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A study on environmental adaptability and behavioural variation of Rambouillet, Ramghani and Kaghani lamb breeds

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A B S T R A C T

High level of temperature along with chronic environmental changes causes metabolic impairments in animals that raise their stress levels. For a variety of interrelated intrinsic and extrinsic factors, individual animals behave substantially from one another, and this behavioural variance is the main feature for evolutionary change. In many cases, both natural and human-induced rapid environmental changes have an impact on behaviour through its wide ranging direct and indirect effects on physiology. The sheep are essential to the establishment of sustainable and ecologically responsible agricultural systems for rural communities, particularly in extremely hot climates. An experiment was conducted at livestock experiment station, Jaba sheep farm, district Mansehra (300 acres) to study the environmental adaptability and behavioural variation of Rambouillet, Ramghani and Kaghani lamb breeds. High increases in the outside temperature of Jaba sheep farm cause population to fall and numerous modifications of routine behaviour to adapt to the circumstances. The study revealed that sheep were severely impacted by the local ecological systems of LES after changing climate and/or weather which also affects the lamb fertility. The rate of abortion increased during the course of the study period, possibly as a result of alterations in the climatic conditions.

Keywords: Heat stress · Environmental adaptability · Behavioural variation · Population · Lamb breeds

1. Introduction

Elevated level in ambient temperature causes to decline in livestock production and numerous modifications in normal behaviour to adapt to the circumstances. Solar radiation, ambient temperature, relative humidity and wind speed are responsibly causing the effective temperature of the environment to frequently breach the animals' thermal neutral zone [1,2]. The IPCC, 2007 [3] is presently very persuaded that environmental change is real phenomenon, that it will go out to be more terrible, and that the poorest localities and little scale farmers will suffer the most prominently. It is considered that greenhouse gases are the primary cause of climate change. Through the extensive direct and indirect impacts on physiology, rapid environmental changes that are both natural and human-induced have an impact on behaviour. The effect of environmental change will require a familiar type of creature which can provide in disappointing condition accordingly the use of valuable domesticated animal's genotypes which may support generations and yields in such manner. The IPCC (2014) [4] assessment makes the stronger prediction that the world's temperature would rise by about 4°C by the end of the 20th century. Joined with expanding food demand, this will bring about more food variability all around the world. Wheat, rice and maize cultivation in the tropical zone is predicted to be adversely affected by nearby temperature rises of at least 2°c above in late 20th century. Some other studies reported that besides other factors climatic conditions have a significant impact on livestock [5-10].

According to (Foster, 2013) [11] the long-term evolution can be both facilitated and constrained by behavioural variation. Some factors like population density of animals, cropping patterns, agro-climatic conditions and livestock output are all closely related [12]. People who live in arid and semi-arid regions of the world have turned to sheep farming as a viable source of income. It is anticipated that the sheep business would expand in the years to come and play a significant socioeconomic role in the arid and semiarid regions [13]. In many cases, human-induced rapid environmental change has an impact on behaviour through its wide ranging direct and indirect effects on physiology. Thermal radiation, temperature, wind speed, humidity and precipitation are the potential environmental stressors and/or major climate factors have a significant impact on livestock production and their health [14-18]. An experiment was conducted at livestock experiment station, Jaba sheep farm, district Mansehra (300 acres) to study the environmental adaptability and behavioural variation of Rambouillet, Ramghani and Kaghani lamb breeds.

2. Materials and Methods

The present research was conducted in LES, Jaba sheep farm (300 acres), District Maneshra, located in the Province Khyber Pakhtunkhawa (KPK), Pakistan and the data were collected on population, fertility and abortion rate of three breeds of sheep. It is situated at the coordinates of 34°09' N latitude and 73°13' E longitude, at an altitude of 4,120 feet (1456 m). It is located about 125 km from Islamabad, and about 235 km from Peshawar. The district's mean maximum and minimum temperatures are 23°C and 11°C respectively and its climate varies with altitude. The temperature can rise as high as 30^0C during the mid-summer months and drop below 0°C during the winter.

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Maneshra has a humid subtropical moderate climate, with mild to warm temperatures during the spring and autumn months, humid temperatures during June and July, and cool to mild temperatures during the winter. There are three breeds of sheep in livestock experiment station (LES) Jaba, district Mansehra, Pakistan, like (1) Rambouillet, (2) Kaghani and (3), Ramghani were taken for the study.

The Rambouillet sheep has its roots in France, white in colour, with light pigment on nose and mouth loose skin from neck to chest floor area. Mature Rambouillet rams weigh between 250 and 300 pounds, and ewes average from 165 to 200 pounds. Both male and female can be horned or polled, and they are very regal in appearance. This breed named after Kaghan valley. Kaghani sheep during winter stay in plains, moving east as far as Jhelum district in Punjab, but in spring they go back up to the alpine ranges of Kaghan valley, have coarse wool. Adult weight of ewe is 30-40 kg whereas ram weighs 40-50 kg. The Ramghani sheep is a newly developed variety is renowned for producing semi-fine wool to meet the increased demand for high-quality wool clothing through the winter time. The Ramghani sheep is white in colour, tail is thin, has semi fine wool. Adult ewes` weight is about 100-150 pounds whereas rams weigh up to 200 pounds.

3. Results and Discussion

Both natural as well as human-induced rapid environmental changes have an impact on behaviour through its wide ranging direct and indirect effects on physiology. Hyperthermia i.e. abnormally high body temperature, significantly affects body weight, physiology and growth of animals. According to Yousef 1985 [19] the heat stress is the totality of outside force acting to raise body temperature above the resting level on a homeothermic animal. Understanding the impact of environmental changes on organisms as well as their adaptation mechanisms is crucial in the context of the current discussion over global climate change. In a hot, stressful environment, a deviation from the stipulated body temperature interferes with physiological processes and as a result, reduces animal productivity [20]. Various stresses can alter an animal's physiology along with its productive capacity [21].

3.1. Effects of climate change on behavioural variation of Rambouillet, Ramghani and Kaghani lamb breeds

3.1.1. Population, fertility and abortion rate of Rambouillet (RB)

Figure 1 shows the behaviour of Rambouillet (RB) sheep female in LES Jaba. The highest RB female population during 2008 – 2017 was 181, during 2015, with the highest fertile female ewes and highest abortion rate i.e., 176 and 8, respectively. While during 2016, the minimum population of ewes, fertility and abortion rates were 120, 114 and 4, respectively. Due to climate and or weather change of the local ecology of LES, these sheep were affected. An increasing trend in the abortion rate was observe during the analyzed duration (2008 – 2017), perhaps due to changes in the weather conditions and as this is an American breed, its needs substantial food and favourable climate. Secondly, LES is not very well equipped in terms of operation tools and technology, as well as unqualified and less skilled staff and veterinarian.

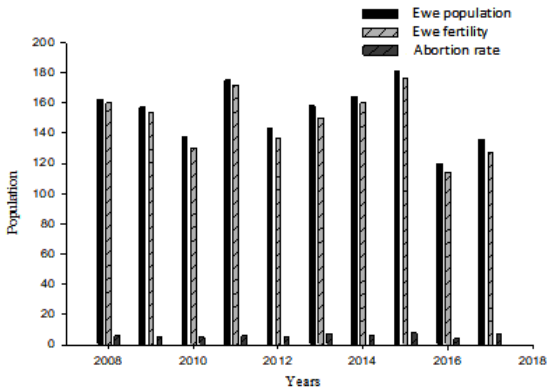

Fig. 1. Effects of climate change on population, fertility and abortion rate of Rambouillet (RB)

3.1.2. Population, fertility and abortion rate of Ramghani (RM)

Figure 2 shows the behaviour of Ramghani (RM) sheep female in LES Jaba, during 2008-2017. During 2008 RM female population behaviour was normal as the temperature and precipitation were most suitable for the sheep's survival. During 2009, with the increase in temperature the ewe population got disturbed. As it is a cross breed of American and native Pakistani breed, so perhaps it cannot withstand high temperatures. In 2010, ewe population was 142 in which the fertility rate was 140 and abortion of ewes was 3. The maximum ratio of fertile ewes was in 2008 and 2015 as fertility and the number of animals released in spring are unaffected by weather conditions. The abortion rate was high in 2013. Minimum abortion rate is 1 in 2010 and 2016.

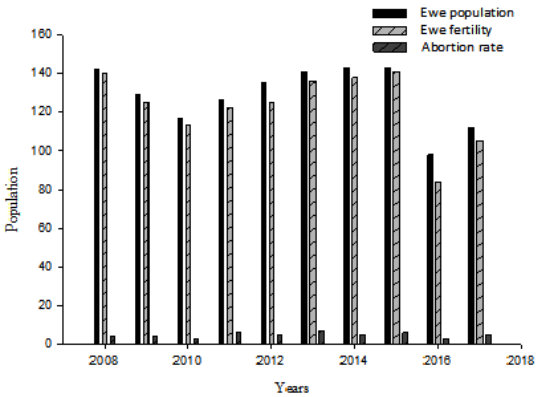

Fig. 2. Effects of climate change on population, fertility and abortion rate of Ramghani (RM)

3.1.3. Population, fertility and abortion rate of Kaghani (KG)

Figure 3 shows the behaviour of kaghani female (KG) during 2008 -2017. The population of ewes was 105 and the fertile ewes were 101 and abortion rate was 3 during

the year of 2008, because the temperature was suitable in this year. But in 2009-2011 the fertility rate and abortion gradually decrease due to some diseases and parasites because in this year's temperature and precipitation increase (1-2%) Diseases and parasites are the most severed factor that affects the livestock health. During 2017 the ewes population is 110, fertile ewes was 97 and abortion is 2 in this year the abortion rate is low because abortion reduction is the direct result of drugs vaccine and control diseases technologies.

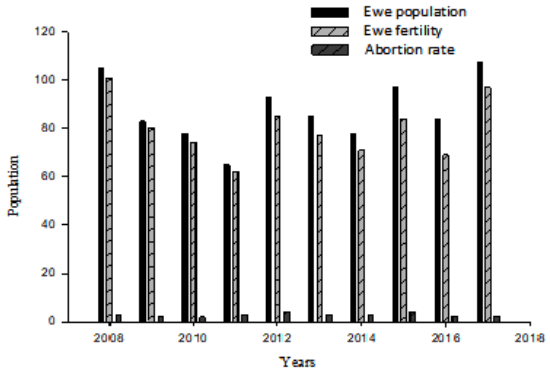

Fig. 3. Effects of climate change on population, fertility and abortion rate of Kaghani (KG)

3.2. Behaviour of Rambouillet, Ramghani and Kaghani lamb breeds

The Lambs are young sheep i.e., < 1year old or without permanent teeth. Behaviour of Rambouillet, Ramghani and Kaghani lamb breeds has been described.

3.2.1. Behaviour of Rambouillet (RB) lambs in LES

Table 1 shows that Rambouillet children behaviour in LES Jaba during 2008-2017. Because of their exceptional agility and great flocking behaviour, these sheep are easier to manage. The maximum population of alive lambs was 112 in 2008 in which male lambs are 48 % and female lambs are 52% and minimum population of lambs was 79 in 2014 in which male ratio is 52 % and female ratio is 48 %, the maximum mortality rate of lambs was 7 in 2017 and the minimum mortality rate of lambs was 1 in 209 and in the whole 10 years the average male mortality rate of lambs was 3.6 % and female lamb mortality was 3.5 %. The male maximum birth weight of male lambs was 4.85 kg in 2008 and minimum birth weight of male lambs was 3.9 in 2017 and average weight of 10 years (2008-2017) was 4.1 3kg and female maximum birth weight 4.64kg in 2008 and minimum birth weight of lambs was 3.6 kg in 2017 and average weight of female lambs in 10 years (2008-2017) was 4.15 kg.

Table 1 Rambouillet (RB) children behaviour

Rambouillet (RB) children behaviour							
	Alive lamb	Male female ratio in lambs		Mortality rate in lambs		Birth wt (kg) in lambs	
Year	Lambing	M%	F%	M	F	M	F
2008	112	48	52	4	3	4.85	4.64
2009	100	44	66	1	5	4.78	4.54
2010	104	44	66	3	3	3.98	4.06
2011	94	47	53	2	3	3.67	3.99
2012	87	48	52	3	1	4.44	4.01
2013	85	48	52	4	6	3.45	4.45
2014	79	52	48	3	4	3.43	4.33
2015	97	54	46	3	2	4.43	4.01
2016	92	41	59	6	5	4.41	3.9
2017	104	51	49	7	4	3.9	3.60

3.2.2. Behaviour of Ramghani (RM) lambs in LES

The Ramghani children behaviour in LES, Jaba during 2008-2017 is presented in the table 2.

Table 2 Ramghani (RM) children behaviour

Ramghani (RM) children behaviour							
	Alive lamb	Male female ratio in lambs		Mortality rate in lambs		Birth wt (kg) in lambs	
Year	Lambing	M %	F %	M	F	M	F
2008	100	43	57	2	4	4.72	4.57
2009	94	48	52	5	3	4.65	4.56
2010	86	42	58	2	2	4.45	4.34
2011	84	40	60	4	3	3.98	3.88
2012	91	43	57	3	3	4.76	4.42
2013	71	47	53	6	4	4.65	4.22
2014	72	58	42	3	5	4.12	3.73
2015	66	46	54	1	3	3.21	3.83
2016	86	56	44	2	5	3.73	3.48
2017	84	45	55	4	4	3.7	3.60

The maximum population of alive lambs was 100 in 2008 in which male lambs are 43 % and female lambs are 57% and minimum population of lambs was 71 in 2013 in which male ratio is 47 % and female ratio is 53 %, the maximum mortality rate of lambs was 6 in 2013 and the minimum mortality rate of lambs was 1 in 2015 and in the whole 10 years the average male mortality rate of lambs was 3.2 % and female lamb mortality was 3.7 %. The maximum birth weight of male lambs was 4.76 kg in 2012 and minimum birth weight of lambs was 3.7 in 2017 and average weight of 10 years (2008-2017) was 4.19 kg and female maximum birth weight 4.57 kg in 2008 and minimum birth weight of lambs was 3.6kg in 2017 and average weight of 10 years (2008-2017) was 4.06 kg.

3.2.3. Behaviour of Kaghani (KG) lambs in LES

Table 3 shows the kaghani children behaviour in LES Jaba during the last years (2008-2017). The maximum population of alive lambs was 118 in 2008 in which male lambs are 45 % and female lambs are 55% and minimum population of lambs was 69 in 2011 in which male ratio is 57 % and female ratio is 43 %, next the mortality rate of lambs was the maximum mortality rate of male lambs was 6 in 2013 and the minimum mortality rate of male lambs was 1 in 2016 and in the whole 10 years the average male mortality rate of lambs was 2.9 % and the maximum mortality rate of female was 7 in 2013 and minimum mortality rate of female lamb was 1 in 2008 and whole 10 years mortality rate of female lamb is 2.9 in kaghani breed. The maximum birth weight of male lambs was 4.96 kg in 2012 and minimum birth weight of lambs was 3.3 in 2017 and average weight of 10 years (2008-2017) was 4.21 kg and kaghani female lamb, maximum birth weight 4.89 in 2009 and minimum birth weight of lambs was 2.9 in 2017 and average weight of kaghani female lambs in 10 years (2008-2017) was 4.14 kg.

Table 3 Kaghani (KG) children behaviour

Kaghani (KG) children behaviour							
	Alive lamb	Male female ratio in lambs		Mortality rate in lambs		Birth wt (kg) in lambs	
Year	Lambing	M %	F %	M	F	M	F
2008	118	45	55	2	3	4.96	4.8
2009	96	45	55	2	2	4.85	4.89
2010	109	38	62	3	1	3.58	3.46
2011	69	57	43	2	3	4.79	4.72
2012	90	31	69	4	2	4.66	4.35
2013	94	52	48	6	7	4.85	4.57
2014	104	48	52	4	3	4.65	4.45
2015	88	52	48	3	2	3.23	4.23
2016	77	45	55	1	5	3.31	3.10
2017	102	59	41	4	3	3.3	2.90

Negative effect of environmental change on livestock and domesticated animals represents a great danger to food security. Increase in temperature equally brings about increasing pests attack and germs which results loss in crop yield. Climate change adversely affects the livestock production by decreasing the accessibility of feed and fodder. Some of the effects of climate change include increased variability in storm and winter precipitation pattern, increase in normal temperatures, warmer winters, decaying biological communities, the despair of icy masses in the Himalayas; and expanded repetition of climatic extremes occasions like floods, typhoons, and dry seasons [22]. Livestock is an essential part of farming as the huge majority of the general population because of various reasons depends upon the livestock for their financial benefit. A drop in growth of animals is likely to result from the 2 to 3 °C increase in temperature that will occur across the entire country along with the sustained increase in humidity brought on by climate change.

4. Conclusion

Due to climate and or weather change of the local ecology of LES, population and also behaviour of these sheep were affected profoundly. An increasing trend in the abortion rate was observed during the analyzed duration, perhaps due to changes in the weather condition. The study revealed that climate changes have negative impacts on livestock production. The sheep population is severely being threatened due to the continuous increase in temperature. Climate change negatively affects the livestock production by reducing the availability of feed and fodder. Climatic change that causes chronic heat stress is considered the most important external factor drastically affecting long term small ruminants. To stay healthy and productive, sheep, which are small ruminants and homeotherms, must maintain their body temperature within a specific range. Thus, under changing climatic conditions, heat stress is thought to be the most significant element affecting the production lambs in the LES, Jaba.

Conflict of interest

The authors declare that there is no conflict of interest in this manuscript.

Data availability

The authors confirm that all data collected or analyzed during this study are included in this published article.

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