

Regional Considerations For Appropriate Livestock Development Strategies in India*

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This report, an updated version of the original study conducted in 1992, is a compilation of secondary information and data from various sources on different aspects of the livestock sector and analysis of the same with relevance to the 15 agro-climatic regions of the country. The purpose was to view the land-livestock-human relationships and livestock production patterns in each of the agro-climatic regions. On the whole, Bengal plains, central and north Bihar plus eastern UP, central and western UP and mid and western MP, Bundelkhand region of UP and southeastern Rajasthan, turn out to be the top most priority areas as regards urgency and intensity of livestock development. Next in priority are the eastern half of Peninsular India and western Rajasthan. An attempt was also made to suggest the species priority within the priority regions identified as described above, by considering densities and holding patterns of individual species. Development of cattle followed by goats needs priority in the Gangetic plains, cattle followed by buffaloes in the vast interior area of the peninsular India, goats and sheep in the arid tracts of Rajasthan and buffalo followed by cattle all along the East Coast of India. Shortage of feeds, especially grazing, is universal and this situation is going to persist, if not worsen, for a long time to come. Delineation of different livestock farming zones in the country was also attempted.

The need is being increasingly felt for orienting farming development strategies along micro and regional lines for optimal and economic use of available resources, equipping us with insight into micro and regional aspects and aspirations of livestock sector is of utmost importance. Lack of appropriate and comparable facts and figures on dynamics of livestock population, their performance and husbandry systems over a timeframe in the country as a whole, prevents us from delineation of animal farming zones of India more precisely. Such zoning is a prerequisite for regional planning for livestock development and integration of such regional plans into state and national plans.

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An attempt was made in this study to - a) collect, as far as possible, relevant secondary data for the whole country pertaining to livestock and related matters. b) analyse them agroclimatic region (ACR) wise. c) Identify inter zonal differences in livestock sector, and d) try to define, from the resultant findings, the animal farming zones of India. At the time of undertaking this exercise in 1992, comparable data were not available for all the districts/states. The present report is an update of the original report by incorporating data (now available) for all the states on all the considered aspects till 1991-92 and reexamination of the resultant scenario.

Methodology

Based on a comprehensive exercise covering the entire length and breadth of the country, the Indian Council of Agricultural Research delineated 15 broad ACRs (Figure 1). These are contiguous areas even across state boundaries and such zones being further divided into sub-zones (total 126) based on similarities in crop, soil, farming patterns (Ghosh, 1991). As beginning, it is this ICAR delineation of ACRs that were used in this study, though, it was realised that livestock farming has its own ground realities, however, closely it may be inter-linked with crop farming.

The study is a compilation of secondary information and data from various sources on different aspects of the livestock sector and analysis of the same with relevance to the 15 agro-climatic regions of the country. The purpose was to view the land-livestock-Human relationships and livestock production patterns in each of the agro-climatic regions as shown in Figure 1; the abbreviations used in this paper are the same as indicated in this Figure 1.

*This paper is based on the study, "Role of Animal Husbandry in Different Agroclimatic regions of India", sponsored by the Swiss Development Cooperation. International Book Distribution Company, Lucknow, published report of this study conducted by the author as a book entitled "Livestock Sector

of India - Regional Aspects" in 1995. This paper is based on the updated version of data for some states in LGP, EH and EPH regions now available, but unavailable at the time of the original study.

The data and information were collected district-wise (to the extent available) and then the districts were grouped according to the agro-climatic regions in which they fall even across State boundaries. The data and the information could be collected in this manner from 25% to 100% of the districts for each of the regions. Thus the data and information presented either represent the whole region or part of the region, the part never being less than one quarter of the districts in any region. The various parameters were arrived at via broadly the methods followed by earlier workers (Amble, 1965; Mishra, 1979; Vaidyanathan, 1979; NDDDB, 1980; Raut, 1981; CLRI, 1987; D.A.H. & D., 1990; Mishra Sharma, 1990) with modification in factors and constants as seemed appropriate. The ultimate results are expressed on per district basis so that there is comparability across regions. In view of the inadequacy, diverse nature and reliability question of the data and information, no use of conventional models was attempted. The analytical techniques mostly comprised of deriving descriptive statistics, wherever appropriate and amenable. The study thus is a critical appraisal of the available information on livestock and related aspects in a logical manner, aimed at deriving the inter and intra agro-climatic region differences.

This study differs from the earlier ones, however, in trying to make estimates more realistic as regards feed availability. Crop residue estimates were calculated for each district of the regions separately, with due regard to the crops and their yields (grain; stem-leaf ratios; Nirvan *et. al*, 1982) with reference to the high yielding varieties, while milling data were used to check commodity production data for concentrate feeds in the given region. Since crop residue and concentrate feed estimates are based to a considerable extent on grain yields, the

former follows the trend of the latter. Ground based district wise data on forest area was corrected for each district based on satellite imagery data, before calculating availability of greens from forests. Forage availability from rangelands and grasslands was estimated using different factors for different regions with due consideration to the type and available yields of the local grass-cover (Punjab Singh & Pathak, 1988).

Results & Discussion

Regional Differences in Livestock Endowment

Cattle: Highest densities of cattle (82-139 /Sq.km) as well as annual growth rate (1.03 to 6.62%) were found in LGP, MGP and WCPH regions (Figure 2), while the lowest (21-32/Sq.km) and growth rate (< 1% or -) in the WH, UGP, WD, GPH and ECPH regions. In other regions they range from 39 to 71 /Sq. km. The vast area of the plateau and hills regions (EPH, CPH, WPH and SPH) has intermediate level densities. Thus one finds high densities of cattle where they are used intensively for work or milk production or both. Their densities are lower in regions where other species have a more significant role in the rural economy. This trend seems to remain so even by the year 2000. In fact, the projected figures for cattle population for the year 200 based on this study, i.e. 205 million, is similar to the actual figures reported in the latest Economic Survey (Anon., 2000).

Buffalo: The characteristic feature of the buffalo is their low densities (4-13%) and growth rate in regions with less developed agriculture, extreme climatic (too, arid, hot or cold), difficult terrain (undulating/upland) conditions, or greater economic importance of other species of livestock. Such regions are the WH, EH, WD, GPH, EPH, WPH and WCPG regions (Figure 2). The Gangetic Plains regions (excepting the LGP) and to some extent the ECPH region are the buffalo areas. This trend too, like in cattle, seems to remain so even in future.

Sheep and Goats: The CPH region (com-

prising of south-east Rajasthan, northwest Madhya Pradesh and the extreme mid-south of Uttar Pradesh) is the only region that has the highest densities of both sheep (28-48/Sq.km) and goats (50-150/Sq.km) in the whole country (Figure 2). Goat keeping, mainly small scale is most widely practiced in this region. The region also suits: has less developed agriculture (more dependence on livestock), upland and ravenous terrain (offering good browse), large proportion (above 30%) of population living below poverty-line, the less arid climate etc. make goat keeping amenable to rural families. This region also falls along the path of seasonal migration by nomads of Rajasthan and Gujarat, offering good marketing in the traditional way.

Barring the CPH region. There is no other region where sheep and goat densities occur on a uniform pattern. The other regions where sheep densities are highest (28 to 48/Sq.km) are the WD (comprising of the desert districts) and the SPH region comprising of interior regions of Andhra Pradesh, Karnataka and Tamil Nadu. While in the former region sheep are reared primarily for wool. In the latter region they are reared for meat. In fact, while the WD region is well known for wool production (crucial economic activity) and wool breeds, the SPH region is renowned for its mutton breeds and mutton production. Though lower in density (19/Sq.km), sheep are important in the WH region, which produces substantial quantities of wool and wool products traditionally.

As regards goats, apart from the CPH region already mentioned, their densities are highest. (50-150/Sq.km) in LGP and MGP regions which are also, like the CPH region, ideally suited to the higher proportion of below poverty-line rural population of the regions. Sheep and goat numbers are increasing (0.87 to 9.48%) per annum in the whole country as a rule with the exception of the EH region, causing an increase in their numbers by up to 10% by the year 2000 (Figure 2) at the country level.

Pigs: The highest densities and annual

growth rates of pigs are seen in the Gangetic Plains, extreme north-east and west coast of India. The density was 10-18/sq. km in the LGP, MGP and UGP and 4-8/sq. km in the EH, TGP and WCPG regions (Figure 2). It may be noted that pig keeping remains an important activity in regions where the proportion of people of weaker sections are more, while it is not important in other regions. Hence there is a need to develop efficient small-scale pig keeping in such regions as a livelihood-supporting venture.

Thus if one considers the densities and growth trends of individual species together in various regions the species priorities in each region could be as shown in Figure 3. This can be summarised as shown in Table 1.

Table 1. Highest and lowest priority regions as per density-growth rate of different species occurring in them.

Species highest priority regions Lowest priority regions

Cattle EPH (tribal areas of Orissa, Bihar and MP), LGP (Plains of Bengal) and WCPH (Kerala and coastal belt of Karnataka and Maharashtra) WD (Western and central Rajasthan) and CPH (south eastern Rajasthan, south western UP, north western and central MP)

Buffalo TGP (Punjab and Haryana) and UGP (western and central UP)

WD (Western and central Rajasthan, GPH (Gujarat), WCPH (Kerala and coastal belt of Karnataka and Maharashtra), EPH (tribal areas of Orissa, Bihar and MP) and LGP (Plains of Bengal)

Sheep WD (Western and central Rajasthan) LGP (Plains of Bengal)

Goats LGP (Plains of Bengal) WD (J&K, HP, UP Hills), WD (Western and central Rajasthan), GPH (Gujarat) and SPH (Interior AP, TN and Karnataka) Pigs Moderate only =TGP, UGP,MGP,LGP & EH Rest of the country

Such a simplistic prioritisation based on preponderance of the species in a given region may not be always appropriate, in view of the overall development needs and scope

of a given region. Foremost among such factors is the feed resources position of the region.

Regional Differences in Feed Availability

Green Fodder: Green fodder is the crux of the problem of livestock production in India. Availability of green fodder and annual change in its availability per district in each of the agro-climatic regions is shown in Figure 4 (top row; left map). Green fodder shortage problem (24-61% of requirement) is acute in all regions and it is going to continue to be so if the present conditions prevail (0.5 to 5.77% negative growth per annum). The availability as per cent of requirement in 1987-91 (Figure 4) was highest in the TGP (61%) and WH (49/0) regions. While in WH the reason for this was the medium Cow Unit density (44/Sq.km) and good forest cover (40%), in TGP it was high (13%, highest in India) proportion of area under fodder crops (with high per hectare fodder yield, 14T). In most of the regions a combination of medium to high Cow Unit Density, lower forest cover and smaller grazing land area result in serious green fodder shortage. Further, unfortunately, availability per cent of green fodder is coming down in all the regions, most so in regions already having low availability, that spread over a vast area in the northwestern, western and southern parts of the country (Figure 4; top row; right map).

Dry Fodder (Crop residues): There is a shortage of dry fodder in all the agro-climatic regions (Figure 4; middle row; left map) with unique exception of the TGP region where it was more (118.4%) than the requirement. The regions with highest (but still short) per cent availability of dry fodder (53-69%) are EH, EPH and CPH regions. This is due to relatively low density of Cow Units (25-50/Sq. Km), even though agriculture is not so intensive in these three regions. Whereas in the TGP region (Punjab and Haryana; high) the availability is more than requirement despite high stock density (113/Sq. Km), due to intensive agricul-

ture and high (highest in the country) grain production. Though dry fodder availability is short of requirement. Its availability (as % per annum) is increasing over the past 15-20 years in all the regions (Figure 4; middle row; right map), it is growing mostly at a low rate (< 3% per annum) in high (> 100/Sq. Km) and medium (50-100/Sq. Km) Cow Unit density regions. In low Cow Unit density areas (< 50/Sq. Km) the per annum increase in dry fodder availability has been better (4.9%).

Concentrates: Availability of concentrate feeds was short of requirement by more than 50% in all the states/regions including the agriculturally most developed TGP region (Figure 4; bottom row; left map). It could be even more acute in TGP region if the higher productivity of animals of this region and the consequent higher feed requirement are taken into consideration. Otherwise, the trends of concentrate availability follow more or less the same trend as that of the dry fodder availability, since both are based on the production of food crops. The difference in trends between regions seem to be brought about mostly due to exclusion of the estimated concentrate requirements for poultry population from the total concentrate feeds available in each district, while calculating the available feed before calculating percentages based on Cow Units. The better off regions as regards concentrate feed availability (26-43%) were the TGP, UGP, CPH and WPH followed by MGP and EPH regions (21-23%). The worst off regions as regards concentrate feed availability were WD, GPH and EH regions (6.0-7.5%). Even in the agriculturally better off ECPH region the availability per cent was low (15.33) for Cow Units, perhaps due sharing of the available feeds by the considerably high poultry and pig population of the region.

The availability per cent of concentrate feeds has been increasing in all the regions during the last 15-20 years, though the annual growth rates of the same varied from region to region (Figure 4; bottom row; right map). It is moderately good (2-6% per annum) in most regions. The lowest growth

rates in availability were in WH, EH, WD and WCPH (< 1%), which are not known to be crop production-wise progressed regions.

From the data on availability of livestock feeds the scenario looks obviously very grim, what with the export of many livestock feed stuffs. But on the ground the animals in the farmers' holdings do survive and obviously serve the purpose for which they are reared. Where the requisite sustenance for livestock comes from than? From extensive field studies carried out later (after the present study was concluded) in Andhra Pradesh (Lehmann *et. al.*, 1994; Subrahmanyam *et. al.*, 1995; Anon., 1997) and Orissa (Anon., 1999), it is known that the farmer resorts to great rationalisation in feeding his herd so as to overcome the scarce feed resources. If we, specialists, say that 4 animals of a farmer's herd nutrition wise require 100 units of feed, the farmer actually manages with a quarter or third of that, by feeding individual members in his herd strictly on each animal's production/use. This rationalisation may some times leave the remaining (not currently producing or useful) animals to fend for them on the accessible common lands. This situation, known to veteran animal husbandry men, has to be kept in mind in considering information on feed shortages under extensive system of livestock farming.

Possible Development Priorities

Some how livestock development plans and strategies have come to be seen in isolation, whereas livestock keeping is one of the several integral and important parts of rural life. Success of any recommended measure for livestock development, hence, has to be location (region, state, area, district) specific. An attempt was made here to do so with regards to the agroclimatic regions. The criteria or the emanating need for arriving at the livestock development priority are determined and the consequent results are as shown in Figure 5. It may be noted that, here the attempt is to arrive at broad general conclusions rather than develop precise action plans, leaving the reader to be the judge of the scenario. The factors

considered to be of great relevance for determination of regional development strategies were - **a)** *livestock endowment*, **b)** *livestock productivity levels*, **c)** *climate agriculture/land use*, **d)** *livestock feed constraint position*, and **e)** *demographic features*.

A. Livestock Density-Growth rate (Figure 5; top-left): The 14 regions (15th Islands, was not considered) were ranked from highest to lowest with regards to the density of different livestock species and changes in their numbers over the last 10-15 years. Then pooled ranks were developed for density-growth across the species on a scale of 1 (maximum) to 4 (minimum) priority/scope for development. With productivity of animals being generally low in the country, the regions with higher livestock endowment need more efforts to reduce numbers or increase productivity or both.

Based on this criterion the MGP (north and central Bihar and eastern UP), UGP (mid, western and southern UP) and CPH (southeastern Rajasthan, west, central and southern MP) deserve highest priority followed by LGP (Bengal plains) and SPH (interior plateau areas of AP, TN and Karnataka)

B. Livestock Product-Production (Figure 5; top-right): Various regions were ranked according to the various livestock products produced per 1000 rural population and also the number of work (draft) animals per hectare of net sown area. For all the measurable livestock products the ranks range from the lowest to highest production, while for the draft animal power usage the ranks vary from highest to lowest dependence on the same. This procedure was felt necessary, as otherwise the contribution animal power as a product worth consideration may be ignored. This procedure also reckons that livestock (especially cattle) density may not always be related production of measurable livestock products in India. Since cattle are maintained in good numbers in draft-dependent regions, such regions have potential for improvement of cattle production. The pooled ranks of these production based rankings are similar to the ones under A above.

It may be noted that MGP and UGP are high priority regions according to this criterion also. So is LGP. Only next in priority are EH (northeastern hilly areas), EPH (tribal areas of southern Bihar, eastern MP and Orissa) and ECPH (the entire east coast; though there are pockets of superior livestock in the delta areas of rivers).

C. Feed Availability-Changes (Figure 5; middle-left): Ranks of the different regions as per the availability and annual changes in the livestock feed resources (greens, crop residues and concentrate feeds) of the regions were also developed in a similar manner. The pooled ranks of these indicate, from 1 (most) to 4 (least), the severity of the feed constraint over the period. WD regions with a pooled rank 1 is feed availability wise most critical, while LGP, GPH, WCPH and SPH were are also considerably critical.

D. Ecology-Agriculture (Figure 5; middle-right): Ranking of regions was also carried out according to the extent of development agriculture (cropping intensity and area irrigated) plus harshness or otherwise of the environment (physical climatic features and topography) and forest cover as a collective indicator of the farming-ecological scenario. Very low pooled ranks are indicative of lesser development of agriculture due to constraints of climate, water and terrain and hence the need and scope for developing livestock as an alternative means livelihood security. It may be noted that WD is most critical by these criteria while the vast stretch of WH, GPH, CPH, WPH and EPH, is only next in this severity.

F. Demographic Features (Figure 5; bottom-left): The people inhabiting a particular area carry out farming and their livelihood needs, resources and empowerment status determine what they can do. Hence the various regions were also ranked based on their demographic features. By this an attempt was made to suggest the regions where livestock can play an important role in the lives of rural people who are less endowed with resources. It was felt, also supported by the rankings (high to low)

obtained for rural population density, weaker section population (SC and ST) and percentage of people below the poverty-line that lack of resources are generally at the household level rather than at the village level. In other words, the unfortunate situation in the rural areas may not always be due entirely to the harshness of the "environment" of the region in which they live. The common resources of the region if properly managed and exploited, can help the people to resort to better livestock rearing and for a better livelihood. The Gangetic Plains regions, barring the TGP region (Punjab and Haryana) and the CPH (SE Rajasthan-western MP), the entire eastern half of Peninsular India and the WD (W and NW Rajasthan) are next in need from demography point of view.

G. Overall Priority Regions (Figure 5; bottom-right): Ranks of the regions as per all the above-discussed features were also considered together (pooled). By this overall criterion, LGP (Bengal plains), MGP central and north Bihar plus eastern UP), UGP (central and western UP) and CPH (mid and western MP, Bundelkhand region of UP and southeastern Rajasthan) turn out to be the top most priority areas. Next in priority are EPH, SPH and ECPH (eastern half of Peninsular India) and the WD (western Rajasthan) regions. It is proposed that, right now, urgent livestock development action is needed only in regions with top priority, (Rank 1) and next priority (Rank 2) described earlier in this paragraph.

One aspect needs considerations here. Though UGP region is a top priority region as regards livestock development, the extreme western parts of this region is quite well developed, almost like the TGP region. Similarly, the delta areas of the Mahanadi, Godavari, and Krishna rivers in the ECPH region are also better developed. It is the tracts out side these pockets of development that need attention in these two regions. Regions with best (4) rank are TGP, WCPG and GPH, i.e. the least priority areas from the point of view of urgency and intensity of need for further livestock development.

Development Priorities:

Livestock numbers: The entirety of the milieu of a region (climate, terrain, soil, ecology, people and, through them, crop production) determine which species or species-mix of animals will be reared by people there. It is difficult, if not impossible, to change this situation easily, i.e. replacement of the existing established category of animal by another one, (e.g.: Crossbred cattle in place of indigenous ones) considering the long-term population trends. Need for work bullocks is still the prime moving force behind cattle keeping universally, and seems to remain so for quite some time to come. Tractorisation has not yet caused any great reduction in bullock numbers. There is scope, however, to reduce the need for keeping bullocks by majority of the rural households (thus reducing numbers), by propagating a system of 'sharing bullocks' or 'custom hiring of bullocks' within village (Lehmann *et. al.*, 1994; Subrahmanyam *et. Al.*, 1995; Anon., 1999). Stakeholder oriented field level genetic improvement programmes, over a period of time, would improve the productivity of other species of livestock, leading to a reduction their numbers.

Species priority: An attempt was made to suggest the species priority within the priority regions identified as described above, by considering densities and holding patterns of individual species (Figure 6). Development of cattle followed by goats needs priority in the Gangetic plains regions, cattle followed by buffaloes in the vast interior area of the peninsular India, goats and sheep in the arid tracts of Rajasthan and buffalo followed by cattle all along the East Coast of India.

Feeds & Fodders: Shortage of feeds, especially grazing, is universal and this situation is going to persist, if not worsen, for a long time to come. The most crucial but most under developed aspect of animal husbandry in India is feed resource augmentation, especially greens.

This is so in all the regions, though the two Himalayan, the Trans Gangetic Plain, the West Coast Plains and Ghats and the Eastern Plateau and Hill regions are somewhat in a better (but yet deficit position). This situation needs to be bettered on priority basis, as it is a universal problem. In as much as the common grazing lands or the common access lands in villages are the most crucial and critical feed sources for livestock of small farmers, prevention of further loss of rangelands to grazing, their renovation and proper management of their use assumes importance. Fodder production enhancement programmes can go only in such a way that arable lands are not be diverted from crop production and better utilization and improvement nutritional value of crop residues and other by-products are the other options available.

Livestock Zones of India

Taking advantage of the data and information collected in the present study, an attempt was made to delineate the livestock zones of India. The study indicates that, as yet and in major part of the country, keeping of one or the other species of livestock or a mix of them is less determined by the productivity or products for the market and more on the locally desired type of livelihood security. Also since the annual changes in numbers of individual species are following the same pattern as their density levels, the latter parameter as per 1987 census for the whole country were considered. Average density in each region for each species is classified as Very Low (<Mean-1 Standard Deviation), Low (1 SD to M), High (M+1 SD) and Very High (>M=1 SD), with respect to the mean density for the country as a whole. The resultant patterns are shown in Table 2.

The species, in order of priority in each region, is indicated in the last-but-one col-

umn. Whereas the regions as per main and the next major product for which the livestock are reared is indicated in the last column. Usage of cattle and buffaloes for draft is universal in the country. The above descriptive terms of productivity only indicate the main thrust of production of keeping one or the other species deduced with due consideration to the total features of the concerned zone. For example, buffaloes in the TGP (Punjab and Haryana) are primarily for milk, sheep in WH (J & K, HP and UP hills) are primarily for wool, but sheep in the SPH (interior area of the peninsula) are primarily for meat, and so on. And there are special regions (WPH, GPH and I, where all the livestock exist in smaller densities with no dominance of a single species. In

such regions, it was construed that the livestock in general play a general and moderate supportive role in the local farming systems.

Using the information from the last two columns, an attempt was made to delineate livestock zones of India as depicted in Figure 7. It is hoped that the diagrams are self-explanatory. These are proposed for further discussion. Livestock specialists may judge and comment on them.

In view of limited financial resources, there is need to concentrate our livestock development efforts in most needy regions of the country, on most critical aspects and for locally the most desirable species. The present study is an effort in arriving at such

Agro-climatic Regions	Species Priority				region description	regions products
	very high	high	low	very low		
WH		s	cbg	p	sheep-goat -cattle	Wool-meat
EH		CP	G	BS	Cattle-Goat- Pig	Meat-Draft
LGP	CGP	S	B		Cattle-Goat-Pig	Draft-Meat
MGP	P	CBG	S		Pg-Bovine-Goat	Draft-Meat
UGP	BP	G	CS		Buffalo-Pig-Goat	Milk-Meat
TGP	B	SP	CG		Buffalo-Sheep -Goat	Milk-Meat
EPH		C	BSGP		Cattle-All others	Draft-Meat
CPH :	SG	B	CP		Sheep-Goat- Buffalo	Wool-Meat
WPH			CBSG	A	All livestock	Supplementary
SPH	S		CBGP		Sheep-All others	Meat-Suppl.
ECPH		BS	CGP		Buffalo-Sheep	Milk-Suppl.
WCPG	C	G	P	BS	Cattle-Goats -Pigs	Draft-Meat
GPH			CBSG	P	All livestock	Supplementary
WD	S		BG	CP	Sheep-Others	Wool-Meat
I			GP	CBS	Low livestock	Supplementary

Note: C = cattle; b = buffalo; s = sheep; g = goats; p = pigs

priority regions, aspects and species in India from urgency and intensity of development efforts needed. The constraints of data, the time lag, the need for generalisations, etc. concerning a study of this size and nature have to be kept in mind in understanding the conclusions drawn and suggestions proposed.

References

- Anon. 1993. Role of *Animal Husbandry in different agroclimatic regions of India*. Report of study conducted by N.S.R. Sastry, Indo-Swiss Project A.P. / Swiss Development Cooperation, Hyderabad.
- Anon. 1999. Personal communication during discussions with Members of the Steering Committee, Orissa State Livestock Sector Review 1999; Report, Government of Orissa, Department of Fisheries & Animal Resources Development & Indo-Swiss Project Orissa, Bhubaneswar.
- Lehman, R., *et.al.* 1994. *Bovine and dairy development in Andhra Pradesh*. Indo Swiss Project A.P., Hyderabad.
- Anon. 1997. Final Report of the Policy Study on Feed & Fodder Sector of A.P., Indo-Swiss Project Andhra Pradesh, Hyderabad.
- Amble, V.N. 1965. Feed requirements of bovines and possibilities of meeting them. *Indian J. Agri. Econ.*, Jan.-Mar., 1965.
- Anon. 2000. Economic Survey, Part II Sectoral Developments. Ministry of Finance, Government of India, New Delhi.
- CLRI. 1987. Report of All India Survey on Raw Hides and Skins, Central Leather Research Institute, Chennai.
- DAH & D. 1990. Report of the Technical Committee of Direction for Improvement of Animal Husbandry & Dairying Statistics. Deptt AH & Dairying, Government of India, New Delhi.
- Ghosh, S.P. (Ed). 1991. *Agro-climatic zone specific research*. Indian Council of Agricultural Research, New Delhi.
- Mishra, S.N. 1979. *Livestock planning in India*. Vikas Publishing House, New Delhi.
- Mishra, S.N. and Sharma, R.K. 1990. *Livestock Development in India: An appraisal*. Vikas Publishing House, New Delhi.
- NDDB. 1980. Breeding and feeding for milk production in Operation Flood II. National Dairy Development Board, Anand.
- Nirvan, K.P. *et.al.* 1982. Estimation of crop residues using grain to straw ratios. *Ag. Situation in India*, March, 1982.
- Raut, K.C. *et.al.* 1981. Estimates of milk production in India. *Coop. Dairying*, July, 1981.
- Sastry, N.S.R. 1995. *Livestock sector of India: Regional aspects*. International Book Distributing Company, Lucknow.
- Subrahmanyam, S., *et.al.* 1995. *Bovine development in Andhra Pradesh: Analysis of regional variations*. Centre for Economic & Social Studies and Indo-Swiss Project A.P., Hyderabad.
- Vaidyanathan, A. 1988. *Bovine economy of India*. Oxford & IBH Publishing Co., New Delhi.

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Fig. 1 Agro-Climatic Zones of India as Delineated by I.C.A.R.

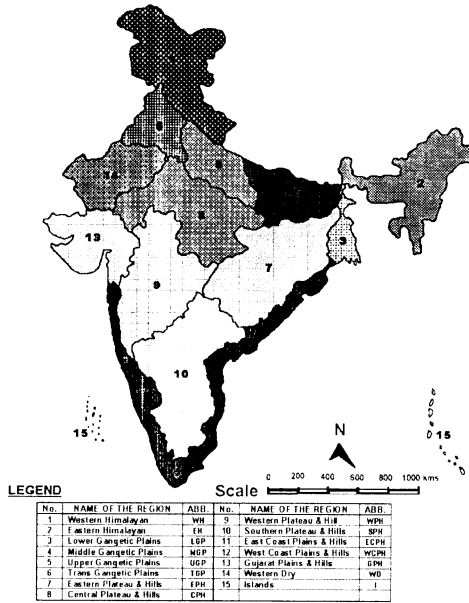


Fig 2 Dynamics of livestock density in different agro-climatic zones of india over the last decade.

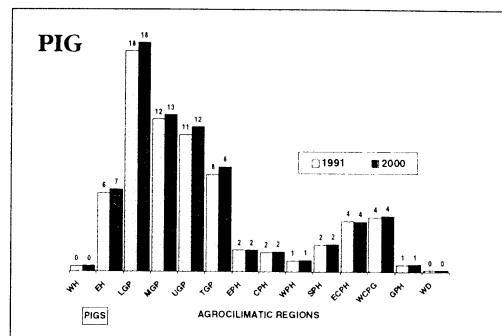
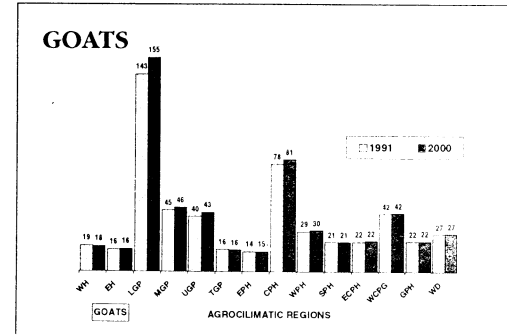
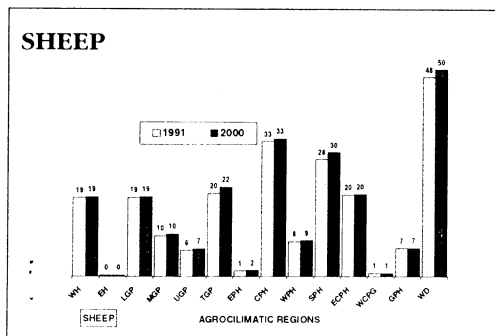
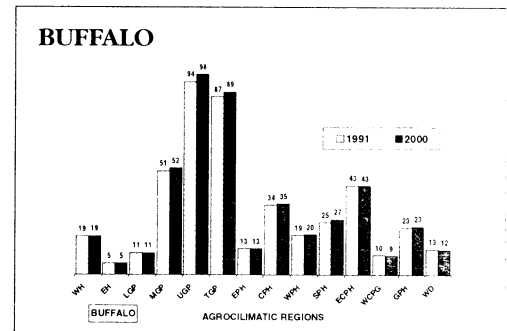
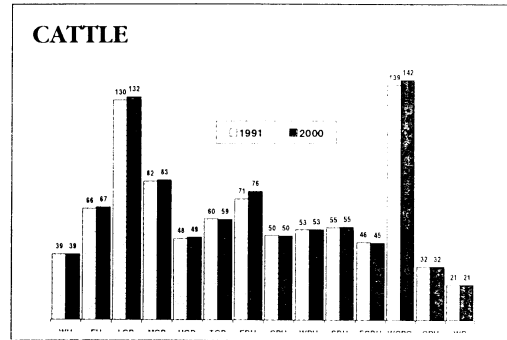
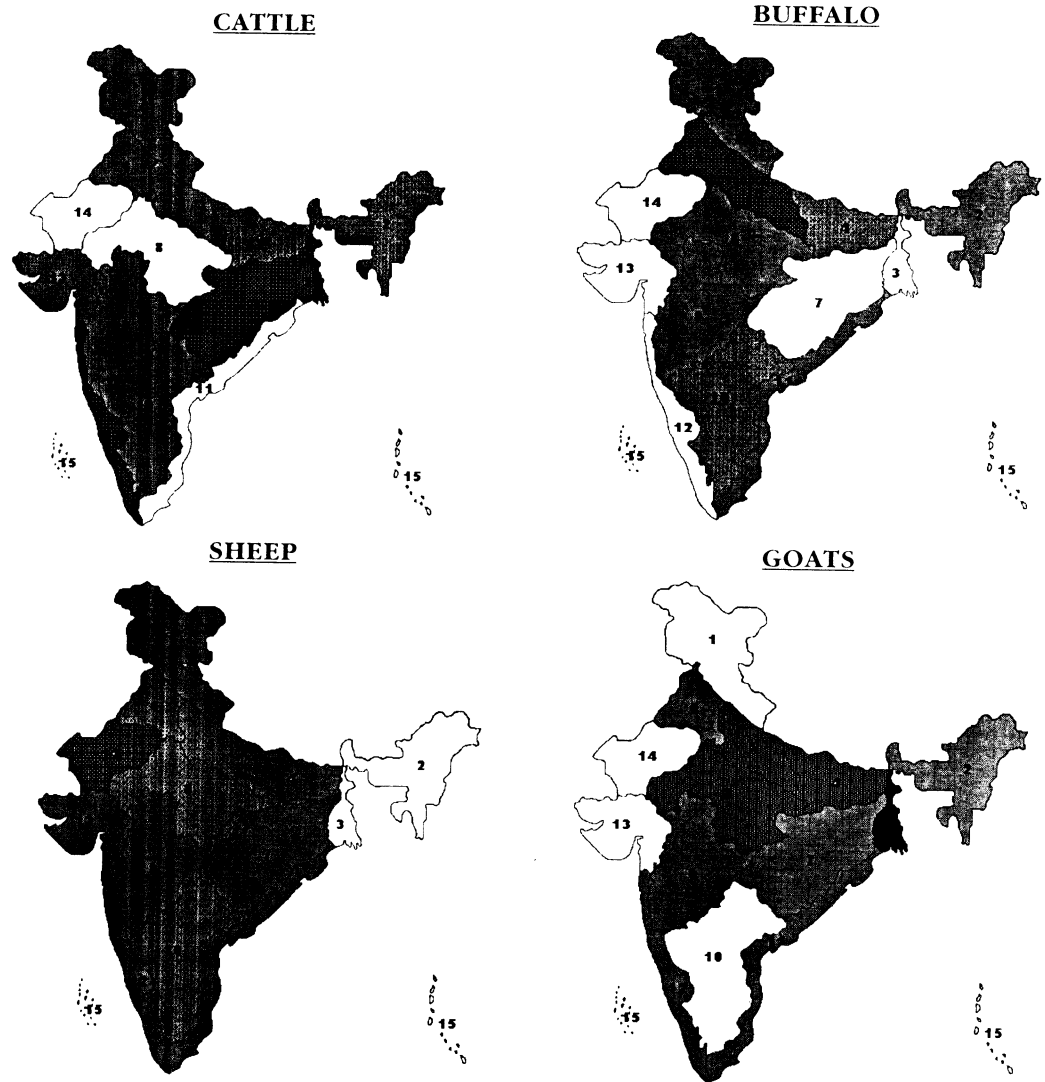


Fig. 3 Possible Species And Regional Priorities For Livestock Development In India

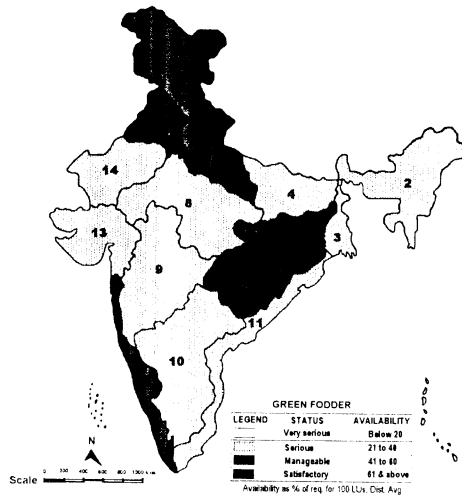


NOTE: Maps are not official nor scale specific.

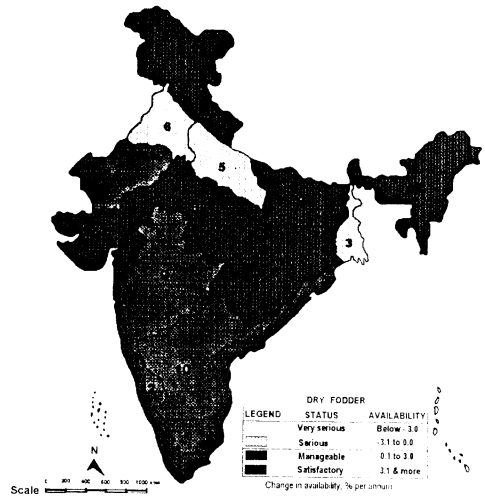
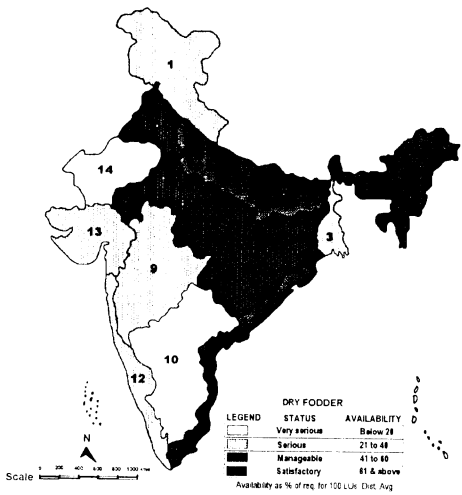
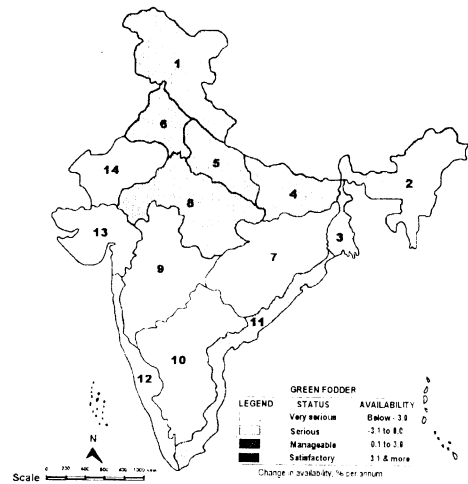
LEGEND =		Density X Annual Growth Score
	VERY VERY HIGH	= 26 & >
	VERY HIGH	= 21-25
	HIGH	= 16-20
	MODERATE	= 11-15
	LOW	= 6-10
	VERY LOW	= <5

Fig. 4 feed availability scenario in diff. Zones

Availability (87-91)



Annual



CHANGE

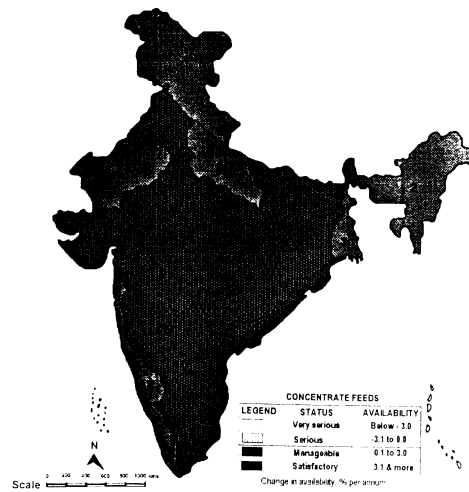
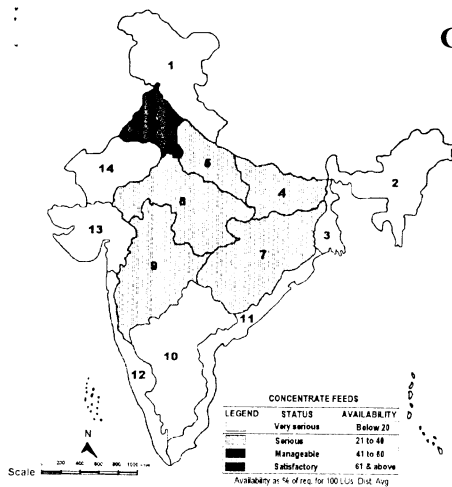


Fig. 5 Development Priorities In Different Regions From Various Livestock Related Situations

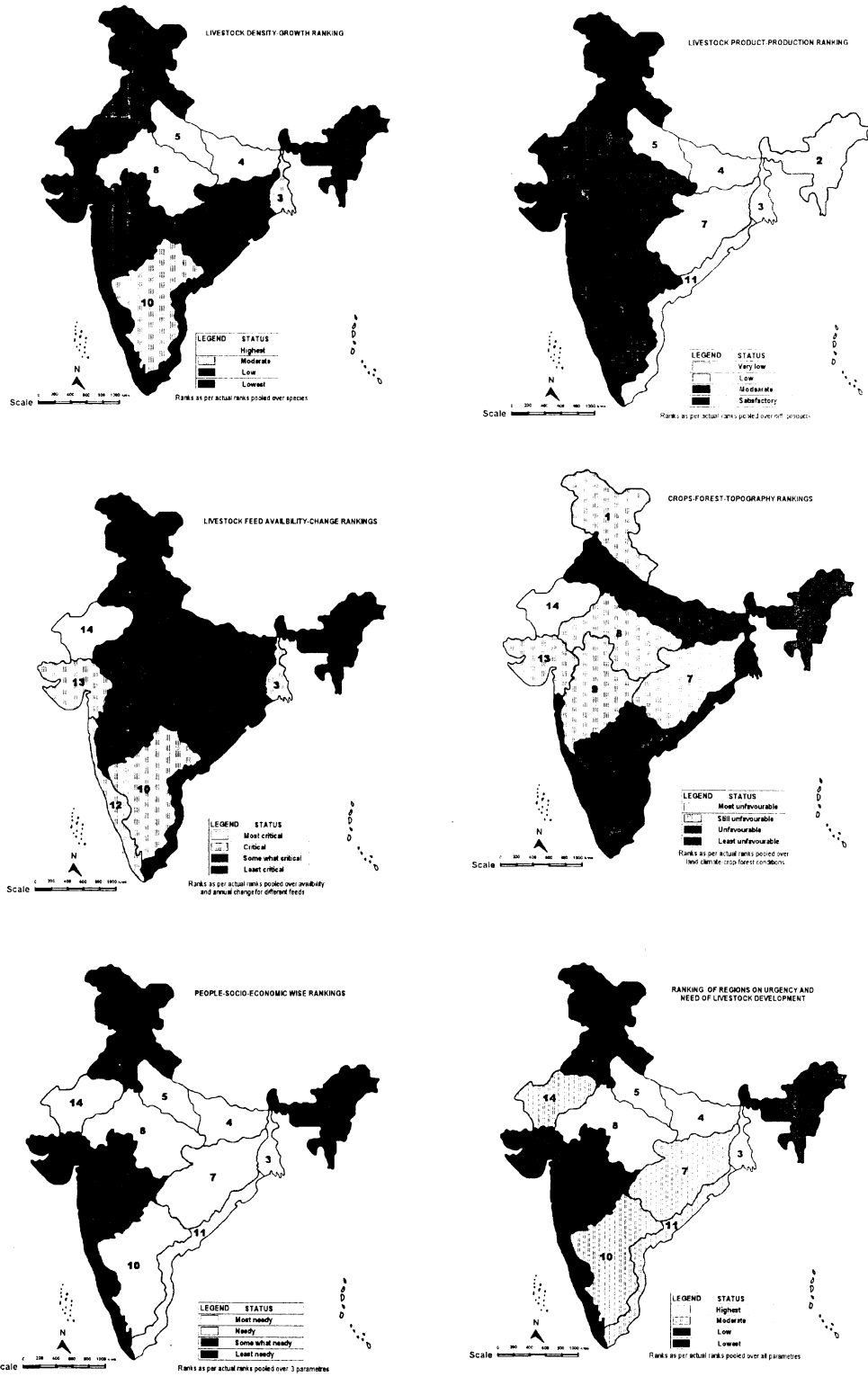
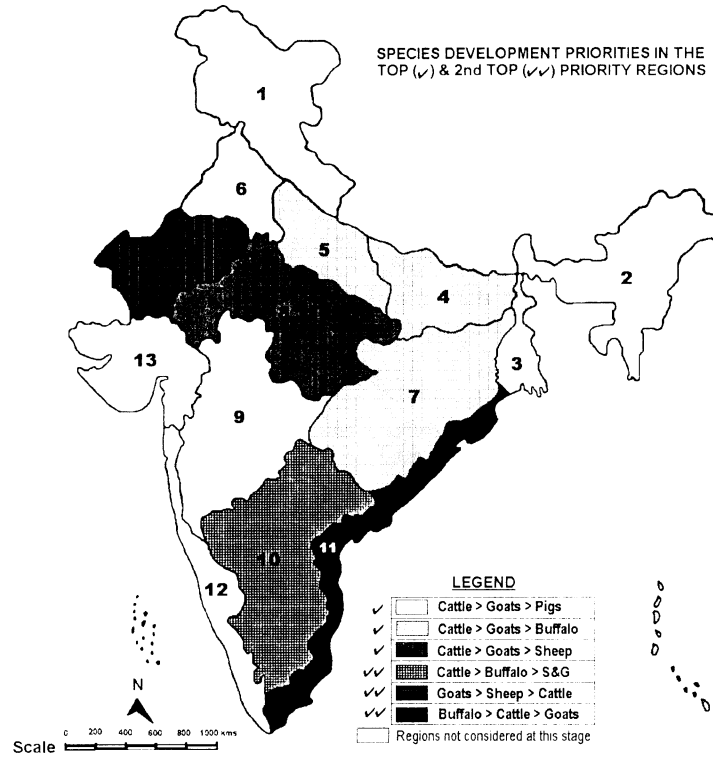


Fig. 6. Possible Order Of Species Development Priorities Within The Top Priority (3, 4, 5 & 8) And Next Priority (7, 10, 14 & 11) Regions



NOTE: 3 = LGP 4 = MGP 5 = UGP 8 = CPH
 7 = EPH 10 = SPH 14 = WD 11 = ECPH regions

Figure 7. Livestock Zones Of India Delineated According To - The Dominant Species & The Main Production Orientation of The Regions

