

RESEARCH ARTICLE

Productive and reproductive performance of livestock reared in drought and flood prone areas of Odisha: A comparative analysis

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Abstract: Livestock farming is an integral part of rural livelihood among farmers as income generating option for farmers in Odisha. But the rearing of livestock is greatly affected in a climatic vulnerable State of Odisha due to frequent occurrence of disaster such as flood and drought. These disasters affect the performance of livestock in terms of productive and reproductive efficiency thus denting the output desired by the farmer. This comparative analytical study attempts to understand the performance of livestock reared in flood and drought prone areas on productive and reproductive parameters and gaps in performance with established benchmark. For this study, 320 respondents (160 each from flood and drought areas) were personally interviewed with the help of structured interview schedule administered to them. The performance of livestock reared in disaster prone study area of Odisha performed below par on major parameters such as average daily milk yield, peak yield, dry period, lactation length, inter calving period and age at first calving. Mann Whitney test results at 5% level of significance pointed towards significant difference among performance of bovines reared in flood and drought prone areas of Odisha. The study results suggest

necessary policy interventions by the stakeholders of Odisha like State livestock department in consultation with farmers to devise strategies in improving the productive reproductive performance to minimize the gap in performance of livestock.

Key words: Drought, Flood, Livestock, Productive reproductive performance, Odisha

Introduction

Livestock sector has the potential to emerge as growth engine in agriculture sector and can be relied for risk mitigation and a steady livelihood. Losses faced by the farmer from other sub-sectors of agriculture can be compensated to some extent by livestock and being liquid in nature provides cushion against risk and uncertainty against climate vagaries. For resource poor households, livestock is a living savings bank account where the interest happens to be the offspring. But the potential of livestock is affected due to impact of disaster thereby on rural livelihoods and food security. Several researchers Rojas Downing et al. (2017), Patnaik et al. (2022) have stated that critical factors of livestock production were affected due to disaster like drought and floods resulting in unavailability of water, negative effect on animal production and reproduction performance, health issues, limitations in forage quantity and quality.

Negative impacts were seen on lactation length, dry period, calving interval, loss of conception and milk yield of livestock (Tiruneh and Tegene, 2018). In drought years, availability of water, green fodder and natural grasses declines resulting in animals having depressed and low feed intake leading to reduced body weight. In developing countries like India, Mohanty *et al.* (2019) opined that, damages resulting from climate extremes have gone up. These extreme events like flood and drought surely have a wide-ranging effect on livestock and farmers at large. Study found that once the issues related to production and reproduction is observed in animals, it takes 2-3 years to be restored (productivity). Therefore, documenting the productive and reproductive parameters of the livestock reared in disaster prone areas is vital. This will help policy makers and researchers to understand the productive reproductive performance dimensions

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of livestock rearing thereby devising suitable strategies to minimize disaster impact on livelihood of farmers.

Materials and Methods

The research study was carried out in the purposively selected State of Odisha, considering its vulnerability to natural disasters. Several reviews suggested the western region of Odisha prone to drought while the coastal part of the State was flood prone (Panda, 2015; Samal *et al.*, 2016; Disaster Management Plan, 2017). As depicted in **figure-1**, out of the 8 drought prone districts and 9 flood prone districts (OSDMA, 2017), two drought and two flood prone districts were selected randomly. Balangir and Nuapada districts represented the drought prone area whereas, Jagatsinghpur and Ganjam districts represented the flood prone area. From each district, two blocks were selected randomly and from each block, two villages were randomly selected thus covering 8 blocks comprising 16 villages. With the help of State livestock department, village wise list of livestock farmers was prepared for the randomly selected 16 villages. The inclusion criteria for selection of respondent were the farmer should be rearing at least one large ruminant with five years’ experience in rearing animals. Based on the aforementioned criteria, 20 respondents were selected randomly from each village. Thus, the study comprised a total of 320 respondents with 160 respondents each from drought and flood prone areas.

Household level data was collected through personal interview from 320 respondents with the help of structured interview schedule developed for the study for estimating the productive and reproductive performance of animals. Productive and reproductive performances of the animals were determined on the basis of the parameters such as peak milk yield, average milk yield per day, lactation length, lactation milk yield, dry period, number of services per conception, age at first calving, service period and calving interval. The primary data collected was analysed through statistical techniques such as mean, standard deviation and Mann-Whitney test with SPSS 26 software.

Results and Discussion

A research attempt has been made to delineate the productive and reproductive performance of livestock viz., bovines (Buffalo, Crossbred cattle, Indigenous cattle) reared in study areas of Odisha.

Productive performances of bovines reared in drought and flood areas of Odisha

The animal data recorded from the livestock farmers in the study were 67 buffaloes, 358 crossbred cattle and 374 indigenous cattle. The productive performance of bovines was ascertained through five parameters such as average lactation milk yield, average daily milk yield, lactation length, peak yield and dry period. The

field data collected and analyzed on the productive performance is as follows:

Average lactation milk yield (in litres)

Average lactation milk yield is defined as milk yield in litres from the date of calving to the date of drying. The average lactation milk yield of buffaloes, crossbred cattle and indigenous cattle was 765.82 ± 119.29 , 1528.27 ± 117.29 and 540.49 ± 123.93 respectively, in drought areas. While the average lactation milk yield of buffaloes, crossbred cattle and indigenous cattle was 649.01 ± 88.95 , 1665.92 ± 270.46 and 648.77 ± 114.85 respectively, in flood areas. In the study area, the lactation length was shortened due to compounded effect of disaster and low plane of nutrition which was visible in low lactation milk yield.

Average daily milk yield (in litres)

Average daily milk yield is operationalized as the average milk yield per animal per day of lactation length. The average daily milk yield of buffaloes, crossbred cattle and indigenous cattle was 2.43 ± 0.43 , 5.01 ± 0.43 and 1.68 ± 0.48 litres respectively, in drought areas. While the average daily milk yield of buffaloes, crossbred cattle and indigenous cattle was 1.85 ± 0.32 , 5.97 ± 0.94 and 1.82 ± 0.43 litres respectively, in flood areas (Table-1).

Lactation length (in days)

Lactation length is the length of milk producing period after calving i.e. days in milk from the date of calving to the final

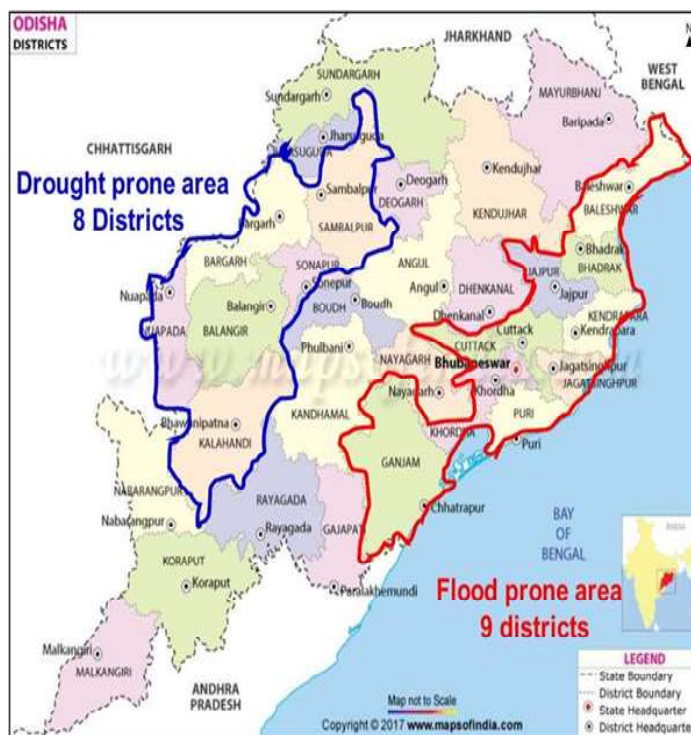


Fig. 1 Depiction of the flood and drought prone areas of Odisha

drying off or cessation of milk. The lactation length of buffaloes, crossbred cattle and indigenous cattle was 269.22 ± 4.09 , 268.62 ± 4.03 and 261.67 ± 5.12 days respectively, in drought areas. The lactation length of buffaloes, crossbred cattle and indigenous cattle was 266.56 ± 5.73 , 272.55 ± 5.65 and 266.10 ± 5.15 days respectively, in flood areas (Table-1).

Peak yield (in litres)

After parturition, the milk yield per day increases and reaches peak within 2-4 weeks after calving which is known as peak yield. The peak yield of buffaloes, crossbred cattle and indigenous cattle was 4.29 ± 0.43 , 7.37 ± 0.62 and 2.97 ± 0.53 litres respectively, in drought areas. The peak yield of buffaloes, crossbred cattle and indigenous cattle was 3.64 ± 0.39 , 8.04 ± 1.28 and 3.64 ± 0.42 litres respectively, in flood areas (Table-1).

Dry period (in days)

It is the period from the date of drying off i.e. stoppage of milk production to next calving. The dry period of buffaloes, crossbred cattle and indigenous cattle was 186.07 ± 11.35 , 139.54 ± 6.79 and 174.53 ± 21.60 days respectively, in drought areas. While dry period of buffaloes, crossbred cattle and indigenous cattle was 180.62 ± 6.55 , 133.12 ± 9.61 and 143.74 ± 5.38 days respectively, in flood areas (Table-1).

The study results had concurrences with similar studies conducted by several researchers on indigenous cattle, cross bred cattle, buffalo in familiar study areas. Kale et al. (2018) conducted a study on productive parameters of buffalo, crossbred

cattle, and indigenous cattle reared in coastal flood prone districts of Odisha. Average daily milk yield of buffalo, crossbred cattle, indigenous cattle was 3.90, 5.85, 4.09 litres/day respectively. Average lactation length of buffalo, crossbred cattle, indigenous cattle was 261.03, 273.59, 264.16 days and average dry period of buffalo, crossbred cattle, indigenous cattle was 183.38, 124.95, 131.09 days respectively. Mahakur et al. (2017) conducted a study on the productive performance of Binjharपुरi, graded Haryana and crossbred Jersey at Jajpur district (coastal region) of Odisha. The study revealed for the three different species, average daily milk yield was 3.32 ± 0.13 , 5.71 ± 0.28 and 9.17 ± 0.25 litres/ day/ animal; total average lactation yield at 830.36 ± 51.00 , 1633.24 ± 104.33 and 2956.24 ± 94.60 ; dry period was 171.72 ± 4.64 , 149.43 ± 9.49 and 149.43 ± 9.49 days respectively for Binjharपुरi, graded Haryana and crossbred Jersey.

Among the productive performance of the bovines, Mann Whitney U test result at 5 % level of significance (Figure 2) state that, there was significant difference in case of peak yield, average daily milk yield, lactation length, lactation milk yield and dry period among the indigenous, crossbred cattle and buffalo reared in drought and flood areas.

Reproductive performances of bovines reared in drought and flood areas of Odisha

The reproductive performance of bovines was investigated through four performance parameters such as age at first calving, calving interval, service period and services per conception.

Table 1: Productive and reproductive performance of bovines in flood and drought prone areas of Odisha (Mean \pm SD)

Parameters	Buffalo		Crossbred cattle		Indigenous cattle	
	Drought (n= 40)	Flood (n= 27)	Drought (n= 59)	Flood (n= 299)	Drought (n= 230)	Flood (n= 144)
Productive performance						
Average lactation milk yield (in litres)	765.82 \pm 119.29	649.01 \pm 88.95	1528.27 \pm 117.29	1665.92 \pm 270.46	540.49 \pm 123.93	648.77 \pm 114.85
Average daily milk yield (in litres)	2.43 \pm 0.43	1.85 \pm 0.32	5.01 \pm 0.43	5.97 \pm 0.94	1.68 \pm 0.48	1.92 \pm 0.43
Lactation length (in days)	269.22 \pm 4.09	266.56 \pm 5.73	268.62 \pm 4.03	272.55 \pm 5.65	261.67 \pm 5.12	266.10 \pm 5.15
Peak yield (in litres)	4.29 \pm 0.43	3.64 \pm 0.39	7.37 \pm 0.62	8.04 \pm 1.28	2.97 \pm 0.53	3.64 \pm 0.42
Dry period (in days)	186.07 \pm 11.35	180.62 \pm 6.55	139.54 \pm 6.79	133.12 \pm 9.61	174.53 \pm 21.60	143.74 \pm 5.38
Reproductive performance						
Age at first calving (in days)	1666.85 \pm 29.12	1599.37 \pm 61.77	1183.32 \pm 17.49	1092.76 \pm 34.30	1505.19 \pm 31.41	1447.59 \pm 106.02
Calving interval (in days)	456.66 \pm 9.60	453.62 \pm 10.65	415.40 \pm 9.15	409.17 \pm 10.17	436.57 \pm 24.41	414.03 \pm 6.42
Service period (in days)	142.48 \pm 4.21	148.43 \pm 12.36	132.75 \pm 8.22	126.72 \pm 11.19	157.03 \pm 22.93	134.74 \pm 9.97
Services per conception (in nos.)	2.81 \pm 0.40	2.96 \pm 0.19	2.70 \pm 0.46	2.40 \pm 0.49	2.77 \pm 0.42	2.64 \pm 0.48

Hypothesis Test Summary				Hypothesis Test Summary				Hypothesis Test Summary						
	Null Hypothesis	Test	Sig.	Decision		Null Hypothesis	Test	Sig.	Decision		Null Hypothesis	Test	Sig.	Decision
1	The distribution of Peak Yield is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	1	The distribution of Peak Yield is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.003	Reject the null hypothesis.	1	The distribution of Peak Yield is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
2	The distribution of Average Daily Milk Yield is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	2	The distribution of Average Daily Milk Yield is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	2	The distribution of Average Daily Milk Yield is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.001	Reject the null hypothesis.
3	The distribution of Lactation Length is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	3	The distribution of Lactation Length is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	3	The distribution of Lactation Length is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.013	Reject the null hypothesis.
4	The distribution of Lactation Milk Yield is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	4	The distribution of Lactation Milk Yield is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	4	The distribution of Lactation Milk Yield is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
5	The distribution of Dry Period is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.004	Reject the null hypothesis.	5	The distribution of Dry Period is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	5	The distribution of Dry Period is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
6	The distribution of Services Per Conception is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.105	Retain the null hypothesis.	6	The distribution of Services Per Conception is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.	6	The distribution of Services Per Conception is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.074	Retain the null hypothesis.
7	The distribution of Age at First Calving is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	7	The distribution of Age at First Calving is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	7	The distribution of Age at First Calving is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.015	Reject the null hypothesis.
8	The distribution of Service Period is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	8	The distribution of Service Period is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	8	The distribution of Service Period is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
9	The distribution of Calving Interval is the same across categories of Buffalo in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	9	The distribution of Calving Interval is the same across categories of Crossbred cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.	9	The distribution of Calving Interval is the same across categories of Indigenous cattle in Drought and Flood prone areas.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Fig. 2 Mann Whitney U test results for difference in productive and reproductive performance of buffalo, Crossbred cattle and Indigenous cattle bovines reared in drought and flood prone areas

Reproductive performance field data post analysis has been presented as follows:

Age at first calving (in days)

Age at first calving refers to the actual age of animal at the time of its first calving. For high life time production, the age at first calving of the livestock is very important. The age at first calving of buffaloes, crossbred cattle and indigenous cattle was 1666.85 ± 29.12 , 1183.32 ± 17.49 and 1505.19 ± 31.41 days respectively, in drought areas. While age at first calving of buffaloes, crossbred cattle and indigenous cattle was 1599.37 ± 61.77 , 1092.76 ± 34.30 and 1447.59 ± 106.02 respectively, in flood areas (Table-1).

Calving interval (in days)

This is the period between two successive calving, also called as inter-calving period. If the calving interval is more, the total number of calvings in the productive life time will be decreased and also decline in total life milk production. The calving interval of buffaloes, crossbred cattle and indigenous cattle was 456.66 ± 9.60 , 415.40 ± 9.15 and 436.57 ± 24.41 days respectively, in drought

areas. The calving interval of buffaloes, crossbred cattle and indigenous cattle was 453.62 ± 10.65 , 409.17 ± 10.17 and 414.03 ± 6.42 days respectively, in flood areas (Table-1).

Service period (in days)

It is defined as the period between date of calving and date of successful conception. The service period of buffaloes, crossbred cattle and indigenous cattle was 142.48 ± 4.21 , 132.75 ± 8.22 and 157.03 ± 22.93 days respectively, in drought areas. The service period of buffaloes, crossbred cattle and indigenous cattle was 148.43 ± 12.36 , 126.72 ± 11.19 and 134.74 ± 9.97 days respectively, in flood areas (Table-1).

Services per conception (in nos.)

Services per conception refers to the average number of artificial insemination or natural service required by the animal to become pregnant. This is a measure of breeding or reproduction efficiency of the livestock. The services per conception of buffaloes, crossbred cattle and indigenous cattle were 2.81 ± 0.40 , 2.70 ± 0.46 and 2.77 ± 0.42 respectively, in drought areas. The services per conception of buffaloes, crossbred cattle and indigenous

Table 2: Gap between ideal and existing performance of bovines on productive and reproductive parameters in flood prone areas of Odisha

Sl. No.	Productive and reproductive parameters	Ideal performance	Existing performance	GAP
1.	Average daily milk yield (in litres)			
	Indigenous cattle	3.5-4.0	1.5-2.5	(-) 1.5-2.0
	Crossbred cattle	10-12	6.0-7.0	(-) 4.0-5.0
	Buffalo	3.0-3.5	1.5-2.25	(-) 1.25-1.5
2.	Lactation length (in days)			
	Indigenous cattle	280-290	260-270	(-) 20
	Crossbred cattle	290-300	265-275	(-) 25
	Buffalo	280-285	260-270	(-) 15-20
3.	Peak yield (in litres)			
	Indigenous cattle	4.5-5.0	2.5-3.5	(-) 1.5-2.0
	Crossbred cattle	15-20	8.0-10.0	(-) 7.0-10.0
	Buffalo	4.0-5.0	2.5-3.0	(-) 1.5-2.0
4.	Dry period (in days)			
	Indigenous cattle	120-130	140-150	(+) 20
	Crossbred cattle	80-110	125-140	(+) 30-45
	Buffalo	130-140	145-160	(+) 15-20
5.	Calving interval (in days)			
	Indigenous cattle	410-420	420-440	(+) 10-20
	Crossbred cattle	365-395	400-425	(+) 30-35
	Buffalo	400-420	450-460	(+) 40-50
6.	Service period (in days)			
	Indigenous cattle	120-140	130-150	(+) 10-20
	Crossbred cattle	100-120	120-130	(+) 10-20
	Buffalo	120-130	140-150	(+) 20
7.	Age at first Calving (in days)			
	Indigenous cattle	1350-1400	1440-1470	(+) 70-90
	Crossbred cattle	960-990	1080-1120	(+) 120-130
	Buffalo	1510-1530	1580-1630	(+) 70-100

cattle were 2.96 ± 0.19 , 2.40 ± 0.49 and 2.64 ± 0.48 respectively, in flood areas (Table-1).

The study findings on reproductive performance had similarities to the study conducted by several researchers. For western dry region of Odisha, Dhal et al. (2016) studied the reproductive traits of crossbred Jersey. Their findings were 34.46 ± 0.22 months age at first calving, 505.95 ± 3.24 days calving interval, 224.20 ± 3.31 days dry period and 228.26 ± 3.21 days service period. In case of Sambalpuri buffaloes (non-descript buffalo breed) reared in Sambalpur district (western part of Odisha) and adjoining areas, Sahu et al. (2016) studied their genetic parameters. The study revealed average daily milk yield of 2.95 ± 0.08 litres; lactation length at 282.26 ± 2.69 days; lactation yield was 809.57 ± 18.75 litres; dry period was 251.15 ± 3.46 days; age at first calving and calving interval at 1488.42 ± 3.24 and 533.92 ± 2.12 days respectively.

For the reproductive performance of the bovines, Mann Whitney U test result at 5 % level of significance (Figure 2) state that, there was significant difference in case of calving interval, age at first calving and service period among the indigenous, crossbred

cattle and buffalo reared in drought and flood areas. But in case of services per conception, Mann Whitney U test result at 5 % level of significance revealed that there was significant difference for crossbred cattle reared in drought and flood area. There was no significant difference in services per conception for the buffaloes and indigenous cattle reared in drought and flood areas.

Gaps between Ideal and Actual existing Performance of bovines

With the help of Quantitative data generated at field level, it forms the actual existing performance of the milch animals in the study area. The data on ideal productive and reproductive performance of Crossbred cattle was ascertained through National Dairy Research Institute (NDRI) publications and the animals maintained at Livestock Research Centre at NDRI (available at ndri.res.in). For the buffaloes and indigenous cattle breeds reared in Odisha, the ideal productive and reproductive parameters were picked out from Odisha Livestock Resources Development Society (OLRDS) publications. Experts from NDRI, Odisha Veterinary College (OUAT) and field level veterinary doctors working with State Livestock Department of Odisha were also consulted to establish the ideal performance of the milch animals.

Table 3: Gap between ideal and existing performance of bovines on productive and reproductive parameters in drought prone areas of Odisha

Sl. No.	Productive and reproductive parameters	Ideal performance	Existing performance	GAP
1.	Average daily milk yield (in litres)			
	Indigenous cattle	3.5-4.0	1.5-2.0	(-) 2.0
	Crossbred cattle	10-12	5.0-6.0	(-) 5.0-6.0
2.	Lactation length (in days)			
	Indigenous cattle	280-290	255-265	(-) 25
	Crossbred cattle	290-300	260-270	(-) 30
3.	Peak yield (in litres)			
	Indigenous cattle	4.5-5.0	2.0-3.0	(-) 2.0-2.5
	Crossbred cattle	15-20	7.0-8.0	(-) 8.0-12.0
4.	Dry period (in days)			
	Indigenous cattle	120-130	160-180	(+) 40-50
	Crossbred cattle	80-110	135-145	(+) 35-55
5.	Calving interval (in days)			
	Indigenous cattle	410-420	430-460	(+) 20-40
	Crossbred cattle	365-395	410-430	(+) 35-45
6.	Service period (in days)			
	Indigenous cattle	120-140	145-165	(+) 25
	Crossbred cattle	100-120	130-140	(+) 20-30
7.	Age at first Calving (in days)			
	Indigenous cattle	1350-1400	1480-1530	(+) 120-130
	Crossbred cattle	960-990	1160-1190	(+) 180-190
	Buffalo	1510-1530	1640-1670	(+) 130

Gaps between ideal and existing performance of bovines on productive and reproductive parameters in flood areas

The average daily milk yield gap was quite steep at 1.5-2.0, 4.0-5.0, 1.25-1.50 litres for indigenous, crossbred cattle and buffalo respectively, shown in table-2. On similar veins, peak yield gap was very high at 1.5-2.0, 7.0-10.0, 1.5-2.0 litres for indigenous, crossbred cattle and buffalo, respectively (Table-2). Poor feeding practices have led to drastic decrease in milk yield potential of the milch animals. Lack of adequate amount of dry fodder and green fodder feeding due to unavailability at critical times was an issue stated by the farmers. In the flood areas, the water sources were contaminated which remains for a long time and unfit for consumption by animals. The lactation length decreased by 20, 25, 15-20 days for indigenous, crossbred cattle and buffalo, respectively. A steep rise in dry period was found in indigenous, crossbred cattle and buffalo at 20, 30-35, 40-45 days, respectively. To minimize the gap, the farmers ought to be made aware against

the alternative feeding practices and improved animal husbandry management. Dry fodder in the form of hay was not a major issue in flood areas but green fodder requirement was a major issue. In the flood prone districts, few respondents were found to be growing hybrid Napier grass to feed their animals. Green fodder requirement was met through cutting grasses from field bunds, pasture grass or allowing the animals to graze. The reason for such variations from the ideal may be attributed to silent heat, poor estrus detection, improper A.I and feeding practices. The gaps can be minimized by balanced feeding, timely A.I or natural service and providing adequate health care to the animals.

Gaps between ideal and existing performance of bovines on productive and reproductive parameters in drought areas

The reproductive performance of the bovines in the drought areas were unsatisfactory compared to the desired ideal performance levels. As depicted in table-3, the indigenous,

crossbred cattle and buffalo had a gap of average daily milk yield at 2.0, 5.0, 1.0 litres, respectively. Peak yield too had a gap of 2.0, 8.0- 12.0, 1.0 litres for indigenous, crossbred cattle and buffalo respectively, from the ideal performance as shown in table-3. The bovines in drought prone areas were heavily dependent on grazing for their feeding requirement. Maintenance cost per animal was also very less as the milk production was meant for home consumption with little surplus for sale. Declining performance on parameters such as lactation length, dry period and increased duration for calving interval, service period, age at first calving was seen for indigenous, crossbred cattle and buffalo (Table-3). In the drought area, the requirement of green fodder was met mostly through grazing the animals in pasture lands. In summer season with onset of heat stress and drought like conditions, the animals were devoid of both water and sufficient green grass. Hence, the effects are visible in the dismal productive and reproductive performance of the animals.

Conclusion

Disaster like drought and flood has negative impact on the productive and reproductive parameters of the livestock. There was significant difference in terms of increase in the age at first calving, inter calving interval, dry period and service period whereas, decreasing performance was found in average daily milk yield, peak yield and lactation length. To achieve the desired performance of livestock to its potential and minimize the gaps in performance requires concerted efforts from different stakeholders. Research ought to be taken up to develop suitable strategies differently for flood and drought ecosystem to overcome the productive and reproductive insufficiencies. The existing adaptation strategies for drought and flood areas such as balanced nutrition feeding and mineral mixture, restricting long distance grazing and wallowing of animals, exploring alternate and unconventional feeds, establishing community fodder banks and *pani panchayats*, carrying out artificial insemination of livestock following AM-PM rule targeting different livestock types ought to be popularized among farmers through technology interventions and capacity building programs viz. training, demonstration, awareness camps by extension functionaries and KVKs for adoption. Policy initiatives would also motivate the farmers to continue in livestock rearing as source of livelihood by streamlining the credit and insurance opportunities for farmers and strengthening the linkage support.

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References

- Dhal SK, Mishra S, Ray S, Sahoo L, Sahoo G, Dash SK (2016) Genetic Studies on Reproduction Traits in Crossbred Jersey Cattle in Western Odisha. *Exp Ani and Med Res* 6(1), 68-74
- Disaster Management Plan (2017) Panchayati Raj Department. Government of Odisha
- Kale RB, Ponnusamy K, Chakravarty AK, Mohammad A and Sendhil R (2018) Productive and Reproductive Performance of Cattle and Buffaloes Reared Under Farmers' Management in Differential Dairy Progressive States in India. *Indian J Anim Res* 52(10): 1513-1517
- Mahakur SK, Panda P, Nayak GD and Das BC (2017) Productive and Reproductive Performance of Dairy Cattle in Jajpur District of Odisha. *IndianVet J* 94(8): 74-76
- Mohanty TK, Bhakat M, Yadav H, Kumar R, Singh R, Lone S, Singh A and Shah N (2019) Impact of Climate Change on Reproductive Efficiency of Indigenous Animals. In "Management of Animal Genetic Resources under Climate Change and Socio-economic Perspectives". ICAR-National Bureau of Animal Genetic Resources, Karnal, Haryana, India, 238pp.
- OSDMA (2017) State Disaster Management Plan June- 2017. Orissa State Disaster Management Authority, Government of Odisha.
- Panda A (2015) Understanding Vulnerability to Climate Variability and Change among Small and Marginal Farmers in Odisha, India. International Conference for Agricultural Economists. August 8-14. Milan, Italy.
- Patnaik NM, Meena BS, Maji S and Kar P (2022) Strategic framework construction for sustainable livelihood of livestock farmers in drought-prone areas: A participatory approach from Odisha. *Ind J of Dai Sci* 75(5): 465-471
- Rojas-Downing MM, Nejadhashemi AP, Harrigan T and Woznicki SA (2017) Climate Change and Livestock: Impacts, Adaptation and Mitigation. *Clim Ri Mgmt* 16: 145-163
- Sahu S, Nayak GD and Karna DK (2016) Genetic Parameters of a Population of Sambalpur Buffalo of Odisha. *IndianVet J* 93(2): 47-50
- Samal P, Mondal B and Pandit A (2016) Rural Livelihood Diversification in Flood Prone Ecosystems of Odisha. *Indian J Econ Dev* 12(3): 413-420
- Tiruneh S and Tegene F (2018) Impacts of climate change on livestock production and productivity and different adaptation strategies in Ethiopia. *J Appl Adv Res* 3(3): 52-58