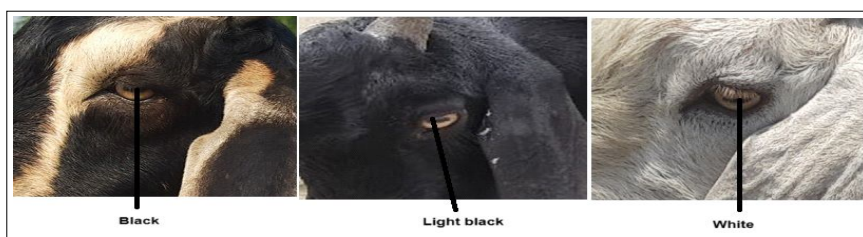


Fig 4: Eye lid colour of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.

Hooves colour

The hooves colours were black (17.04 per cent), light black (82.13 per cent) and white (0.79) in population (Fig 5). In accordance to present study, black colour hooves was found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024). Similarly in Ganjam goat black colour Hooves was found (Verma *et al.*, 2015).

Horn colour, shape and orientations

In 72.3 per cent of the animals, the colour of the horns was light black (81.83 per cent) followed by black (18.17 per cent). Almost 80.91 per cent animals had straight shape horns than curve (19.09 per cent). Horns were oriented upward (83.28 per cent), then downward (16.72 per cent) (Fig 6). The differences might be due to either the effects of random genetic changes or the adaptive response of organisms to different environments. In accordance to present study, Singh *et al.* (2019) were found small, grayish black and curving

backward in Kumaoni and Rohilkhandi but long in Garhwali goats, Rohilkhandi and Barbari goat (Sharma *et al.*, 2005). In accordance to present study, straight, curved and spiral shape of horn and upward and backward horn orientation were found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024). Similarly in Ganjam goat horns was found in grayish black colour (Verma *et al.*, 2015).

Ear position

The ears were pendulous in shape and position was vertical (100 per cent) or drooping (Fig 7). This was unique characteristics in the animals of Mahakaushali goat population. All the population was found similar type of ear pattern (Medium size/drooping/horizontal). In accordance with the present study, Bundelkhandi goat (Mishra *et al.*, 2012), Rohilkhandi goat (Singh *et al.*, 2019), Kumaoni (Singh *et al.*, 2019) and Garhwali goats (Singh *et al.*, 2019;



Fig 5: Hooves colour of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.



Fig 6: Horn colour, shape and orientations of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.



Fig 7: Ear position of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.

Sunder *et al.*, 2018) were found small to medium size pendulous ears. In contrast to present finding Barbari goat (Sharma *et al.*, 2005) and indigenous goat population east gojjan zone Ethiopia (Getaneh *et al.*, 2022) were found small size horizontal erect ear which give the active look to the goat. In accordance to present study, Rohinkhandi, Kumaoni and Garhwali goats had small to medium size pendulous ears with tip slightly curved upward (Singh *et al.*, 2019). In accordance to present study, pendulous ear orientation was found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024). Similarly in Ganjam goat ears were found in medium sized and drooping (Verma *et al.*, 2015).

Forehead

The shape of forehead was observed to be straight (72.44 per cent), slightly convex (22.23 per cent) and slightly concave (5.31 per cent) in animals of goat population (Fig 8). In accordance with present study finding, Verma *et al.* (2006) reported slightly convex fore head in Sirohi goat and straight Barbari goat (Sharma *et al.*, 2006). In contrast to present study, Rohilkhandi, Kumaoni and Garhwali goat variants were having convex head (Singh *et al.*, 2019). In accordance to present study, straight and slightly convex fore head was found in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024).

Temperament

The basic temperament of goat of the region was found to be docile to moderate. Animals were docile in nature and mostly managed by the all members of the family.

Udder and teat shape

The colour of the udder was either pinkish or light black. The udder was compact and medium sized with bowl (5.81 per cent), round (7.82 per cent), trough (85.62 per cent) and pendulous (0.75 per cent) shape. Most of the goat in population had pear shape teats (92.24 per cent) followed by cylindrical (5.18 per cent), round (2.19 per cent) and funnel type (0.40 per cent). The pointed shaped teat tips were observed in 87 per cent of the goats in population whereas, only 13 per cent of goat possessed rounded teat tips. The milk vein was not prominent in 99.83 per cent of goat in population. In accordance to present study, Sharma *et al.* (2005) reported variable udder and teats and Verma *et al.* (2006) reported udder small and round shape teats. The Mahakaushali goat animals with farmers at targeted area are represented in Fig 9.

Wattles and beard in goat

The wattles and beard are absent in the animals of the goat population. In accordance with present study finding of Bundelkhandi goat (Mishra *et al.*, 2012), Barbari goat (Sharma *et al.*, 2005) and Rohilkhandi, Kumaoni and Garhwali goat variants (Singh *et al.*, 2019) were found and in contrast with present study finding were reported Sirohi (Verma *et al.*, 2006) and Beetal goat (Sharma *et al.*, 2006). In contrast to present study, wattle was present or absent in distinct indigenous goats from Vindhyan region of Eastern Uttar Pradesh (Kumar *et al.*, 2024).

Morphological characteristics of goat in the targeted population at Seoni, Chhindwara and Balaghat district region of Madhya Pradesh are shown in the Table 1.

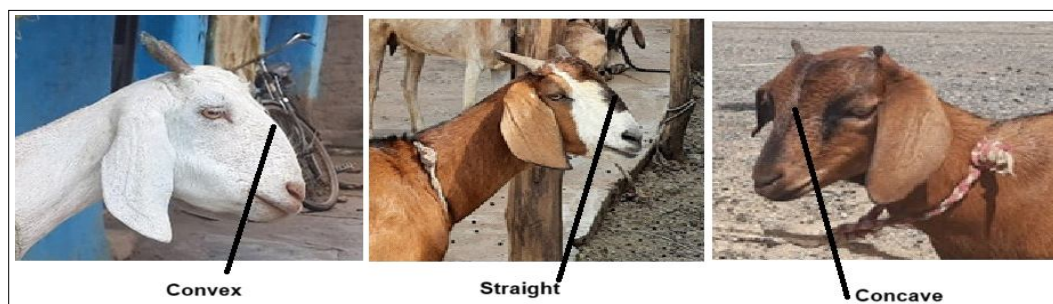


Fig 8: Forehead shape of animals in goat population in Seoni, Chhindwara and Balaghat region of Madhya Pradesh.



Fig 9: Mahakaushali goat animals with farmers at targeted area of study.

The characteristic features recorded during survey of goat population at Seoni, Chhindwara and Balaghat district regions of Mahakaushal region of Madhya Pradesh are summarized below:

Body	:	Small to medium size
Body colour	:	White, black, light brown to mixed colour on all the body in male and female animals.
Skin colour	:	White, black and light black colour. Some animals were having more hairy skin but majority of animals were having less hair on skin
Head	:	The majority of animals had straight foreheads than convex, while only a few had concave shape foreheads.
Muzzle	:	It was black in majority of animals but some animals were having light black and white colour of muzzle.
Eyes	:	Placed wide apart, black colour eyes and eye lid colour might be black, light black and white.
Ears	:	Orientation was vertical/drooping in the animals and shape of ears were observed pendulous.
Horns	:	Horns were found in practically every animal ranging from small to medium in size. Horns were in a straight and curve shapes and colours, including black and light black. Horns oriented upwards and backwards. The majority of the animals had straight upward light black horns.
Hooves	:	Hard and animals were having black, light black and white in colour.
Tail	:	The tail has small to medium-sized hairs along its whole length, the thickness of the tail was about average and its orientation was in the upward direction.
Udder	:	The udder had a pinkish and very light black colour, udder shapes varied from trough, rounded, bowl and pendulous shapes. It is compact and medium sized. Teat shape varied from cylindrical, funnel, pear and round shape. Teat tip shape varied from rounded and pointed.

CONCLUSION

The Mahakaushali goat breed is also known as *atty*, *cabri*, *gorani*, *desi*, *sevni*. Uniform population of Mahakaushali goat was found in Seoni, Chhindwara and Balaghat districts and in adjoining parts of these districts. This study was the first work in targeted areas to examine the goat population in this region. The average body size of Mahakaushali goat in the studied population was medium in size. The

documentation/registration of population is required to further improvement and conservation of this population. The body coat colour variants were white, black, light brown and mixed colour variants. Mixed coat colour animals were found in high number than other colour. Small size horn animals were found in high number than medium and large. All animals in the Mahakaushali goat have medium-sized drooping (vertical) pendulous ears. This was peculiar characteristics of the goat. The tail has small to medium-sized hairs along its whole length, the thickness of the tail was about average and its orientation was in the upward direction. The study was helpful for breed registration or documentation of the Mahakaushali goat in survey area. The population is not registered till date so the present study will be helpful for registration/documentation of the goat population present in Seoni, Chhindwara and Balaghat districts region at Mahakaushal region of Madhya Pradesh.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were as per the standard procedure and protocol.

Conflict of interest

Authors declares that they have no conflict of interest.

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