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Research Prioritization in Indian Livestock Sector: A Policy Appraisal

D. Bardhan[1], S.R.K. Singh[1], A.A. Raut[1]

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ABSTRACT

Background: Livestock makes multi-faceted contribution to socio-economic development of rural people. However, challenges exist in exploiting the opportunities offered by this sector. Focused research efforts will be a key factor in addressing these challenges. There is a need for a critical and objective evaluation of livestock research priorities at the regional, species and commodity-specific levels so as to ensure optimum use of scarce resources. This study was aimed to identify regional, species and commodity wise priorities for allocation of livestock research resources.

Methods: The study used multi-criteria scoring model incorporating the multiple objectives for making choices. The objectives included were growth, equity, sustainability and participation in trade. Such scoring models are used to rank a long list of commodities, research alternatives and target domains.

Result: The study identified regional, species and commodity priorities for allocation of livestock research resources. Significant tradeoffs in the priority rankings of states were revealed when equity and sustainability indicators were considered. Species-wise prioritization including all the criteria revealed that cattle and buffalo stake the highest claims on research resources. The study also revealed inter-regional variations in allocation of research resources based upon species.

Key words: Livestock, Multi-criteria scoring, Research prioritization, Resource allocation.

INTRODUCTION

In spite of the potential offered by livestock, this sector faces emerging challenges which may impede its growth potential. It is assumed that technology development through focused research efforts will be a key factor in addressing these challenges. There exists considerable scope to further increase productivity of livestock through technological interventions. Given the low investment of resources in agricultural research and the existence of other competitive sectors which aim for the same resources, research prioritization in livestock sector becomes all the more important. There have been earlier studies which have analyzed the livestock research priorities at the country level (Birthal *et al*., 2002). However, evidence-based studies on research prioritization in the recent past are scanty. The proposed study intends to address this research gap and provide an objective assessment of macro level research priorities for the livestock sector in India.

MATERIALS AND METHODS

The study uses multi-criteria scoring model as per the framework given by Birthal *et al.* (2002), Das and Khunt (2008), Kumar *et al.* (2013) and Jha and Singh (2015). The approach incorporates multiple objectives for making choices, *viz*. growth, equity, sustainability and participation in trade. The major steps in scoring models are construction of Initial Baseline (IBL), modification of IBL and construction of Final Baseline (FBL); which ultimately leads to assessment of research priorities. Construction of IBL involves identification of indicators that summarize the above-mentioned objectives, *viz*. value of production (as a measure of growth); number of poor people and undernourished population (as measures of equity); area under Common Property Resources (CPR) (as a measure of sustainability) and value of exports (as a measure of participation in trade). For measurement of each of the indicators the sources of data are summarized in Appendix 1. It is to be noted that each of the above indicators was assigned an equal weight (0.25).

Modification of initial baseline

Nine intensity indicators were identified for modification of the IBL (Appendix 2). The efficiency modifiers were represented by yield gaps in indigenous cattle, crossbred cattle and buffalo; equity modifiers were represented by per capita state domestic product, combined share of landless, marginal and small farmers in livestock population (Total Livestock Units[1]), per capita availability of milk, eggs and

[1]ICAR-Agricultural Technology Application Research Institute, Jabalpur-482 004, Madhya Pradesh, India.

Corresponding Author: D. Bardhan, ICAR-Agricultural Technology Application Research Institute, Jabalpur-482 004, Madhya Pradesh, India. Email: dwaipayanbardhan@gmail.com

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[1]Total Livestock Units (TLUs) were estimated as bovines less than 2 years = 0.7; bovine males more than 2 years = 1; heifers = 0.8; milch cows = 1; sheep and goats = 0.1; pig = 0.3 and poultry = 0.014 (Eurostat, 2021).

meat and sustainability modifier was represented by livestock density (Total Livestock Units/ha of net cropped area plus land available for livestock).

Final baseline (FBL)

The impact of individual modifiers was summed up to get the net aggregate impact of all modifiers. The IBL was then modified using the aggregate impact to obtain the FBL, indexed to sum up to 100 across states.

RESULTS AND DISCUSSION

Earlier studies have emphasized on the relatively low resource allocation to livestock research as compared to other agricultural sectors. Birthal *et al.* (2002) had reported that although livestock's share in total agricultural research resources have varied over time, yet, it is low compared to its contribution to agricultural gross domestic product. Kumar *et al.* (2013) had observed that by commodity or commodity group, livestock research demands highest share (33.9 per cent) of the total resources.

Distribution of extensity parameters

Table 1 elicits the shares of different states in indicators/ extensity parameters, *viz*. value of production, poverty, undernourished population, sustainability and exports. Distribution of resources according to share in total Value of Output (VOP) implies that resources should be allocated across states in proportion to their shares in total value of output produced in the country. Accordingly, Table 1 indicates that Uttar Pradesh (12%) claims the highest allocation, followed by Rajasthan (10.5%), Madhya Pradesh (8%) Andhra Pradesh (8%) and Maharashtra (7%). Birthal *et al.* (2002) had assigned highest priority to Uttar Pradesh, followed by Maharashtra, Punjab, Madhya Pradesh, West

Appendix 1

Particulars	Source
Value of output	Basic Animal Husbandry and Statistics, 2020 (Department of Animal Husbandry and Dairying, 2020) State-wise and item-wise value of output from agriculture, forestry and fishing - Year: 2011-12 to 2018-19 (National Statistical Office, 2021) Agricultural Prices in India, 2019. 20th Livestock Census, 2019
Number of poor people	Human Census, 2011, Registrar General
Number of undernourished	National Family and Health Survey, 2015-16 (International Institute of Population Sciences, Mumbai)
Common property resources*	Land Use Statistics at a Glance: 2008-09 to 2017-18 (Department of Agriculture and Cooperation and Farmers' Welfare, 2021)
Value of livestock exports**	Basic Animal Husbandry and Statistics, 2020 (Department of Animal Husbandry and Dairying, 2020)

For some commodities, like hides/skin and draft power, figures on value of production were not available from Government reports. As such, the values of such products were estimated using data available from different sources.

Hides and Skin: No. of species-wise animals slaughtered. *Price of skin/hides.

Draft Power: average no. of days the animals are used for agricultural purposes (90) (Govindaraj et al., 2017) * hiring charges per day (Bardhan *et al.,* 2020).

*Area under barren and uncultivable lands, permanent pastures and grazing lands, cultivable wasteland, fallow lands and lands under miscellaneous tree crops.

**The share of each state to total commodity-wise value of production was imputed on total value of exports from India to arrive at the state-wise value of exports of livestock products.

Appendix 2

Particulars	Source
Yield gaps*	Basic Animal Husbandry and Statistics, 2020 (Department of Animal Husbandry and Dairying, 2020)
Per capita availability	Basic Animal Husbandry and Statistics, 2020 (Department of Animal Husbandry and Dairying, 2020)
Share of landless, marginal and small farmers	Situation Assessment of Agricultural Households and land and livestock holdings of households in rural India (NSO, 2021)
Livestock density**	20th Livestock Census, 2019Land Use Statistics at a Glance: 2008-09 to 2017-18 (Department of Agriculture and Cooperation and Farmers' Welfare, 2021) Situation Assessment of Agricultural Households and land and livestock holdings of households in rural India (NSO, 2021) Basic Animal Husbandry and Statistics, 2020 (Department of Animal Husbandry and Dairying, 2020)

*Average milk yield of indigenous cattle, crossbred cattle and buffaloes for each state was compared to that obtained from Red Sindhi (for indigenous cattle), Holstein Friesian cross (for crossbred cattle) and Murrah (for buffaloes), respectively.

**Measured by dividing livestock population (measured in terms of total livestock units) by sum of net sown area and land available for livestock.

Table 1: Per cent distribution of value of output, poverty, undernourished population, sustainability and exports by states.

States	% VOP	% Poor	% CPR	% Export	% UNNR
North					
Haryana	4.72	1.07	0.65	5.56	1.77
Himachal Pradesh	0.56	0.21	4.00	0.50	0.34
Jammu and Kashmir	0.98	0.49	1.16	1.01	0.51
Punjab	4.29	0.86	0.26	5.16	1.42
Uttar Pradesh	11.88	22.17	4.59	13.43	18.98
Uttarakhand	0.73	0.43	0.36	0.69	0.66
South					
Andhra Pradesh	7.92	2.92	12.98	9.29	5.18
Karnataka	3.37	4.81	7.08	3.32	5.19
Kerala	1.94	0.89	0.38	2.27	1.27
Tamil Nadu	6.56	3.06	6.05	7.63	4.09
Telangana	5.52	-	-	6.09	0.21
East					
Bihar	4.13	13.28	2.87	4.45	11.10
Chhattisgarh	2.45	3.86	0.54	0.95	1.36
Odisha	2.85	5.13	6.36	1.83	3.38
West Bengal	5.37	6.86	0.65	5.13	6.76
Jharkhand	2.82	4.61	0.92	1.13	3.79
West					
Gujarat	5.67	3.79	9.07	6.12	5.71
Goa	0.03	0.03	0	0.03	0.08
Madhya Pradesh	8.04	8.68	7.50	7.08	7.43
Maharashtra	7.30	7.34	10.79	6.29	9.60
Rajasthan	10.23	3.81	18.18	10.26	6.07
North East					
Assam	1.56	3.75	3.00	0.69	2.21
Arunachal Pradesh	0.13	0.18	0.40	0.11	0.07
Manipur	0.10	0.38	0.01	0.11	0.09
Meghalaya	0.15	0.13	1.40	0.07	0.21
Mizoram	0.09	0.09	0.38	0.11	0.03
Nagaland	0.09	0.14	0.49	0.09	0.08
Sikkim	0.03	0.02	0.03	0.03	0.02
Tripura	0.18	0.19	0.03	0.20	1.01
India	100	100	100	100.00	100

Bengal, Andhra Pradesh, Rajasthan, Bihar, Gujarat and Haryana, when research resource allocation was prioritized with the sole objective of accelerating growth. Distribution of poor population, across states, suggests highest allocation for Uttar Pradesh (22%) and Bihar (14%). Distribution of CPR's is skewed in favour of few states, with four states only accounting for more than 50 per cent of the country's CPR (Rajasthan, Andhra Pradesh, Maharashtra and Gujarat). When the focus of resource allocation was on reducing under-nourished population, Uttar Pradesh (19%) and Bihar (11%), rank highest in priority. These states are followed, in order of rankings, by Maharashtra (10%), Madhya Pradesh (7.5%), Rajasthan (6%) and Gujarat (6%). The indicator pertaining to export was meant to prioritize investment in promotion of trade as per shares of states in the country's total value of exports. As per this resource allocation criterion, the states with high rankings are Uttar Pradesh, Rajasthan, Andhra Pradesh and Tamil Nadu, respectively in that order.

Initial baseline

The above distribution of each indicator had prioritized different states differently. A composite index (weighted sum of Indicators) was generated by assigning equal weights to each specified objective to arrive at an initial baseline for research resource allocation. The results of the same are presented in Table 2.

When poverty is superimposed on VOP index, Uttar Pradesh further strengthens its first place in priority ranking. Madhya Pradesh, Rajasthan and Maharashtra retain their positions in the top five ranked states, while Bihar comes up to fifth place at the cost of Andhra Pradesh. With the

addition of undernourished population, the position of Uttar Pradesh as the highest ranked state further strengthens. Bihar climbs up substantially in the priority ranking, becoming the second ranked state, followed closely by Madhya Pradesh, Maharashtra and Rajasthan. Punjab, Haryana, Tamil Nadu and Andhra Pradesh lose their positions further with the addition of both the equity indicators; while West Bengal gains in position in the priority rankings. When sustainability implications are considered by including CPR in the composite index, Uttar Pradesh maintains its first rank, but with reduced share in research resources (12%). Rajasthan (11%) gains in ranking significantly to second place, followed by Maharashtra (9%), Andhra Pradesh (8%) and Madhya Pradesh (8%). West Bengal (4%) loses its share in resource allocation, substantially. When all the indicators are considered in the final composite index (IBL), the priority rankings suggest that Uttar Pradesh (13%) and Rajasthan (11%) should have the highest shares in resource allocation, followed by Andhra Pradesh (8.5%), Maharashtra (8%) and Madhya Pradesh (8%).

Final baseline

The final baseline for different states is shown in Table 3. When extensity indicators and their modifiers are considered together, the shares of states in livestock research resources increase by the highest margin for Himachal Pradesh, Uttar Pradesh, Karnataka, Bihar, Odisha, Gujarat and Maharashtra. On the other hand, shares of sates like Haryana, Punjab, Chhattisgarh and West Bengal decline substantially. This implies the need for including the intensity parameters in any policy decisions on research resource allocation. The FBL/VOP ratios as given in Table 3 further

Table 2: Initial base line (IBL) with different research objectives.

States	VOP	VOP+Poor	VOP+Poor+UNNR	VOP+Poor+UNNR+CPR	IBL
North					
Haryana	4.72	3.50	3.07	2.26	3.09
Himachal Pradesh	0.56	0.44	0.42	1.61	1.33
Jammu and Kashmir	0.98	0.82	0.74	0.88	0.91
Punjab	4.29	3.15	2.71	1.90	2.71
Uttar Pradesh	11.87	15.31	16.23	12.35	12.62
Uttarakhand	0.73	0.63	0.64	0.55	0.58
South					
Andhra Pradesh	7.92	6.25	5.98	8.31	8.56
Karnataka	3.37	3.85	4.18	5.15	4.69
Kerala	1.94	1.59	1.51	1.13	1.42
Tamil Nadu	6.56	5.39	5.07	5.39	5.95
Telangana	5.52	3.68	2.81	1.87	2.93
East					
Bihar	4.13	7.18	8.16	6.40	5.91
Chhattisgarh	2.45	2.92	2.53	1.87	1.64
Odisha	2.85	3.61	3.55	4.49	3.82
West Bengal	5.37	5.87	6.09	4.28	4.49
Jharkhand	2.82	3.41	3.51	2.65	2.27
West					
Gujarat	5.67	5.04	5.21	6.50	6.40
Goa	0.03	0.03	0.04	0.03	0.03
Madhya Pradesh	8.04	8.25	8.05	7.87	7.67
Maharashtra	7.30	7.31	7.88	8.85	8.21
Rajasthan	10.23	8.09	7.59	11.12	10.90
North east					
Assam	1.56	2.29	2.27	2.52	2.06
Arunachal Pradesh	0.13	0.15	0.13	0.22	0.19
Manipur	0.10	0.20	0.17	0.12	0.12
Meghalaya	0.15	0.14	0.16	0.57	0.45
Mizoram	0.09	0.09	0.08	0.18	0.16
Nagaland	0.09	0.11	0.10	0.23	0.20
Sikkim	0.03	0.03	0.03	0.03	0.03
Tripura	0.19	0.19	0.40	0.27	0.26
India	100	100	100	100	100

Table 3: Impact of modifiers on IBL.

States	VOP	IBL	FBL	FBL/VOP
North				
Haryana	4.72	3.09	3.02	0.64
Himachal Pradesh	0.56	1.33	1.36	2.43
Jammu and Kashmir	0.98	0.91	0.92	0.94
Punjab	4.29	2.71	2.62	0.61
Uttar Pradesh	11.87	12.62	12.72	1.07
Uttarakhand	0.73	0.58	0.59	0.81
South				
Andhra Pradesh	7.92	8.56	8.40	1.06
Karnataka	3.37	4.69	4.68	1.39
Kerala	1.94	1.42	1.41	0.73
Tamil Nadu	6.56	5.95	5.93	0.90
Telangana	5.52	2.93	2.88	0.52
East				
Bihar	4.13	5.91	5.98	1.45
Chhattisgarh	2.45	1.64	1.65	0.67
Odisha	2.85	3.82	3.88	1.36
West Bengal	5.37	4.49	4.60	0.86
Jharkhand	2.82	2.27	2.35	0.83
West				
Gujarat	5.67	6.40	6.38	1.13
Goa	0.03	0.03	0.03	1.00
Madhya Pradesh	8.04	7.67	7.67	0.95
Maharashtra	7.30	8.21	8.17	1.20
Rajasthan	10.23	10.90	10.80	1.06
North east				
Assam	1.56	2.06	2.11	1.35
Arunachal Pradesh	0.13	0.19	0.19	1.46
Manipur	0.10	0.12	0.12	1.20
Meghalaya	0.15	0.45	0.45	3.00
Mizoram	0.09	0.16	0.16	1.78
Nagaland	0.09	0.20	0.20	2.22
Sikkim	0.03	0.03	0.03	1.00
Tripura	0.19	0.26	0.26	1.37
India	100	100	100.00	1.00

buttress this point. It is assumed that in the absence of tradeoffs among research objectives, FBL/VOP ratio would be closer to unity. The FBL/VOP ratio lies between 0.95 and 1.05 for Jammu and Kashmir, Uttar Pradesh, Andhra Pradesh, Madhya Pradesh, Rajasthan and Sikkim, implying that their shares in total livestock research resources remain indifferent whether resources are allocated based on growth potential indicator alone or in combination with equity, sustainability and export potential considerations. States which gain over the VOP based allocation in terms of their shares in total research resource allocations, when equity, sustainability and export considerations are considered, are Himachal Pradesh, Karnataka, Bihar, Odisha, Gujarat, Maharashtra and all the north-eastern states except Sikkim. On the other hand states which will lose the most when equity, sustainability and export indicators are included are Haryana, Punjab, Uttarakhand, Kerala and Chhattisgarh.

Species-wise prioritization in states

The species-wise distribution of adjusted value of production[2] in different states is presented in Table 4. Cattle ranks as the major livestock species for research investment, overwhelmingly, in Himachal Pradesh, Jammu and Kashmir and Uttarakhand in the north; Karnataka, Kerala and Tamil Nadu in the south; almost all the states in the east with the exception of Bihar; Gujarat, Madhya Pradesh and

[2]The VOP of each species in each state is adjusted by multiplying with an adjustment factor (ratio of priority distribution based on FBL and priority distribution based on VOP). A ratio greater than one implies an upward adjustment in allocation reinforced by concerns of equity, sustainability or trade or all. A ratio less than one implies otherwise (Birthal *et al*., 2002).

Table 4: Research priorities by livestock species in different states (% of total research resources in a state).

States	Cattle	Buff.	Goat	Sheep	Pig	Poultry	VOP
North							
Haryana	17.71	67.43	0.54	0.87	0.15	13.30	100.00
Himachal Pradesh	74.79	22.11	1.56	0.76	0.01	0.77	100.00
Jammu and Kashmir	66.36	17.86	4.09	6.52	-	5.17	100.00
Punjab	26.49	67.90	0.64	0.27	0.02	4.67	100.00
Uttar Pradesh	30.29	63.39	2.35	0.31	0.56	3.10	100.00
Uttarakhand	58.68	33.51	4.01	0.86	0.37	2.56	100.00
South							
Andhra Pradesh	28.43	47.25	2.42	9.05	0.02	12.82	100.00
Karnataka	65.02	17.47	4.20	5.63	0.17	7.51	100.00
Kerala	66.84	13.79	3.41	-	0.51	15.44	100.00
Tamil Nadu	68.31	6.12	5.20	5.02	0.09	15.26	100.00
Telangana	23.36	34.66	5.31	21.91	0.08	14.67	100.00
East							
Bihar	50.46	37.37	7.56	0.14	1.76	2.71	100.00
Chhattisgarh	79.25	13.37	2.49	0.35	0.14	4.40	100.00
Jharkhand	79.10	15.37	2.98	0.14	0.92	1.50	100.00
Orissa	75.38	5.15	10.53	2.36	0.21	6.37	100.00
West Bengal	55.93	5.95	20.11	1.52	0.73	15.76	100.00
West							
Gujarat	53.01	45.28	0.07	0.03	0.002	1.61	100.00
Goa	49.78	11.25	27.19	-	1.99	9.79	100.00
Madhya Pradesh	59.83	37.38	1.35	0.06	0.03	1.35	100.00
Maharashtra	55.38	26.91	5.69	0.53	0.68	10.81	100.00
Rajasthan	43.36	51.50	3.16	1.35	0.09	0.55	100.00
North-east							
Assam	83.59	7.96	4.00	0.47	1.46	2.52	100.00
Arunachal Pradesh	76.83	4.51	9.56	0.64	5.72	2.74	100.00
Manipur	58.32	17.45	1.41	0.50	6.98	15.34	100.00
Meghalaya	83.43	2.68	2.36	0.002	8.20	3.33	100.00
Mizoram	56.62	3.41	1.50	0.10	23.28	15.08	100.00
Nagaland	57.90	13.55	3.17	0.01	23.02	2.34	100.00
Sikkim	91.74	2.36	0.75	0.02	2.70	2.43	100.00
Tripura	53.33	1.47	4.46	0.002	9.48	31.26	100.00
India	47.85	38.16	4.15	2.69	0.42	6.74	100.00

Maharashtra in the west; and almost all the north-eastern states. Research on buffalo emerges as the major priority in mostly the northern states of Haryana, Uttar Pradesh and Punjab. Other states, where buffalo garners substantial research attention, are Andhra Pradesh in the south; and Gujarat and Rajasthan in the west. Goat stakes claims for the highest research priority in West Bengal and Goa. In order of research priority, sheep emerges as the major species only in the southern state of Telengana and to some extent in states like Andhra Pradesh and Jammu and Kashmir. Pig stakes claim for substantial research investment in the north-eastern states of Mizoram and Nagaland. Poultry research is important in Haryana in the north; all the southern states except Karnataka and Tripura in the north-east.

State-wise prioritization for species

Table 5 elicits the distribution of species-wise research resources across states. In case of cattle research major proportion of resources should be prioritized to Uttar Pradesh in the northern region; Karnataka in the southern region; Bihar in the east and almost all the western states. Birthal *et al.* (2002) had also reported that cattle research should target mainly the western region (Madhya Pradesh, Rajasthan and Maharashtra). For investment in buffalo research, Uttar Pradesh in the northern region; Andhra Pradesh in the south; and Rajasthan in the west emerge as the priority states. Other states to be targeted for buffalo research are Bihar, Gujarat, Madhya Pradesh and Maharashtra. Investment of resources on goat research should target the eastern states of West Bengal, Bihar and

Odisha; and also Maharashtra, Uttar Pradesh and Rajasthan. Investment in sheep research should target the southern states and Rajasthan. Bihar, Uttar Pradesh, Maharashtra, Meghalaya, Nagaland and Assam claim the major share of research resources for pigs. In case of poultry research, the states to target are Andhra Pradesh and Tamil Nadu in south; Maharashtra in West and West Bengal in East.

Species-wise priorities for products and services

Table 6 elicits the priorities for products and services that a species provides. About 69 per cent of resources for cattle research should be earmarked for milk production and 30 per cent for draught power research. Das and Khunt (2008), in their study in Gujarat state of India had also reported that in terms of commodity-wise priority, the highest share (83%)

Table 5: State-wise priorities by livestock species.

States	Cattle	Buff.	Goat	Sheep	Pig	Poultry
North						
Haryana	1.16	5.54	0.41	1.01	1.15	6.18
Himachal Pradesh	2.51	0.93	0.61	0.45	0.05	0.18
Jammu and Kashmir	1.50	0.51	1.07	2.63	-	0.83
Punjab	1.70	5.47	0.47	0.31	0.17	2.13
Uttar Pradesh	8.82	23.14	7.89	1.59	18.71	6.40
Uttarakhand	0.83	0.59	0.65	0.21	0.59	0.26
South						
Andhra Pradesh	4.65	9.71	4.58	26.41	0.46	14.91
Karnataka	8.40	2.83	6.27	12.94	2.49	6.89
Kerala	1.63	0.42	0.96	-	1.42	2.68
Tamil Nadu	5.74	0.65	5.04	7.51	0.86	9.10
Telangana	1.16	2.17	3.05	19.46	0.50	5.19
East						
Bihar	7.16	6.66	12.39	0.36	28.37	2.73
Chhattisgarh	2.64	0.56	0.96	0.21	0.51	1.04
Jharkhand	3.78	0.92	1.64	0.12	5.00	0.51
Orissa	5.67	0.49	9.14	3.16	1.76	3.40
West Bengal	5.07	0.68	21.07	2.46	7.53	10.16
West						
Gujarat	7.23	7.75	0.10	0.07	0.04	1.56
Goa	0.04	0.01	0.23	-	0.17	0.05
Madhya Pradesh	9.50	7.45	2.48	0.16	0.58	1.52
Maharashtra	10.15	6.18	12.04	1.73	14.17	14.07
Rajasthan	10.02	14.92	8.41	5.56	2.24	0.91
North-east						
Assam	3.32	0.40	1.84	0.33	6.60	0.71
Arunachal Pradesh	0.23	0.02	0.34	0.04	2.01	0.06
Manipur	0.12	0.05	0.03	0.02	1.70	0.23
Meghalaya	0.99	0.04	0.32	0.001	11.03	0.28
Mizoram	0.07	0.01	0.02	0.002	3.31	0.13
Nagaland	0.20	0.06	0.13	0.001	9.13	0.06
Sikkim	0.06	0.002	0.01	0.0002	0.21	0.01
Tripura	0.24	0.01	0.23	0.0001	4.91	1.01
India	100	100	100	100	100	100

Table 6: Species-wise priorities for products and services.

Species	Milk	Meat	Hides/Skin	Draft	Wool/Hair	Egg	Total
Cattle	68.95	1.01	0.03	30.01	-	-	100
Buffalo	90.38	6.56	0.14	2.92	-	-	100
Goat	24.77	72.76	1.85	-	0.62	-	100
Sheep		97.30	2.07	-	0.63	-	100
Pig	-	100	-	-	-	-	100
Poultry	-	59.21	-	-	-	40.79	100

was claimed by milk, followed by draught power (15%) for cattle. In case of buffalo, significantly higher proportion (90%) of research resources - than in case of cattle - should be spent on milk production. About 7 per cent of the rest of research resources should be invested in meat (Carabeef) research with draft power and hides sharing the rest. Meat production emerges as the priority research area for sheep (97%). For goat, 73 per cent of research resources should be spent on meat, while 25 per cent should be earmarked for milk. For both the small ruminant species, higher proportion of resources should be spent on skin than wool research. Greater proportion (59%) of poultry research resources should be earmarked for meat research than for egg research (41%).

CONCLUSION

The study revealed significant tradeoffs in the priority rankings of states when equity and sustainability indicators are considered along with efficiency parameter (denoted by value of production); implying ignoring social and environmental dimensions will lead to sub-optimal research resource allocation across regions. Species-wise prioritization including all the criteria reveals that cattle and buffalo stake the highest claims on research resources. The study also reveals inter-regional variations in allocation of research resources based upon species.

Conflict of interest

All authors declared that there is no conflict of interest.

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