Livestock Income in Rural Households in India: An Empirical Analysis

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Abstract

Historically, India has been an agrarian economy and it is true even today. But there have been marked changes in agriculture and especially in allied sector. There is an observable shift towards livestock sector as seen in increasing share of livestock sector in agricultural GDP. This paper tries to analyse the drivers of this shift with the use of NSSO 77TH Round, Situation Assessment Survey of Agricultural Households, 2019. In this paper, focus has been given to finding out the significant household characteristics that have a bearing on ownership of livestock and income derived from it, by agricultural households. An empirical approach has been used to create an explanatory model of livestock ownership and preference. Further, the paper also provides for theoretical backing of statistical results with help of existing literature and also new insights.

Introduction

About 70% of India lives in rural areas and about two-third of them are directly dependent on agriculture and allied activities. The share of agriculture in country's GDP continues to decline and there are difficulties in shifting the dependent population to other remunerative avenues. Because of this, there has been an increased focus on high value agriculture and impetus on livestock and fisheries sector. The livestock sector can be a resilient force in agricultural transformation because of its unique characteristics. Livestock sector can provide livelihood for landless, small and marginal farmers who constitute 90% of total farmers. At the same time, it can address the issues of increasing protein requirement owing to rapidly increasing population and changing dietary habits. Also, it can strengthen the backward and forward linkages between agriculture and manufacturing (via food processing). Having listed all the beneficial impacts of livestock sector on rural economy in particular, there is a pressing need to study what are the drivers of livestock and animal husbandry at the household level. How does a household make an economic decision to take up livestock rearing? Or to put it the other way, what household characteristics enhances a household's propensity to diversify their livelihood towards livestock sector? What factors correlate to the net income earned from livestock holding?

Several studies as mentioned in literature review, point towards various dimensions of livestock sector but at aggregated levels like state and national level. There are certain gaps in literature which this paper tries to fill. As possession of land is taken as one of the explanatory variables, the paper also tries to look into 'inverse farm size- productivity' hypothesis in context of livestock sector.

So, the focus of this paper will be to broadly assess the relation between various household level characteristics on income earned from farm animals.

Literature review

The literature in livestock sector has been rapidly evolving in last few decades. This is due to increasing impetus on diversification of agrarian economy to allied sector and industrial sectors. Livestock development is becoming a policy focus in various Government policies and programmes in recent times. So, not only private researchers but also Government think tanks like ICAR and NITI Aayog are producing seminal literature in the field.

Firstly, when we look into the studies that brings out a comprehensive picture of the livestock in India then studies by Birthal and Negi deserves mention. They have used an empirical approach to quantify various determinants and impacts of livestock holding on various parameters like poverty alleviation, reduction of inequality (linked to inequality in land holdings among agricultural households). Furthermore, these socio-economic impacts of livestock like promotion of socio- economic mobility, a fairer distribution of the income among households and engagement of more women in the sector (thus fostering women empowerment) are also pointed by Chaudhary and Singh (2019) and Rola, Degaldo and Antiago, 2006. The former study points out stark findings in Punjab which is one of the highest livestock owning state along with highest land inequality indicators. It un-ambiguously supports the equality smoothening effect of livestock. It can be seen that share of livestock in total income is higher for lower quintiles compared to higher quintiles which is contrary to share of crop farming. Since livestock is labour intensive, it is not preferred by large farmers except for the commercial livestock rearing which requires large investment.

According to Raya and Srivastava, the link between land ownership and income inequality is quite strong. It looks into decomposition of contributors to inequality and finds out that land size explains maximum income inequality in agricultural households. The link between livestock intensification and small landholders has also been testified by Rola, Degaldo and Antiago, 2006 in context of Philippines. This provides an external validity to the researches done in Indian context specifically.

Another study that focuses on similar issue with similar dataset is by Shankar Rao(2017).The study uses the Situation Assessment Survey of Agricultural Households to understand the link between caste-based discrimination and agricultural performance using various input level analysis. It looks into access to various inputs and extension services which can translate into differential output based on differential accessibility of different social groups(SCs, STs, OBCs and others). Caste shapes economic outcomes through various channels like cooperation among communities (Dreze and Sen, 2002), access to resources (Anderson, 2011) etc. Although the research does not focus on livestock sector in particular which leaves scope for further studies to analyse caste impacts in livestock outcomes too.

Jothilakshmi, Thirunavukkarasu and N. Sudeepkumar(2014) analysed the impact of exit of youth and feminisation of livestock farming and it may prove to be detrimental to economic health of rural households. The paper points out that 85% of rural women are engaged in livestock sector in India.According to NSSO estimates (2013) livestock employed highest share of female employees among all the rural occupations. The paper highlights the

symbiotic relation between livestock and crop farming. It also supports the view that smallholder livestock production is more environmentally sustainable compared to large farms.

So, these socio-economic impacts of livestock sector provide an impetus to study the economics of livestock and its linkages with the crop sector. According to Anagol, Etang and Karlan(2013), the returns on farm animals like cow and buffalo are negative if all imputed costs are taken into account. Orazio Attanasio and Britta Augsburg (2017) have countered this observation and present evidence from district Anantpur in Andhra Pradesh which shows that return is negative for some time periods but it is also positive for other time periods and possibly very high. Although livestock holding decisions are not optimal but they are not counter to market tenets of profitability as posited by Aangol et al. Bairwa et al focuses its analyses on population, production and trade in livestock sector thus enlarging the potential of livestock in exports and processing. Growth in exports of livestock products has been a driver of growth in the sector in post liberalisation era.

Pandey and Mishra(2011), in a study published in ENVIS Bulletin Himalayan Ecosystem, analyse the linkage between household characteristics (family size, social status etc) and fodder requirements for livestock in mountainous regions of Uttarakhand. It finds that scale and composition of livestock varies with household characteristics. Although a single regression does not yield any significant parameters but a step wise regression revealed that family size, time spent and social status are significant parameters in determination of fodder extraction. This reflects that with more labour available in family fodder extraction rises. So, there can be an obvious linkage in family size and livestock preference through the channel of fodder collection for the livestock. The study also finds that livestock ownership is considered a social status symbol in the region.

Further, there are circular linkages between farming and livestock (Bairwa and Varadan et al). Livestock provides draught power, manure etc for crop production and in turn agriculture provides for fodder requirements of the livestock sector. The sector acts as an insurance for farmers in bad times like in case of crop failure. This has led to increasing diversification towards livestock sector. So, the next set of literature explores this dimension.

Joshi and Gulati et al (2004), studied the diversification of agriculture using Simpson Index of Diversity for South Asian countries. It supports the diversification towards livestock for the reasons like meeting nutritional demands, providing livelihood to landless and small & marginal farmers and sustainable use of natural resources. The study uses GLS estimates with fixed effects to examine the influence of different forces like profitability, climate, demand etc on agricultural and livestock diversification. It is also seen that regression coefficients were highly significant and positive for small landholders. Within India, there are spatial differences in extent of diversification to livestock which indicate the role of spatial characteristics too.

Apart from this literature which supports/drives the agricultural diversification towards livestock, there also exist a segment of literature which counter this growing trend of animal rearing at commercial levels.

Srinivasan(2015) highlights the concern of animal vulnerability among other ecological concerns. It highlights that protein demand as reflected in demand for meat and dairy sector

has grown manyfold not only in prominently meat-eating countries but also previously vegetarian countries. Further, the paper shows that socio-cultural linkages and global food systems also have strong linkages with growth of livestock.This leads to ethical concerns in context of animal rights and also environmental impacts of largescale livestock rearing.

Having studied the socio-economic dynamics of the sector and various factors that impact livestock income, there is a need to model them into various kinds of models. Livestock is basically a bio-physical system as various biological, economic and physical factors drive it. International Food Policy Research Institute(IFPRI) has pioneered modelling of bio-economic models. This kind of models deal with biological, physical and economic factors in a system where their interactions are modelled for integrated understanding, forecasting, monitoring. These models can further become an input into policy making for dynamic transformation.

Agriculture and its allied sector are also akin to a bio-physical system and various bio-economic models have come up.The Farm System Simulator Model (FSSIM) (Louhichi et al., 2009) was developed within the SEAMLESS project in response to the need for research on public policy impacts in the EU. It aims to provide policymakers with "an integrated tool for ex-ante impact assessment of agricultural, environmental and rural development on the sustainability of agriculture and sustainable development" (Louhichi et al., 2009). FSSIM-MP seeks to describe farmer's behaviour given a set of biophysical, socio-economic and policy constraints, and to predict farmer decision-making responses under new technologies, policy market and environmental changes. FSSIM is applicable to crop-based and livestock-based farm types. Three different livestock activities can be modelled in FSSIM, namely dairy, beef, and small ruminants (sheep and goats).

Since India is not yet transformed to exclusive large scale commercial livestock systems, Integrated farming systems (IFS) are more relevant in Indian context (Wright, Tarawali et al, 2011). *Integrated farming system (IFS)* is a broadly used term to explain the suitability of a more integrated approach towards farming over monoculture approaches. In this system, an interrelated set of enterprises are maintained and by-products or wastes from one production system becomes an input for another production system, which reduces cost and improves production and/or income (Patra, 2016). Thus, IFS works as a system of systems (Soni *et al.*, 2014). It is an environment friendly approach as it focuses on the concept that there is no waste but a misplaced resource to be used somewhere else. This kind of system proves beneficial for small and marginal landholders. This can also help landless farmers if they partner with the land-owning farmers by supplying certain inputs from their livestock holdings. Various models have been developed based on this like rice-fish culture, fish-pig cultureetc. There are added advantages to IFS like productivity, profitability, sustainability, income round the year, recycling and addressing food crisis (Patra and Samal, 2018).

In the evolving literature in field of livestock, this study will be an addition to literature as it utilises the latest available data and focuses on various dimensions of livestock sector instead of just economic determinants. It incorporates various inequality inducing factors like social groups, land holding etc within the framework of analysis. Also, instead of focussing on specific outputs like milk, wool, egg etc for analysis, here net total income has been used which provides overall income potential of the livestock.

Data description

The National Statistical Office (NSO) carried out a survey on Land and Livestock Holdings of Households and Situation Assessment of Agricultural Households in the rural areas ofthe country with an integrated schedule of enquiry. The survey has been conducted during the period, January 2019 to December 2019. Information was collected primarily for the agricultural year 2018-19 in two visits (visit-1: information was collected for July-December 2018 and visit-2: information was collected for January-June 2019) and information was collected from the same set of sample households in two visits.

In the rural areas, 5,940 first stage units were surveyed in visit-1 covering 58,035 households and 5,894 first stage units were surveyed in visit-2 covering 56,894 households. The survey covered the whole of rural India except the villages in Andaman and Nicobar Islands which are difficult to access. With an objective to generate a widerinformation base related to land use and agricultural activities of rural/ agriculturalhouseholds the Working Group of NSS 77th round decided to use an integrated surveyinstrument (Schedule 33.1) which had provision for collecting detailed information on landuse, ownership of livestock and aspects related to farming activities from the same set ofhouseholds.
A group of persons who normally lived together and took food from a common kitchen constituted a household.An agricultural household in general is defined as an 'agricultural production unit'which produced field crops, horticultural crops, livestock and the products of any of the otherspecified agricultural activities with or without possessing and operating any land.
An agricultural household for 77th Round survey was defined as a household receivingvalue of produce more than Rs. 4000/- from agricultural activities (e.g., cultivation of fieldcrops, horticultural crops, fodder crops, plantation, animal husbandry, poultry, fishery,piggery, bee-keeping, vermiculture, sericulture, etc.) and having at least one member self-employedin agriculture either in the principal status or in subsidiary status during last 365days.
The survey also collects data on access to various agriculture related schemes like Kisan Credit Card, MNREGA, Soil Health Card etc which gives a holistic assessment of not only status of agriculture and allied activities but also an assessment of efforts by government.
The survey questionnaire has been divided into various blocks. For this study, we make use of only certain blocks which provide the information on variables considered.
The data is well suited for the study as it provides a number of household level indicators across the country. It is the latest data available in the field with limited number of studies being done with it. Data is reliable on account of being conducted by NSSO on such a large scale and a robust sampling and collection methodology.
Certain limitations of the dataset are that this household level data is difficult to combine with other datasets. This poses difficulty in bringing variables from other sources for analysis purposes. Also, since there are certain changes in survey methodology in this edition of survey, it may pose difficulty in comparable results from previous edition.

Variables in focus:

Total income earned from farming of animals: Livestock are those animals which are used for food, fibre, labour, etc. Animals kept as pets, snakes, reptiles, frogs, fishes are excluded from the coverage of livestock.The total value of output is worked out by adding value of self-consumed products, value of products retained for future sale, used as animal seeds and receipts from sale to outside agencies (including other households).

Input cost: This has been calculated as sum of the paid-out expenses and imputed costs as reported by respondents. It includes costs like animal 'seeds', animal feeds, veterinary charges, interest, lease rent for land, labour charges, cost of livestock insurance and other expenses for the farming of animal activity during reference period of last 30 days will be recorded in whole rupees. In this current analysis, input cost has been used for annual basis. Although paid out expenses are easier to calculate but imputed costs are quite subjective as no real out of pocket flow is being observed.

Net income from livestock: This is the key variable of interest in the study and it has been calculated from above two variables (total income from farming of animals and input cost). It is defined as the income over and above the paid-out expenses and all the imputed costs. Since this variable has a very large spread and skewness, a log transformation of the variable has been used.

Land possessed: Land possessed by a household is defined as land owned (including land under 'owner like possession') + land leased in - land leased out + land otherwise possessed (i.e. neither owned nor leased in) by that household.

Household size:A group of persons normally living together and taking food from a common kitchen will constitute a household. The number of members of a household is its size.

Livestock unit: The survey collects number of livestock under different categories like cattle, buffalo, bovine, other large heads etc. But these cannot be used directly in the analysis as they have different output potential, breeding and feeding patterns, stocking structures etc. So, a transformation to standardised livestock units has been done using FAOSTAT methodology. Livestock Units (LSU) are a reference unit which facilitates the aggregation of livestock from various animal cohorts and species, via the use of specific coefficients, established initially on the basis of feed requirements of each species and category (Eurostat, 2013; Eurostat, 2016). The reference unit used for the calculation of livestock units (=1 LSU) is the grazing equivalent of one adult dairy cow producing 3000 kg of milk annually, fed without additional concentrated foodstuffs. We use Regional Livestock Unit coefficients for South Asian region (released in October 2022).

Table 1. Regional Livestock units (LSU) coefficients*

	Livestock Types**									
Region	**CT**	**BF**	**SH**	**GT**	**PG**	**AS**	**HS**	**MS**	**CM**	**CH**
North America	1	---	0.15	0.1	0.25	0.5	0.8	0.6	---	0.01
Caribbean	0.6	0.6	0.1	0.1	0.2	0.5	0.65	0.6	---	0.01
South Asia	0.5	0.5	0.1	0.1	0.2	0.5	0.65	0.6	---	0.01
Near East and North Africa	0.7	0.7	0.1	0.1	0.2	0.5	0.4	0.6	0.75	0.01
East and South East Asia	0.65	0.7	0.1	0.1	0.25	0.5	0.65	0.6	0.8	0.01
Transition Markets	0.6	0.7	0.1	0.1	0.25	0.5	0.65	0.6	---	0.01
Africa South of Sahara	0.5	---	0.1	0.1	0.2	0.3	0.5	0.6	0.7	0.01
Central America	0.7	---	0.1	0.1	0.25	0.5	0.5	0.6	---	0.01
South America	0.7	---	0.1	0.1	0.25	0.5	0.65	0.6	---	0.01
OECD	0.9	0.7	0.1	0.1	0.25	0.5	0.65	0.6	0.9	0.01
Other	0.6	0.6	0.1	0.1	0.2	0.5	0.65	0.6	---	0.01
South Africa	0.7	---	0.1	0.1	0.2	0.5	0.65	0.6	---	0.01
Near East	0.55	0.6	0.1	0.1	0.25	0.5	0.56	0.6	0.7	0.01

*FAO, 2011; **CT=Cattle; BF = Buffalo; SH = Sheep; GT = Goats; PG = Pigs; AS = Asses; HS = Horses; MS = Mules; CM = Camels; CH = Chickens

For this analysis, sub-categorisation like in-milk, young stock etc have been done away with for simplification purposes. Bovines(includes sheep, goats, pigs etc) have been reported cumulatively, so they have been given an average weight of these included animals equal to 0.134. Similarly, coefficient for 'other large heads' is taken to be 0.58. There is an additional category in survey as 'others' which has been given a default weight of 0.1.

Index of accessibility to technical knowledge: Livestock choices can be largely influenced by availability and accessibility of information at disposal of agricultural households. The survey collects information on a number of sources of technical knowledge dissemination like progressive farmers, Krishi Vigyan Kendras, toll free helplines, input dealers etc. So, an index has been created by clubbing the number of sources accessed by the farmer and whether the information is utilized or not. The index takes a value 1 if atleast one of the sources of technical knowledge dissemination has been accessed by the agricultural households.

Level of education:A dummy has been considered taking literacy as 1 and illiteracy as 0 at the household level. So, even if one of the members is literate in the households then the education dummy takes a value 1.

Religion: Household religion has been categorised into five: Hinduism, Islam, Christianity, Sikhism and Others (including Buddhism, Jainism, Zoroastrianism).

Social category: Social groups have been characterized into four categories namely, scheduled caste, scheduled tribe, other backward classes and others.

States for regional variation: State of the household has been recorded. For the purpose of study, the states have been grouped under five categories based on geographical criteria. And UTs have been clubbed under one category.
1.**North**- Jammu & Kashmir, Himachal Pradesh, Uttarakhand, Punjab, Haryana.
2.**West- Central**- Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Uttar-Pradesh, Goa.
3.**East**- Bihar, Jharkhand, West Bengal, Chhattisgarh, Odisha.
4.**North East**- Arunachal Pradesh, Nagaland, Manipur, Sikkim, Assam, Meghalaya.
5. **South**- Tamil Nadu, Karnataka, Andhra Pradesh, Kerala, Telangana.
6. **Union Territories**- Delhi, Chandigarh, Lakshadweep, Andaman & Nicobar, Pondicherry, Dadar & Nagar Haveli, Daman & Diu.

One caveat here is that Jammu and Kashmir has been taken under states instead of Union Territories.

Descriptive statistics:

	House~ze	Land_p~d	Livest~t	SGC_du~y	Anim_i~o	Religi~y	Educ_d~y
Households~e	1.0000						
Land_posse~d	0.1689	1.0000					
Livestock_~t	0.1276	0.2043	1.0000				
SGC_dummy	0.0248	-0.0328	0.0262	1.0000			
Anim_info	-0.0470	0.0115	0.1260	0.0155	1.0000		
Religion_d~y	-0.0215	0.0086	-0.0382	-0.0770	-0.0140	1.0000	
Educ_dummy	0.2497	0.0525	0.0106	-0.0261	0.0066	0.0258	1.0000

The above matrix shows the correlation between different explanatory variables and it can be inferred that there is no problem of multicollinearity among the explanatory variables.

Variable	Mean	Std. Dev.
lnNet_Income	*9.825784*	*1.320904*
Householdsize	*5.147315*	*2.384957*
Land_Possessed	*1.059796*	*1.378093*
Livestock_Unit	*1.552100*	*1.956308*

Above table shows the summary statistics of the numerical variables used in the paper. Here, mean net income from livestock is around Rs.18500 per annum. Mean household size is 5 members with an average holding of 1 hac.

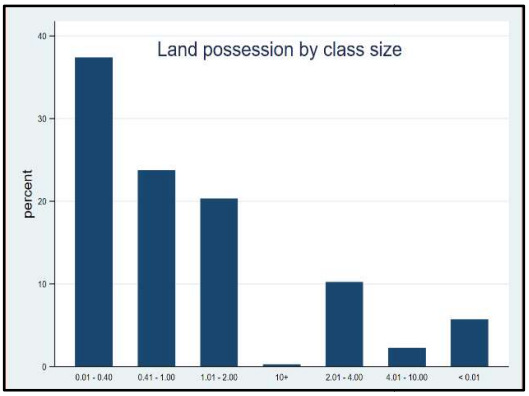
	Religioncode					
SGCode	Buddhism	Christian	Hinduism	Islam	Jainism	Total
Other Backward Class	20	121	12,295	1,493	2	14,082
Others	13	209	5,887	1,368	9	8,001
Scheduled Caste	90	64	4,858	62	0	5,233
Scheduled Tribe	217	2,003	4,986	157	4	7,772
Total	340	2,397	28,026	3,080	15	35,088

	Religioncode			
SGCode	Others	Sikhism	Zoroastri	Total
Other Backward Class	29	122	0	14,082
Others	6	509	0	8,001
Scheduled Caste	10	149	0	5,233
Scheduled Tribe	397	5	3	7,772
Total	442	785	3	35,088

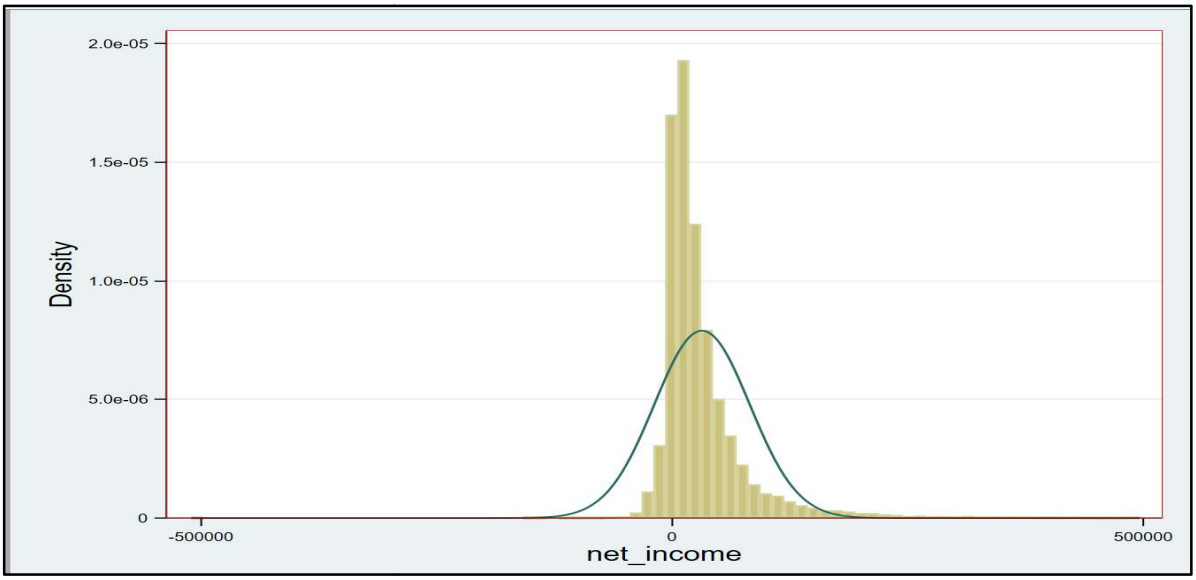
Above tables represent the cross-tabulation of distribution of religion and social group among sample households.

(max) educ_dummy	Freq.	Percent
0	4,393	7.57
1	53,647	92.43
Total	58,040	100.00

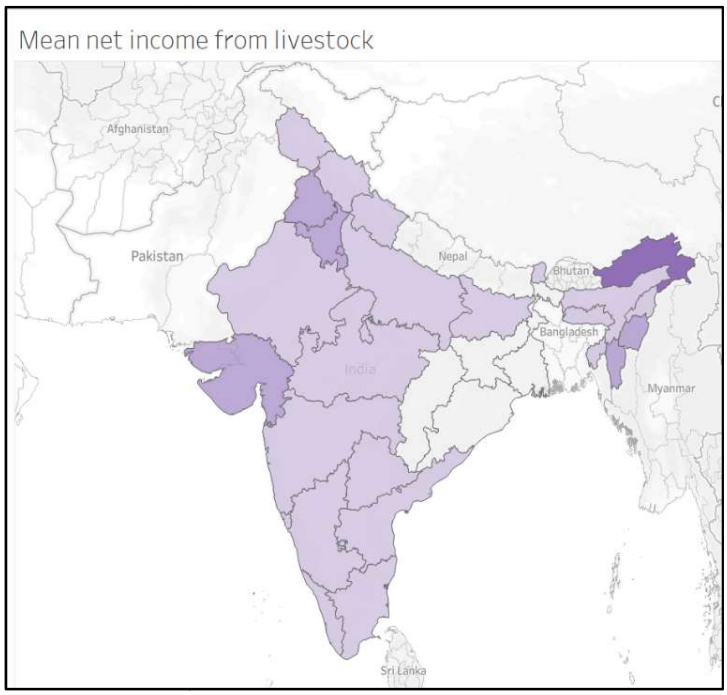
Above table represents the percentage of households by literacy. It takes a value 1 if at least one member is literate.



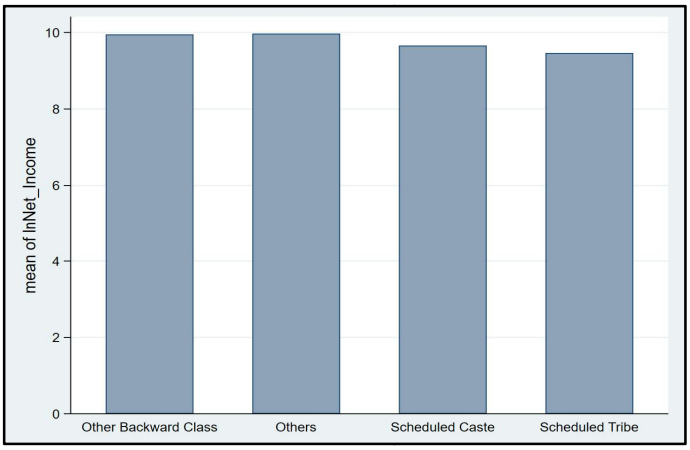
Above histogram shows the land ownership structure by class size. It can be seen that about 80% of households own less than 2 hectares of land. Average land holding size in India is less than 1 hectare per household. So, the focus group in livestock development and diversification is these small and marginal landholders.



Above graph shows the distribution of net income with the help of a histogram. A normal curve has been superimposed for reference and it can be seen that net income is almost normally distributed but it is little skewed to left.



Above graph shows the spatial distribution of mean net income (MNI) from livestock across the states. Here, darker colour represents higher net income. As it can be seen that Arunachal Pradesh has highest MNI followed by states like Haryana, Punjab, Gujarat, Manipur and Mizoram. Highest MNI in Arunachal Pradesh is interesting and it may be due to low input cost and use of traditional methods. Similar, reasoning goes valid for Manipur and Mizoram too. For Haryana and Punjab, it is because of the demand side effect for the livestock products and also higher quality livestock holding. Most of the states in southern India and western central part have similar MNIs, this shows the equalizing distribution of livestock income compared to crop sector. Here, it is also seen that eastern states like Jharkhand, West Bengal, Chhattisgarh and Orissa have lowest MNIs.



Social groupings have an impact on ability to extract income from any economic activity. Here also it can be observed that Scheduled caste and Scheduled tribes have a visibly less mean net income compared to other social groups. This can be attributed to differential accessibility, affordability of various economic resources and also social capital dividends. It also propagates vicious cycle of poverty among these social groups. Across the religious groupings no stark differences are observed. Although it can be noted that agrarian communities like Sikhs and Hindus also have higher livestock incomes.

Methodology

In this paper, we try to model the Indian livestock sector scenario. So, there are agricultural households who derive income from both farm and non-farm activities and agriculture and livestock too. There is no clear distinction between farmers solely concentrating on farming and those who are exclusively engaged in livestock rearing except for a few cases of commercial livestock production eg broiler farms. So, there are input and output circulatory linkages in both activities.

Based on this background, we try to assess the determinants of livestock sector growth in general and the determinants of income from farm animals (dependent variable) in particular. For this purpose, the paper uses a multivariate OLS regression with specification of dummies and fixed effects. The variables as explained under data description section have been identified based on theoretical background, existing literature, economic reasoning, constrained by availability of data. The model builds upon various empirical papers like Birthal and Negi(2012), Gulati et al(2004) who use multivariate regressions for analysis of livestock sector. No claims for exhaustive identification of variables contributing to farm animal income have been made.

Variables included can be categorised under three heads- social (Social group, religion), economic (land ownership, input cost, anim_info, education etc) and spatial (state groups).

The equation for analysis:

lnNet_Income= $\beta 0+\beta 1$(Householdsize) + $\beta 2$ (Land_Possessed) + $\beta 3$(Livestock_Unit) + $\beta 4$(Anim_info) + $\beta 5$(i.SGC_dummy)+ $\beta 6$(i.State_dummy) +$\beta 7$(i.Religion) +$\beta 8$(i.Educ_dummy)

Logarithmic transformation has been used for the variables which had very dispersed spread in values where mean turns out to be less than standard deviation.

Econometric tests were applied so as to ascertain the presence of various fixed effects like state level fixed effects. The idea is to capture the unknown factors which may be common across a state like soil, vegetation, rainfall, temperature etc and may impact the variables of interest.

Findings

	lnNet_Income	lnNet_Income
Householdsize	*0.0253****	*0.0267****
	(0.003)	*(0.0038)*
Land_Possessed	*0.0495****	*0.0536****
	(0.006)	*(0.0062)*
Livestock_Unit	*0.165****	*0.167****
	(0.005)	*(0.0052)*
Anim_Info	*0.369****	*0.354****
	(0.0257)	*(0.0257)*
Educ_dummy	*0.153****	*0.161****
	(0.0433)	*(0.0435)*
Religion_dummy	*0.126****	
	(0.0107)	
SGC_dummy	*0.0111*	
	(.0074)	
State_dummy	*-0.0590****	
	(0.0079)	
Intercept	*9.166****	*9.105****
	(0.0472)	*(0.0433)*
R squared	*0.1395*	*0.0804*
N	19589	19589

Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

- Land possession turns out to be highly significant and coefficient value is high and positive. A 1 unit increase in land holding will increase net livestock income by around 5%.An intuitive reason may be that people who possess more land have more livestock simply because of the resources at their disposal like money to buy high value livestock which turns into higher livestock income. Also, with decrease in common grazing grounds and non-entry into forested lands, increases the cost of

livestock rearing for small and marginal landholders. This reduces net income for small and marginal landholders.

- Household size is like a proxy for labour as an input to livestock rearing. Since there is no distinction between who is actually involved directly, we take it as if every member engages in the activity like a family enterprise. The assumption falls apart when we consider large commercial livestock farming setups, but such observations are very few in the sample considered here. Here, household size turns out to be a significant factor and positively related to the net income. An increase in household size by 1 member will lead to 2.53% increase in net income. So, the labour input still has increasing returns in livestock sector. Further, we can infer that keeping other inputs constant like land, as family size increases, the household will be more inclined to own livestock as a complementary economic activity to crop farming.
- One crucial input in the livestock sector is number of animals like cattle, goat, sheep etc owned by the household and their quality. Here, we use livestock units as a combination for both. The results show that a unit increase in livestock unit increases net income by 16.5%. This shows a strong and highly significant and positive relation to the dependent variable.
- Information and education inputs are crucial at two stages, initially at input selection level and later for output processing and marketing. Information can substantially increase the economic potential of any economic activity and here we see that net income from livestock is positively related to availability and accessibility of information as captured in Anim_Info variable and ability to utilise it as captured in Educ_Dummy variable. The relation is very strong for both the variables and highly significant too.
- Although in regression results, social group dummy turns out to be insignificant but in descriptive statistics, there is a visible disadvantage for SCs and STs. If we see the results for specific social group category then we see that with reference to Others category, SCs and STs have a negative and significant coefficient. This means that presence of SC and ST category reduces the net income relatively.
- In the second column, coefficients and standard errors of the model 2 are reported. This model considers only direct economic inputs to the livestock sector excluding the social group and religion dummies and also state fixed effects as dealt with the State dummy. The results are similar to the comprehensive model 1 which suggest the robustness of these variable's impact. But it can be seen that these dummies are significant in earlier model and also improve the R squared values which suggest their explanatory value in livestock income.
- Overall, we see a low R squared values for both the models but low R squared in the social sciences are not uncommon, especially for cross-sectional analysis.(Woolridge)

Limitations of the study:

Although efforts have been made to include as many significant variables as possible in the study, they are not exhaustive. Due to limitations of availability of data and risk of overcomplicating the model, only few variables of household characteristics have been included.

In case of land possessed, only visit 1 statistics have been used.So, the transfers of land titles through buying and selling in later half of the year have not been captured.

In case of dependent variable i.e.net income from farming of animals, has not been normalised with number and quality of livestock animals held by households. But inclusion of livestock unit as one of the explanatory variable deals with this issue to an extent.

LSU coefficients depend on aspects such as herd structure and feed requirements which may vary between years and which ultimately characterize the diverse production systems in countries. The coefficients are quite recent here so variation across time period is less relevant but other factors may cause certain uncertainties.

Conclusion

The results show that there is a positive relation between net income from livestock and variables like land possessed, livestock unit, household size, education level etc. The results of this study provide crucial insights into the development of livestock sector. Although we cannot take the results at face value given the limitations of dataset and also econometric analysis. But the signs of the coefficients of different factors can be basis of evidence led policy making at national and sub-national level. For instance, household size has a positive relation with income from farming of animals. That suggests that larger households who have less or no land earn positive returns from livestock ownership. It also points that livestock being a labour-intensive activity can play a key role in employment generation in rural areas. Furthermore, positive sign with animal information sought by farmers indicates the effectiveness of ICE(Information Communication Education) activities. So, more emphasis can be put on dissemination of technical knowledge through media and strengthening the research environment in both private and public sector. Although not studied directly in this paper but through related researches in the field, we must also acknowledge the adverse impacts of increasing livestock production. Livestock rearing systems(farms) need to be designed in a way to reduce methane emissions and also low input- output ratios to be focussed on. Ethical dimensions of biodiversity and right to life of other lifeforms cannot be overlooked altogether. So, the study places itself in current literature by re-affirming certain correlations while contradicting a few of them with the latest set of data available in the field.

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