Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP1: 2329-2333

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Goat husbandry under changing climate scenario in Banka district, Bihar

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Abstract
Goat farming was a very popular among rural farmers particularly in landless and marginal farmers at Banka district of Bihar. It was observed that in almost all household farmers keep at least 2 to 5 goats in their houses. Considering the above fact a study was undertaken to find out the pattern of goat husbandry practices in climate change scenario in Banka district, Bihar. In total 100 farmers were interrogated through pre-module questionnaire. The responses were statistically analysed as per standard procedure. During the one year study period at Banka district the data were recorded on impact of climate change in goat husbandry practices especially in breed composition, goat population, feed and fodder availability, area of grazing land, disease incidences, reproductive disorders, productive performances, consumer demand etc. The analysis of data revealed that in Banka district the area of grazing land was declined significantly ($P<0.01$) by average 51 percent during last 3 decades. With declining and erratic distribution of rain fodder production declined in quality and quantity. Age at first conception and calving in goats increased by 2.0 and 2.5 months, respectively. Average kid production per goat decreased in number i. e. Kids delivered in one time decreased. Last age of kidding reduced to 4.5 years. The kid's mortality increased by 24.35 % due to poor milk yield but adult mortality decreased by 18%. Growth performances like total body weight gain in Scheduled tribe villages reduced by 15%, Whereas, in other villages similar growth rate (67.31 and 66.73g/day) was found. Stress on animals, extreme weather conditions and change in weather in short interval, erratic rain leads to increase of incidences and emergence of PPR, haemorrhagic septicemia enterotoxemia, contagious ecthyma etc diseases. Cold stress causes increase the pneumonia and diarrhea like diseases. Poor availability of green grass, other than monsoon season increases the incidence of metabolic disease, corneal opacity and night blindness. The increased morbidity and mortality and declined production under climate change leads to economic losses to the farmers. The availability of safe drinking water was declining rapidly. However farmers provide fresh water at home or in field at noon and evening. Scarcity of feed and fodder from grazing farmers resort to early disposal of goat for mutton purposes. Less number of farmers was interested in rearing of castrated male goat. Rich farmers sold their goats at 8.5 month of age weighing 15 kg body weight where as poor farmers sold at an age of 4.5 months when they hardly attain body weight of 5.5 kg due to scarcity of feed and fodder. Climate change causes extreme weather and erratic rain condition affecting the feed and fodder availability and emergence of diseases. These affect the productivity of goat and causes economic losses of framers.

Keywords: Climate change, Goat husbandry, Feed availability, Goat diseases, Kid mortality

Introduction
The effect of climate change on crops is well known, but much less is known about the effects of climate change on livestock (Reilly *et al.*, 1996 [1]; McCarthy *et al.*, 2001 [2]; Seo & Mendelsohn, 2006) [3]. Climate can affect livestock directly and indirectly. Direct effects from air temperature, humidity, wind speed and other climate factors influence animal performance: growth, milk production, wool production and reproduction (Houghton, 2001) [4]. One of the most evident and important effects of climate change on livestock production is mediated through changes in feed resources. Although indirect, feed resources can have a significant impact on livestock productivity, the carrying capacity of rangelands, the buffering ability of ecosystems and their sustainability, and the distribution of livestock diseases and parasites (Thornton *et al.*, 2007) [5].

Goat production for milk and meat is an age old practice and goat is one of the first animals to be domesticated by men. In early biblical literature references are made regarding goat for milk, meat, hide and manure. Throughout the world goat is considered as 'poor man's cow'. In Switzerland goat is nicknamed as "Swiss baby's foster mother' (Chakrabarti *et al*, 2014) [6]. The role of goat farming in the upliftment of small, marginal farmers including landless agricultural labours in India is well recognized (Kumar *et al.*, 2014) [7]. The contribution of goat to total milk production of India was 3.82 percent whereas; it is 69.35 percent in case of meat production (GOI, 2006) [8]. ICAR Central Institute for Research on Goats (CIRG)

projected goat as 'Future Animal' for rural and urban prosperity. Goat husbandry is a source of livelihood and economic sustenance among poor farmers of dry plain, mountain and hilly regions of the country. As temperatures increase as a result of climate change, the probability of choosing sheep and goats as livestock species will increase (Seo and Mendelsohn, 2006) [3]. India's goat husbandry depends largely on the monsoon grasses (Shinde and Bhatta, 2002) [9] and changing rainfall pattern would cause scarcity of grazing resources. There will be lengthier droughts in dry areas, which will subsequently affect grazing resources, water scarcity and hamper goat husbandry activities. Bihar possesses the third largest goat population in the country. India's total livestock and goat population has decreased by about 3.33% and 3.82% but in Bihar increased by 8.56% and 19.54%. Given the importance of climate change affecting livestock productivity, this overview collates and synthesizes literature on effect of changing climate on goat farming in Bihar and Banka district (hilly and plane).

Material and methods

The study area had mixed farming, comprised of crop, livestock including goat and other domesticated animals.Banka district is located in between latitude 24.7757° N and longitude 86.8220° E at an altitude of 85 - 247 meters above Sea level (MSL) having annual average rainfall of 1200 mm and area 3,019 km². Total 100 farmers from 10 villages in which 5 tribal village of Banka district were randomly identified and 10 farmers from each villages interviewed personally using standard procedure with pre-module questionnaires. Data were collected from November 2015 to October 2016. The data generated were analysed by independent samples t-test using SPSS-24.

Results and discussion

Goat population and production status in Bihar

India is host to 135.17 million of goat which contributes 26.40% of total livestock population and declined by 3.82% over the previous census (2007). The population of goat decreased by 3.18% and 15.66% in rural and urban areas, respectively. In Bihar total number of goat as per census 2012 is 12.15 million which is 8.99% share of India and third position after Rajasthan and Uttar Pradesh. In relation to increase in goat population it is on 2nd position (19.54%) after Assam (42.81%).Total number of female goat population Bihar has increased by 28.38% from 6.66 million in 2003 to 8.63 million in 2012 (Livestock census 2012). The relatively increase in population of goat show the increase in interest of rural people towards goat farming, stall feeding and also increase the dependency as secondary income and also high prolific goat breed present in Bihar.

Table 1. Goat population growth rate in goat dominating state

States	Inter census growth rate (%)	
	1982-92	2003-12
Andhra Pradesh	-28	31
Bihar	30	22
Madhya Pradesh	10	-2
Maharashtra	23	-27
Rajasthan	-1	22
Tamilnadu	17	0
Uttar Pradesh	26	17
West Bengal	23	-63
All India	16	3

Government of India Livestock census 2012

Impact of climate change on goat husbandry

The analysis of data collected on goat husbandry practices under climate change scenario revealed that there was a significant impact on goat husbandry as there were changes in breed composition, goat population, feed and fodder scarcity, shrinkage of grazing land, spread of diseases, reproductive disorders, productive performances, consumer demand etc.

Breed composition

The local breeds in different agro-ecological niches have evolved over a period through natural selection. They are well adapted to climate, feed, fodder, and diseases of native tract. These breeds would be of great use in near future in the context of increasing climatic variability. Farmers prefer goat breeds which can withstand thermal and nutritional stresses and give better growth rate. In view of climate change, many breeds are shifting from native tract, changing their production and other characteristics in new environment. Black Bengal breed is found in Bihar, produce excellent meat. However, their population reduced sizably because of intermixing of breeds due to migration. Some educated farmers purchasing buck of Jamunapari, Beetal, Sirohi and Barbari from Uttar Pradesh and Punjab, also government scheme like "Goat development under rural condition" distributed Balck bengal and Jamunapari buck to rural farmers are playing main role in cross bred goat population. In study area Schedule tribe villages Black Bengal, Black Bengal x Jamunapari and Black Bengal *Beetal was 96.25, 1.25 and, 0% but in other villages 29.0, 40.0 and 31.0%, respectively. Farmers of urban and around area feeding more grain are interested in cross bred goat locally known as "Bagar" due to better growth rate. With the increasing demand of chevon and easy marketing farmers are inclining to cross with long ear buck like jamunapari, beetal, barbari and sirohi. Hence farmers are taking initiative for adopting breeding strategies to cope with the changing climate.

Feed and fodder scarcity and shrinkage of grazing land

In Banka district the area of grazing land (Table 2) has declined significantly ($P<0.01$) by average 51 percent during last 3 decades mainly due to large-scale privatization and barren land converted into agriculture land. The area of common property resources (CPRs) has declined by 26 to 63% during last 3 decades mainly due to large-scale privatization to help the poor. However, 49–86% of the privatized CPR ended up in the hands of the non-poor in different areas (Jodha, 1986) [10]. Despite Feed and fodder available from only July to January due to decreased rain fall but, three decades ago whole year feeds and fodder were available due to pre monsoon, monsoon and post monsoon rain. Grasses are stunted, yellowish with less biomass hence quality of grasses decreased. But in irrigated area grazing grasses are available only in march to june and in intercrop periods due to most time standing crop in the field but grasses are green, better in height and yielding more biomass. In irrigated area also grass production is less due to use of more pre and post emerging herbicides, fertilizer, insecticides and pesticides in field. With declining and erratic distribution of rain, fodder production declined 40 percent in tribal villages but inclined to 21% due to more irrigation facility in other villages. With decrease in grass land farmers shifting the grazing to stall fed like straw and some grains and collected grasses and leaves from field. Sankhyan *et al*. (1999) [11] opined that common property resources (CPR) produce 2–3q/ha of dry fodder yield under normal rainfall and reduce to 40–50% of normal with declining and erratic distribution of

rain. In a study Kumar and Pant (2003) [12] demonstrates that, the associates between goat density and area under pasture/waste lands were positive, which indicates the role of common property resources (CPRs) in small nutrient production system. The CPRs comprise of barren and uncultivable lands, cultivable wastes, permanent pastures and other grazing land and land under miscellaneous trees, crops and other fallow land. Despite of critical role of CPRs in livelihood security of rural people, the area under CPRs are continuously declining (Jodha, 1986) [10]. The availability of safe drinking water was declining rapidly. Farmers were aware about contamination of storage water by insecticides and pesticides so they provide fresh water at noon and evening at home or in field.

Reproductive disorders

The cases of Retention of placenta, Anestrus and repeat breeding are increased therefore farmers sold their female goat after five or six parturition. It may be because of less variation in grasses is available, so natural deworming may not occurs and deworming practices also not followed. Copper, cobalt selenium, zinc, and iodine are some of the trace mineral deficiencies resulting in anemia and reproductive disorders. The climate changes and its effect on tree pods would adversely affect the reproduction in sheep and goats Shinde and Sejian (2013) [13].

Productive performance

Age at first conception and calving (Table 2) was significantly ($P<0.01$) increased by 2.0 and 2.5 months, respectively from three decades ago. Average kid production per goat was 1.67 and 2.67 in present and past years which was significantly ($P<0.01$) decreased. Hence, kids delivered in one time is decreased it is mainly due to less feed availability and also due to cross breeding with larger breeds. Dey *et al*., (2007) [2] reported that female of Bengal breed comes in puberty at the age of 8-9 months whereas the age of 1st kidding is on an average 422 days and kidding interval at 250 days. This breed is highly prolific and twining percentage has been recorded as 44.5. Last age of kidding significantly ($P<0.01$) reduced to 4.5 years from 6.14 years. Farmers sold her goat earlier due to reproductive problems, infertility, disease outbreaks etc. The heat stress affects the spermatogenesis and fertility in rams (Patel, 2013) [14]. Average growth rate in male goat of tribal villages is 41.33 g/day which is reduced by 15 percent from earlier growth rate 48.78g/day. Whereas, in other villages similar growth rate (67.31 and 66.73g/day) was found. All over growth rate was 58.49 and 54.63g/day which decreased by only 6.58% hence growth rate recovered by cross breeding and grain feeding 50-100g grains /day by farmers. Decreased growth rate may be also affected by insecticide and pesticide polluted water feeding. In western Rajasthan, drinking water contains fluoride, nitrate and TSS more than tolerance levels, which affect health, production and reproduction of animals (Mittal and Ghosh, 1984) [15]. The climatic stress particularly due to heat during growth period of animal reduced the body weight gain (Patel, 2013) [14].

Table 2: Production and reproduction performances of goat under field conditions of Banka, Bihar

Si.No.	Parameters	Performance		
		1982	2016	P value
I	Permanent Pasture (%)	71.11[a]	20.28[b]	
	Tribal villages	82.5 [b]	37.88 [a]	
	Other villages	62.0 [b]	6.2 [a]	
II	Age of first conception (Month)	6.86 [a]	8.93 [b]	0.000
	Tribal villages	7.80 [a]	10.20 [b]	
	Other villages	6.00	7.77	
III	Age of first kidding (Month)	11.90 [a]	14.43 [b]	0.000
	Tribal villages	12.90 [a]	15.65 [b]	
	Other villages	11.00 [a]	13.32 [b]	
IV	Average inter kidding period (Month)	6.04	6.80	0.226
	Tribal villages	5.63	6.58	
	Other villages	6.50	7.05	
V	Av. Kid delivered in one time	2.67 [b]	1.67 [a]	0.000
	Tribal villages	2.30 [b]	1.30 [a]	
	Other villages	3.00 [b]	2.00 [a]	
VI	Last age of kidding (Years)	6.14 [b]	4.52 [a]	0.000
	Tribal villages	5.50 [b]	4.10 [a]	
	Other villages	6.73 [b]	4.91 [a]	
VII	Marketing age (Month)	8.48 [b]	6.62 [a]	0.01
	Tribal villages	6.5 [b]	4.5 [a]	
	Other villages	10.27 [b]	8.55	
VIII	Marketing weight (Kg)	13.90 [b]	10.76 [a]	0.01
	Tribal villages	7.30 [b]	5.50 [a]	
	Other villages	19.91 [b]	15.55 [a]	
IX	Adult mortality (%)	33.33 [b]	15.24 [a]	0.000
	Tribal villages	38.00 [b]	13.30 [a]	
	Other villages	29.09 [b]	17.00 [a]	
X	Kids mortality (%)	6.38 [a]	30.67 [b]	0.000
	Tribal villages	5.80 [a]	37.50 [b]	
	Other villages	6.91 [a]	24.45 [b]	
XI	Cost of treatment (Rs)		95.24	
	Tribal villages		67.50	
	Other villages		120.45	

[a,.b] Values with different superscripts in arrow differ significantly.

Spread of diseases

Cold stress causes increase the pneumonia and diarrhea like diseases, but less effect of heat stress on goat. In contrast to above result Shinde and Sejian (2013) [13] reported heat related diseases and stresses increased in sheep. Increase in Pneumonia and diarrhea like diseases due to absence of practices of deworming and less variation in grasses and more stall feeding of grasses due to less grazing land availability. Due to less rainfall variability in grasses decreased so effect of deworming through natural grasses decreased. Similarly, Dey *et al* (2007) [16] reported that toxemia and diarrhea due to parasitic infestation were found to be most common diseases at farmers field especially during onset of monsoon. Change in weather in short interval, erratic rain leads to increase of incidences and emergence of Peste des petits ruminants (PPR), haemorrhagic septicemia, enterotoxemia, contagious ecthyma etc diseases. Outbreaks of PPR like diseases occur round the year shows effect of climate change on goat farming. Increase the skin related diseases like hair loss, itching and ectoparasites reoccurrence. Under climatic change, erratic rain leads to emergence of haemorrhagic septicemia, pneumonia, skin and foot diseases in sheep (Shinde and Sejian, 2013) [13]. The extremes of hot and cold climatic conditions directly affect the health and productivity of small ruminants under extensive system of rearing (Patel, 2013) [14].

Poor availability of green grasses and more feeding practices of straw and grains increase the incidence of metabolic disease, corneal opacity and night blindness. Climate change sizably reduces the natural vegetation in grazing lands leading to metabolic disease of varying nature and poor availability of green grass, other than monsoon season increases the incidence of corneal opacity and night blindness associated with vitamin A deficiency Shinde and Sejian (2013) [13]. Climate changes reduce the natural vegetation in grazing lands leading to metabolic diseases of varying nature (Patel, 2013) [14]. Farmers were exspend average Rs. 97.50 /goat on treatment but earlier they were not interested in treatment due to unavailability of treatment facility and some of the farmers practiced indigenous method of treatment.

The kids mortality increased by 24.35% percent but adult mortality decreased by 18%. Kids mortality mainly due to poor milk yield and multiple birth in black Bengal causes less availability of milk. Increased treatment facility and awareness of farmers decrease the mortality of adult goat. The nutritional stress increases the case of pregnancy toxaemia and neonatal death due to poor milk yield and immunity, prone to many infectious diseases opined Shinde and Sejian, (2013) [13]. The increased morbidity and mortality and declined production under climate change leads to economic losses to farmer (Singh *et al.*, 2010) [17]. In goat morbidity is high but mortality is low because farmers prefer to sell their diseased goat to butcher at low price rather than risk of treatments. Hence better marketing facility of goat also decrease the mortality rate in goat. Similarly, Dey *et al.*, (2007) [16] reported that goat is under hand of the poor farmers and being less important animal for the big farmer, the information on goat diseases is mostly reported to quack. Sometime in serious condition, emergency slaughter is practiced to recover certain percentage of cost.

Marketing and economics

Due to scarcity of feed and fodder from grazing, farmers opt for early disposal of goat for mutton purposes. Rich farmers sold their goats at 8.5 month of age weighing 15.55 kg body weight where as poor farmers sold at an age of 4.5 months when they hardly attain body weight of 5.5 kg due to scarcity of feed and fodder. However, Dey *et al*, (2007) [2] reported that Male black Bengal goat is sold at the age of 12-15 months with body weight 15 kg. In tribal and other villages hardly 2% and 36% farmers respectively were interested in rearing castrated goat because it takes more time and better feeding. In current scenario, shrinkage of grazing lands, scarcity of feed and fodder from grazing lands, as a result of climate change, farmers resort to early disposal of lambs for mutton purposes (Shinde and Sejian,2013) [13]. In Banka district farmers earn Rs.4000-5000/annum from one goat by selling two kids weighing average 13-15kg @ Rs.300/kg meat weight (50% of gross weight). In which feeding cost Rs.300/goat (Rs.2 /day for 150 days). Kumar and Deoghare (2002) [19] estimated actual cost of rearing which was Rs.395 per annum with net returns of Rs.1126 per goat /annum in Mathura district.

Climate change causes extreme weather and erratic rain condition affecting the feed and fodder availability and emergence of diseases. These affect the productivity of goat and causes economic losses of framers.

Conclusion

Goat farming is very popular in Banka district in Bihar and farmers are adopting the new technologies and uses scientific managemental practices to coup up the climatic stress in goat production. It may be conferred that feeding practices in goat may be changed due to change in climatic variation like rainfall, temperature humidity etc and stall feeding in stead of grazing or browsing and semi untensive management practices will definitely improve the economic loss to the farmers in total. Health management with timely treatment will improve kid mortality also.

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