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Role of Livestock Sector in Sustainable Livelihood Security in Yamuna Ravine Area of Uttar Pradesh

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ABSTRACT

Livestock has been an integral part of human life since civilization started. It provides enormous opportunities to bring required growth in agriculture and households income, especially in remote and poor endowed regions. Ravines are the worst forms of land degradation caused by water erosion. The households those residents within ravine areas have low socio-economical status compared to residents of outside ravine areas. The present study explored the role of livestock in agriculture and households income in Yamuna ravine areas using both primary and secondary data. Further, this study also attempted for economic analysis of livestock and to identify significant factors that influence the households' decision to rear livestock. The livestock (particularly buffalo) contributed substantially to the household's income. Hence crop-livestock mixed farming could produce worthy results for farmers and the growth of the agriculture sector. The small ruminants per household were found less in the study areas. However, these ruminants have tremendous potential to enhance farmers' income, particularly landless, marginal, and women farmers in ravine areas. Hence rearing of small ruminants should encourage. The milk productivity of animals was low in study areas compared to country levels. The results of the logit econometric model show that household age, family size, land holdings, irrigated area, and own ravine land were significant factors for the household's decision to rear livestock. Therefore, supportive technical, institutional, and policy initiatives for improvement in breeds, animal health care, quality feed & fodder availability, and veterinary extension services are required for improving the productivity of the animal.

Key words: Livestock; Food and livelihood security; Price spread; Rural development; Yamuna ravine area.

Livestock with agriculture has been an integral part of human life since civilization started due to their multiple benefits to the society in the form of cheap and nutrient-rich food products, drought animal power, maintaining ecological balance, income, and employment (Saxena *et al.*, 2017). Livestock and agriculture are naturally linked, and livestock acts as a supplementary and complementary enterprise. This sector contributed 31.11 % to the agricultural GVA in 2016-17 (at 2011-12 prices) (Govt. of India, 2019).

In India, land degradation is a serious problem that threatens the sustainability of agriculture (Meena *et al.*, 2020). Among the various forms of land degradation, ravines are the worst manifestation of

terrain deformation by water erosion. The maximum severe ravine incidences are in Rajasthan (1884.92 sq. km), followed by Uttar Pradesh (1502.06 sq. km) and Madhya Pradesh (1481.11 sq. km.) (Govt. of India, 2010). In Uttar Pradesh (UP), ravines problems are observed mainly along the Yamuna river bank and its tributaries. The severe ravine problems are in the Agra, Etawah, Kanpur, and Fatehpur districts of UP (Singh *et al.*, 2015). The ravine lands are the most fragile ecosystem and are subjected to a magnitude of degradation imposed by climatic, edaphic, and biotic pressure. The ravine inhabitants enforce heavy pressure on ravine lands mainly for agriculture expansion, fuelwood, and fodder (Uthappa *et al.*, 2018). In ravine

areas, livelihood insecurity forces the members of low-income families to migrate to big cities from villages for employment. The households situated within the ravine area have lower socio-economic status and less access to public infrastructure and services than those outside the ravine area (Pani and Carling, 2015).

The agriculture sector is suffering from high risk and uncertainty due to climate change and the vagaries of nature. However, the livestock sector offers opportunities for sustainable and continuous employment and income to rural households (Nedunchezian and Thirunavukkarasu, 2007).

METHODOLOGY

In this study, we used both primary and secondary data. The secondary data on the output value of agriculture, livestock, milk production, etc. were collected from various issues of National Accounts Statistics of the Central Statistical Organization (CSO), Ministry of Statistics and Program Implementation, Government of India. We selected two districts, namely Agra and Etwah purposively, that have severe ravine problems in UP State, to collect primary data related. Two blocks were identified from each selected district based on the maximum area under the ravine in the blocks. From each identified block, two villages were selected randomly, and 40 respondents were selected from each selected village to make a sample

size of 320. The information on various parameters was collected using a well-structured schedule through personal household interviews. The other information was also recorded employing different methods such as focus group discussion, key informants interview, transect walk, and field observation. We used descriptive statistics to analyze the collected data.

The logit model was employed to identify the significant factors influencing households' decisions to keep livestock (Kumar et al., 2007) in ravine areas. Household age, education, occupation, family size, farmers categories (farm size), the area under rainfed agriculture, and own ravine land variables were used as explanatory variables. The dependent variable was binary, taking a value of 1 if a farmer reared livestock, zero otherwise. The mathematical expression of the logit model is specified as:

$$P_i = \Sigma (Y = 1 / X_i) = 1/1 + e^{-(b_1 + b_i X_i)}$$

Where P_i is the probability that $Y = 1$, i.e., the household rears livestock; X_{is} are the factors that influence the household's decision to keep livestock; e is the base of the natural logarithm, and β_{is} are the coefficients of the explanatory variables (X_{is}).

RESULTS AND DISCUSSION

Socio-economic profile of households : The socio-economic profile of respondents is presented in Table 1, and results revealed that about 76 per cent

Table 1. Socio-economic status of different categories of farmers in the ravine area

Particulars	Overall	Marginal	Small	Medium	Landless	
Avg. land size (ha)	1.09	0.48	1.41	2.75	-	
Household distribution (%)	-	48.75	27.50	15.62	8.13	
Family size (No.)	7.26	7.10	7.50	7.25	7.13	
Education Status (%)	Illiterate	28.38	26.91	23.63	33.0	29.97
	Primary	20.27	20.2	25.49	15.6	19.8
	Middle school	25.55	24.17	23.27	25.3	29.51
	Secondary school	16.17	18.51	15.39	16.9	13.88
	Higher Secondary & above	9.63	10.21	12.23	9.2	6.84
Age-wise distribution (%)	<35	21.21	17.88	19.02	17.19	30.77
	35-54	33.64	46.06	24.79	40.63	23.08
	55-64	31.63	19.09	37.61	31.38	38.46
	>65	13.52	16.97	18.59	10.82	7.69
Main Occupation (%)	Agriculture (crop +livestock)	40.97	40.43	49.12	74.31	-
	Private	46.46	51.06	46.12	23.55	65.09
	Business	4.64	5.31	4.76	2.14	6.34
	Mule rearing	7.94	3.2	-	-	28.57
	Migrated population (%)	18.08	21.42	18.65	8.89	22.34

of respondents are marginal and small farmers; meanwhile, about 16% are medium, and 8 per cent are landless. The average landholding was 1.09 ha, and the average family size was large (more than seven members per family). About 21 per cent of respondents were below the 35 years' age, and most households belonged to the age group of 35-64 years. Similarly, about 25 per cent of respondents had an education of secondary school level, and about 28 per cent of respondents were illiterate. Agriculture was the main occupation for 41 per cent of households, whereas 51 per cent of households were dependent on private casual work and business as the main occupation. The landless households (8%) had adopted mule rearing as one of their source of livelihood.

Share of different sectors in Agriculture in Uttar Pradesh and India : The livestock sector is a vital enterprise in the agriculture economy of Uttar Pradesh. Livestock is a significant source of income for the food security of rural households (BIRTHAL and NEGI, 2012). Figure 1 shows the share of different sectors in the output value of agriculture and allied sector for the two periods 2011-12 and 2016-2017. The livestock share in the total value of agriculture output has increased from 29 per cent in 2011-12 to 31 per cent in 2016-17 in Uttar Pradesh. Whereas the crop sector share declined significantly during this period in the state and the country. Evidence confirms that contribution of livestock sector in agriculture GVA was higher in

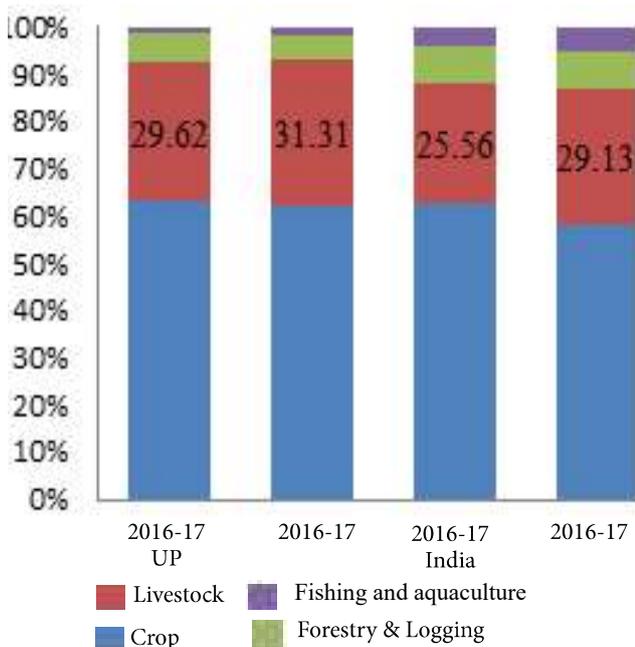


Figure 1. Share of sectors in the output value of Agriculture and allied activities

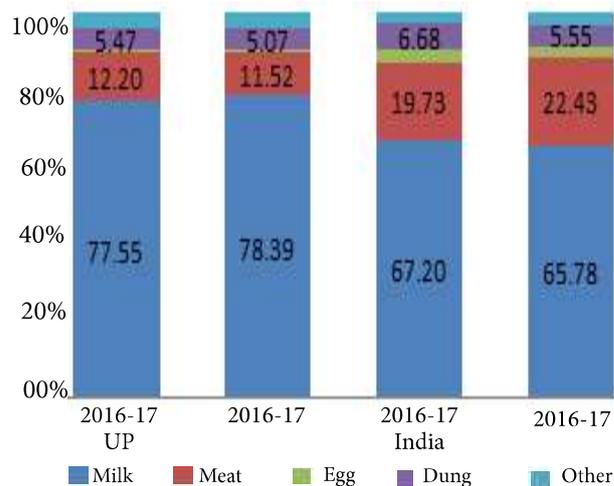


Figure 2. Share of components in the output value of livestock

Uttar Pradesh than country level.

Share of different components in the livestock sector in Uttar Pradesh and India : Figure 2 shows that the contribution of milk in the output value of livestock was highest, and its contribution was more than third-fourth of the total value of livestock in Uttar Pradesh, followed by the meat component. The share of milk has increased from 77 per cent in 2011-12 to 78 per cent in 2016-17. In India, milk share has declined from 67 per cent in 2011-12 to 65 per cent in 2016-17, whereas meat share has increased 19 per cent to 22 per cent. Uttar Pradesh has been the largest milk producer in India since 2001-02 and contributed about 16.47 per cent to all-India milk production in 2017-18 (GoI, 2019).

Share of buffalo and cows in total milk production in Uttar Pradesh and India : The buffalo has the

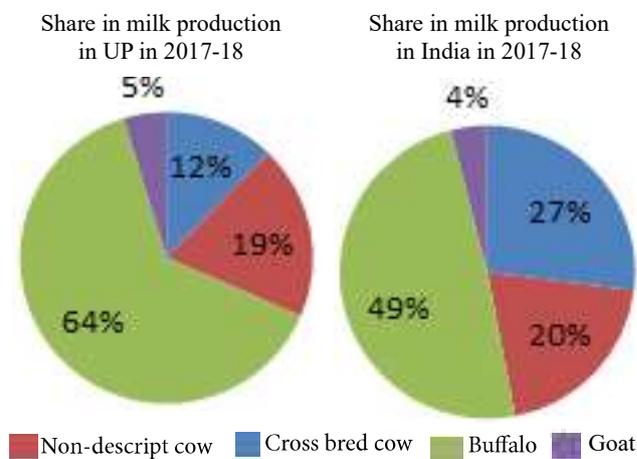


Figure 3. Species-wise share in milk production in Uttar Pradesh and India

dominant share in total milk production in UP, whereas both buffalo and cows have an almost equal share at the country level. The share of buffalo was 64 per cent in total milk production in Uttar Pradesh, and it was 49 per cent in India during 2017-18 (Figure 3). The evidence from Figure 3 confirms that there is increasing prominence and preference for buffalo rearing over cow rearing due to its high milk price,

Table 2. Average milk yield (kg/day/animal) from livestock in Uttar Pradesh and India in 2017-18

Particular	Ravine area in UP	Uttar Pradesh	India
Cross Bred Cows	-	7.15	9.64
Non- Descript Cows	3.06	2.99	3.17
Buffalo	5.89	4.49	6.34
Goat	0.50	0.78	0.45

longer productive life, and higher milk productivity. *Average milk productivity* : Livestock resources in ravine areas of Uttar Pradesh are considerable, but milk productivity of indigenous cows and buffalo was relatively low, which is evident from Table 2. The average productivity of buffalo was 6.35 liters per day in India, but it was 4.49 liters per day in UP during 2017-18. Similarly, the productivity of local cows was 3.17 liters per day at the India level, whereas it was 2.99 liters per day in UP. Thus, the milk productivity of animals is less in the UP state than the average milk productivity of the country and other states (Punjab, Haryana, and Gujarat). However, the average milk productivities of animals (except goats) were higher in the Yamuna ravine area than that of state-level but lower than that of national level. Despite this fact, there is enormous scope for improvement in the milk productivity of livestock. Enhancement in livestock productivity is required to increase the significant contribution of the dairy sector in doubling farmers' income.

Livestock population in the study area : The share of Murrah buffalo was 17 per cent, and that of non-descript buffalo was 83 per cent in the total buffalo population (Table 3). The indigenous cows mainly existed in the study area, whereas crossbred cows were almost absent. It is also noteworthy to notice that small farmers rear more animals than marginal and medium farmers. The farmers should also encourage adopting crossbred cows as researchers have reported the economic superiority of crossbred cows over indigenous cows (*Bhowmik et*

Table 3. Number of animals per household

Particular	Overall	Marginal	Small	Medium	Landless
Cow	0.96	0.92	1.39	1.02	0.52
Buffalo	1.84	1.64	2.23	2.16	0.72
Desi (%)	82.83	84.62	81.43	77.78	87.50
Murrah (%)	17.17	15.38	18.57	22.22	12.50
Number of Goat/ Household	1.66	2.16	2.46	0.20	1.83

al., 2006; Paul and Chandel, 2010). Livestock is ideal for mixed farming because of its valuable contribution to human nutrition (milk), plant nutrition (farmyard manure), and energy (cow dung). However, in the study area, the goats per household were only 1.66, whereas the population of sheep was almost nil. The rearing of small ruminants is most suitable for marginal and small farmers, landless, and women because of low input requirement, high fecundity, and assured income, employment, and nutrition. Small ruminants browse on plants and shrubs, which are less desired by other livestock species, and thus rearing of these species add flexibility to the management of livestock in the rainfed areas having low agriculture and livestock (*Kumar et al., 2006; Singh et al., 2013; Wodajo et al. 2020; Rashmi et al., 2021*). From the perspective of doubling farmers' income, food, and livelihood security, it is essential to highlight the importance of small ruminant

Table 4. Source of cooking energy (%)

Particular	Overall	Marginal	Small	Medium	Landless
Fuelwood	74.90	75.45	80.00	58.33	85.83
Crop residue	9.31	7.05	8.50	21.67	-
Animal Dung	14.09	13.18	11.50	18.33	13.33
LPG gas & Kerosene	1.92	4.32	-	1.67	1.67
Use of Cow dung (%)					
Fuel	26.64	24.41	27.14	25.00	30.00
FYM	73.36	75.59	72.86	75.00	70.00

rearing, particularly goat rearing in ravine areas.

Source of cooking energy : Results revealed (Table 4) that fuelwood from the ravine accounts for 75 per cent of total cooking fuel due to easy availability and cost-free. Moreover, the landless households were using maximum fuelwoods. Similarly, cow dung was used for about 14 per cent of total cooking purposes, and it accounted for 26 per cent of total dung production. Further, we also observed that the households

depended on the ravine areas for grazing their animal for 4-5 months of the year. Thus, the ravine ecosystem provides substantial provisioning services to the ravine residents.

Economic analysis of major livestock in Yamuna ravine : The different costs, return, and net return are presented in Table 5 and revealed that buffalo generated maximum net return (Rs 18,737 per animal) over cost A, followed by a cow (Rs 10,622) and goat (Rs 2,520). The mule rearing fetched the highest net profit of Rs 52,834 per animal among the livestock species.

Role of Livestock in farming/livelihood system : With the primacy of marginal and small farmers, Indian agriculture is governed by a crop-livestock mixed farming system. The economics of the crop-livestock farming system in the ravine area is presented in Table 6 and show that crop contributed 16.6 to 59.6 per cent and livestock contributed 26.4 to 33.0 per cent to the total net income of different categories of farmers in this farming system. The livestock was the primary source of income for marginal farmers, and it is also an equally important source of income with the crop for small farmers. This system also provided more employment than the only cropping system (Meena *et al.*, 2021). Similarly, the evidence from Table 7 confirms that livestock was an essential source of livelihood of landless households in the ravine area, and it was contributed about 13 per cent to the total income. Besides this, mule rearing was contributed 23 per cent of the total income of landless households, and it was the most profitable business for scheduled caste households. The evidence from Tables 6 & 7 confirms that livestock rearing plays a vital role in enhancing households' incomes, particularly of marginal and small farmers and landless.

Price spread in major marketing channels of milk : The results of prevalent marketing channels of milk and price spread (difference between producer price and consumer price) in channels are presented in Table 8, and results show that four major marketing channels were prevalent in the study area. All milk marketing channels were inefficient as the price spread was more than 50 per cent. The marketing channels: producer-milk collector-consumer was dominant, and it was the most efficient channel in terms of low price spread, but producer gets least milk price in this channel. In the study area and the state and country, milk marketing is mainly operated in the unorganized sector through the fragmented supply chains, including milk collectors,

Table 5. Economic analysis of major livestock in Yamuna ravine areas

Particular	Cow	Buffalo	Goat	Mule
<i>Different Costs (Rs./animal)</i>				
Cost A	16978	42722	2430	38666
Cost B	17934	44178	2705	44666
Cost C	20747	47178	3155	81166
Return (Rs./animal)	27600	61460	4950	91500
<i>Net profit over (Rs./animal)</i>				
Cost A	10622	18737	2520	52834
Cost B	9666	17281	2245	46834
Cost C	6853	14281	1795	10334

Table 6. Cost and return of Crop- livestock farming system

Farmers Category	Percentage contribution in total net income			
	Crops	Livestock	Farm Income	Off-farm Income
Marginal	16.6	26.4	43.0	57.0
Small	32.7	30.7	63.4	36.6
Medium	59.6	33.0	92.6	7.4

Table 7. Livelihood system for Landless household

Particular	Livestock	Mule rearing	Private	Total
Gross Income (Rs)	45473	49269	75143	169885
Net Income (Rs)	15667	28449		119259
Contribution in total net income (%)	13.14	23.85	63.01	100.00
Per day household income (Rs)	43	78	206	327

Table 8. Price spread in prevalent marketing channels of milk

Channels / Milk price (Rs/lit)	Producers price	Consumers Price	Price spread (%)
Producer-private dairy-retailer-consumer	30	50	60.00
Producer-private dairy-Cooperative dairy-consumer	30	52	57.69
Producer-milk collector-consumer	27	60	45.00
Producer-milk collector-processor (Shop)	27	53	51.92

private dairy, and retailers. The milk producers received lower prices (Rs 27/liter) from milk collectors (Dudhiya) as compared to the prices received from private dairy (Rs 30/liter). The private dairy was operating only in two villages out of selected eight villages, and hence, we can infer that milk producers do not have alternate options to sell their produce. It was observed that the choice of marketing channel was decided mainly by prices received by the producer, and they preferred to sell their milk to private dairies if there were existed. While interacting with the households, it was observed that milk producers were getting a better price from the cooperative dairy in the past, when these dairies were functional in study areas. Therefore, there is a need for special attention to strengthening the milk marketing network through cooperatives or private dairy for better prices. The setting up dairy processing plants with increased participation of successful cooperatives like AMUL and other private players, the dairy sector can contribute significantly in achieving a desired agriculture growth rate of state and can also lead to a significant improvement in the rural households' incomes (Verma et al., 2017).

The households were rearing different livestock species in traditional ways as a reliable source of income and cash reserve in times of emergency. The low yield of livestock was mainly due to existing low-yielding breeds, poor access to health care services, lack of quality feed and fodder, lack of technical guidance to adopt good husbandry practices, ignorance about zoonotic diseases, etc. Veterinary hospitals of State animal husbandry departments are not providing animal health care services in villages of ravine areas as these areas are in remote locations. Thus, veterinarians provide their services from veterinary dispensaries to treat animals rather than visiting villages to educate and advise farmers about feed, fodder, and animal health. As a result, most farmers are dependent on untrained personnel or self-medication. The priority policy interventions for enhancing the productivity of dairy animals are proper breeding strategies, adopting high-yielding breeds, addressing the shortage of quality feed and fodder, overcoming flaws in veterinary services, and strengthening poor extension services. To solve the problem of the shortage of quality feed and fodder, there is a need to adopt a comprehensive approach that encourages the cultivation of high-yielding fodder varieties on-farm bunds adoption of agroforestry Silvi-pastoral practices on community land and wastelands.

Factors affecting the decision of livestock rearing : Households' decisions to keep livestock are affected by many household variables and the surrounding socio-economic environment. We have estimated these explanatory variables, and the results are presented in Table 9. The effect of household age had a negative and significant influence on the decision of livestock rearing, implying that young households perceive higher benefits from livestock rearing. The family size was used as a proxy for the availability of labour for livestock rearing. The coefficient was positive and significant, implying that sufficient availability of family labour enabled livestock rearing. The coefficient of other variable variables like household education and agriculture occupation was positive and non-significant. The relationship between farm size and livestock rearing was found positive, and it was significant in the case of small farmers as compared to marginal farmers, which indicated the existence of positive crop-livestock interaction. It was assumed that feed and fodder availability increased with increased landholding size.

Similarly, there was a positive relationship between livestock rearing and irrigated land and own ravine land, as their coefficients were positive and significant. It indicates that irrigated land assures the availability of fodder throughout the year. The coefficient of

Table 9. Factors influencing farmers' decision to keep livestock in Yamuna ravine area

Explanatory variables	Coefficient	SE
Age of household head (years)	- 0.050**	0.023
Education of household head (literate=1, otherwise=0)	0.054	0.0679
Cast (SC=1, otherwise=0)	-1.627**	0.815
Family Size	0.273*	0.152
Farmer categories (Marginal = reference category)		
Small farmers	1.386***	0.269
Medium farmers	0.124	0.335
Occupation (Agri.=1, otherwise=0)	0.057	0.808
Number of migrated family persons (workers)	-0.217	0.328
Rainfed land (if > 50 per cent of total land is rainfed=1, otherwise =0)	-2.491***	0.773
Own ravine land (ha,)	0.493**	0.223
Constant	2.80*	1.69
R ²		0.43

Schedule Caste (SC) was negative and significant and is attributed to poor resource endowments available to the schedule caste. Besides, schedule cast people were mainly dependent on labour wages for their livelihood. Thus, the SC labourers may face trade-offs between allocating their labor for wage-earning and rearing livestock to supplement their household income. The positive coefficients for households whose primary occupation was agriculture were expected, as these households would like to maximize their income by pursuing agricultural and allied activities.

CONCLUSION

This study explored the role of livestock in food and livestock security of households in Yamuna ravine areas. Further, the share of livestock in value of agriculture output, different components in livestock output, average milk productivity, the economics of major livestock, and factors influencing households' decision to rear livestock were also explored. The contribution of livestock, particularly buffalo, was substantial in agriculture growth and households' income, especially landless, marginal, and small farmer. Hence crop-livestock mixed farming could produce worthy results for farmers and the agricultural sector in Uttar Pradesh. The household was rearing only goats among small ruminants, and the population of goats was only 1.66 per household. Many researchers have highlighted that small ruminant have massive potential in ravine areas to enhance the income of households,

particularly for landless, marginal, and small farmers. Hence rearing of these animals should encourage. The milk productivity of animals was low in study areas compared to all India level and other states (Punjab, Haryana, and Gujarat). Therefore, supportive technical, institutional, and policy initiatives for improvement in breeds, animal health care, quality feed & fodder availability, and veterinary extension services are required to improve the animal's milk productivity. The prevalent marketing channels of milk were inefficient as the price spread was more than 50 per cent. The milk producer received higher prices from private dairy than milk collectors (Dudhiya). Therefore, there is a need to set up dairy processing plants with increased participation of successful cooperatives like AMUL and other private players to improve the farmers' incomes significantly. The logit model results showed that household age, family size, caste system, land holdings, and irrigated area were crucial drivers influencing the households' decision to rear livestock. The livestock sector has a vital role in households' food and livelihood security. In conjunction with research institutions and successful cooperatives, the UP-state governments have to play a prominent role in providing access to livestock development programs and services to the livestock keepers in remote areas, especially in ravine areas, for the potential use of multi-benefits of the livestock sector.

CONFLICTS OF INTEREST

The authors have no conflicts of interest.

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