LIVESTOCK-WATER INTERACTION: STATUS AND ISSUES

SJ Phansalkar
Project leader, IWMI-Tata Water Policy Programme, Anand, India
s.phansalkar@cgiar.org

ABSTRACT

At 479 million, India has a large and rising livestock population comprising of cattle, buffaloes, goat, sheep, camel etc. Draught power for agriculture and dairy milk production are the two main purposes for rearing bovines while small ruminants are reared in a low input intensity manner taking advantage of the forest and common lands. Livestock composition is seen to be influenced by numerous factors: prevalence of forests, availability of irrigation, advent of mechanization and development of remunerative markets for livestock products. Water is required for direct consumption by livestock as well as for supporting the production of biomass on which livestock thrives. The estimate of 5 billion cubic meters of water for livestock as done by the National Commission for Integrated Water Resources Development is possibly on the lower side when both these factors are considered. Livestock contributes significantly to the household economy of the poor but they own no water sources for supporting their livestock. As such the water requirement of livestock has an important dimension of social equity. Finally, water quality and livestock production appear to have a two way interaction. This paper presents a broad picture on the above issues as a prelude to identifying four research issues that are taken up for work in this theme. These issues are as follows:

a. *Carrying out an assessment of water needs, both direct and indirect;*
b. *Understanding how do the poor and the underprivileged manage the water needs of livestock Do farm households with access to irrigation engage in more intensive livestock production than those who do not have access to irrigation?*
c. *Understanding what is the current state regarding quality of water available to animals and what impacts does it seem to have on their health and productivity.*

***Key words**: livestock, water requirement, fodder, nomadic herdsmen, water quality*

1. INTRODUCTION

At 479 million, India has a large and rising livestock population. The livestock population density in 1997 was about 150 animals per square kilometer of total land and about 3.40 heads per hectare of cropped area. Poultry birds, not included in the above, number about 350 million. As can be seen from Table 1, the livestock population has risen from 252 million to 479 million in the fifty year period, a rise that is far smaller than in human population in the country. Within the livestock heads, the sharpest increase has been registered for pigs (200%), followed by goat (155%), buffaloes (104%), sheep (45%) and cattle (27%). Poultry has grown by 378% during the same period. Share of bovines in livestock has fallen from 68% 1951 to 60% in 1997. Within bovines, share of cattle has come down from 78% to 69% during this time. Share of adult female buffaloes in bovines has risen from 11% to 15% while the share of adult cows has fallen from 27% to 21% during the same period. The population of "beasts of burden": horses, ponies, donkeys and has fallen while the population of camels has gone up by about 50% to 9 lakhs.

Livestock contributes to the national income in several ways. Livestock products such as milk, meat, eggs, wool, hair, skins and hides contribute to the gross domestic product of the country. Livestock contributes approximately a fourth of the agricultural production and about 5% of the total GDP. In 1999-2000, livestock sector contributed Rs. 984 billion or about 5.5% of the GDP that year. Table 2 shows the trend in share of livestock sector in GDP over years. Livestock sector has important indirect contribution to the agriculture, contributing energy for cultivation, irrigation and transport. Farm yard manures enrich the soils. In turn, livestock sector receives contributions from crop economy in the form of specially cultivated fodders as well as crop residues and feeds.

Livestock contributes important dietary inputs to the population. Milk, eggs, meat, and poultry are important sources of energy and protein. Role of milk as a source of protein is particularly important for infants and for the elderly. They also enrich and bring in variety to the diets. In India, the production of milk as well as poultry has registered particularly large growth in the last three decades as the demand for these products has risen and effective arrangements of linking producers to markets were put in place. IFPRI studies indicate that as incomes rise, the diets will be further diversified with larger consumption of livestock products. (IFPRI, 2002)

Indian livestock production system is fragmented. Small livestock herds are maintained by a large number of farmers engaged in mixed rather than specialized farming. While there are specialized livestock producers especially for poultry, sheep and goat (and milk, though in urban areas), most livestock owners keep the stock along with their farming operations. Average herd size in case of bovines seldom exceeds single digits while the herd sizes for small ruminants are some what larger. Small land-holders or landless households are seen keeping a small herd of goat that grazes off common lands. This nature of livestock rearing in India makes the sector more important to poor rural households as often the share of income from livestock in their total income basket is significant. In drought prone areas and other regions of high rainfall variability, livestock production is more stable than crop

production since the latter have more narrowly defined time windows of water needs. Thus livestock serves the purpose of reducing the total portfolio risk for a poor household.

Livestock need water for three purposes. Livestock need water as all living beings for mere survival. Water is used for growing feeds and fodders for the livestock. And water is necessary for cleaning etc. Presence of open water bodies for buffaloes to bathe in summer is considered helpful for a proper reproductive cycle. Some of these needs (e.g in case of free grazing livestock that grazes or browses on wastelands and forests) are met from "green water" while stored (blue) water has to be deliberately diverted to meet the other needs. Water is used in cleaning or bathing of livestock non-consumptively. The National Commission on Integrated Water Resources Development (1999; p.61) had suggested that the direct watering requirement of livestock is about 5 billion cubic meters a year based on a norm of 18-30 litres per caput per day (lpcd), but had not gone on to assess the need for water for other purposes.

The subject of water needs of livestock sector is important in view of the importance of livestock to the national economy and the even greater importance of livestock production systems to the household economies of poor households as well as the households in drought prone areas. Poor households usually do not have their own source of water and have to depend on water obtained from wells or other sources either belonging to other households or to the public agencies. The complex interactions involved in these transactions are important to the socio-economic conditions surrounding the livestock sector.

2.0 LAND USE PATTERN AND LIVESTOCK

Table 4 shows the data on land use pattern and livestock for the year 2001 for major Indian states. To interpret the data, it is useful to understand that in the main livestock provide draught power to agriculture. Bullocks are used in all non-paddy areas while buffalos are used in paddy growing Eastern States. . Draught power requirement defines the need for rearing livestock. Farms provide biomass in the form of crop residues as well as cultivated fodders. Biomass is also available from forests, wastelands, common lands and village grazing lands. Biomass availability defines the livestock carrying capacity of land. Buffaloes are basically dairy animals in India and their numbers are likely to increase with the access to well paying markets. Buffalo rearing is thus driven by desire to increase incomes, while cattle population is driven more by need to assure oneself of draught power. When tractors are used to plough farms, need for cattle reduces and a quantity of biomass is thus "released", to be now applied to rearing dairy animals, usually buffaloes for producing milk. Observation suggests that both sheep and goat are reared in a "low input intensity" fashion and hence fodder or biomass is neither specifically grown for them nor such released biomass applied for rearing them. They simply survive on biomass available from common lands. Based on these statements, some preliminary hypotheses about land use pattern and livestock are:

- Given the need for draught power for farming, cattle population should be strongly linked with net sown area
- For the same reason, cattle population should tend to decline with advent of tractors.

- ? There should be a positive and strong link between buffalo population and number of tractors.
- ? Population of sheep and goat should be closely linked with forest area.

These hypotheses were tested using the aggregate State level data and found tenable. It is possible to argue that aggregation of the data at state level masks possibly strong relations between these data. Yet the trend is discernible.

The difference between gross cropped area and net sown area is the area that is cropped more than once. The larger this area, the greater the incremental biomass that is available for supporting livestock production. How is this applied?

a. We find that there is a very strong relation of buffalo population and the "second crop" area, much stronger than the relation with any other livestock. This clearly implies that "incremental" biomass grown in the second or the third crop is preferentially applied to buffalos. Since second crop is most often grown with irrigation, it is possible to argue that this biomass is based on blue water.

b. Goat population is quite closely linked with the forest area in a State. Goat population as a function of forest area is estimated as

Goat population (in 000) = 190.5 + 1.626 * forest area in '000 ha

(*adjusted R square = 0.93, t value of coefficient of forest area = 20.3, significant at 1%*)

c. There is a link between sheep population and forest area, but sheep population is more strongly related with geographic area than with forest area, a similar regression showing that one sheep head is associated with 0.189 ha of geographic area, with an adjusted R square of 0.9 and t value of 16, significant at 1%.

d. Buffalo population does seem to rise with number of tractors as hypothesized above. A regression between the number of buffaloes as dependent variable and net sown area and tractors as independent area shows a positive coefficient for tractors, adjusted R square of 0.81 and a significance at 1%.

e. Cattle population and tractor number are weakly but negatively linked, a similar regression with cattle as the dependent variable and NSA and tractor numbers as independent itself is significant but coefficient of number of tractor is negative but with a small t value.

3. ESTIMATING FODDER AND WATER NEEDS FOR LIVESTOCK

3.1 Estimation of total quantity of feeds, fodder and water

Estimation of total quantity of feeds and fodder as well as water needed for maintaining the livestock and livestock production at desired levels helps assess comparison of demand

supply gaps and hence directions of desirable policy. Logically, the approach adopted for this estimation should follow these lines:

a. Assessing first the "maintenance ration" for various categories of livestock across the age groups. The quantities differ by type of animals, breed of the animals of a type, age and ambient conditions. This quantity is expected to be necessary just to keep the current size of livestock herd alive and intact.

b. Assessing the need for feed, fodder and water for carrying out the production activities. This is done often by estimating feed/ fodder "conversion ratio". Thus one attempts to see how much feed and fodder must be given to produce one litre of milk or one kilogram of meat etc. Again this conversion ratio will vary by animal type, breed and ambient conditions.

c. Similarly assessing the fodder and water needs of "working bullocks" and assessment of the length of the time period during which they are to be treated as such.

d. The feed, fodder and water need for the national livestock is then assessed by combining the population of livestock in these different categories with the maintenance and production rations as assessed above.

Estimates of feed and fodder needs compared with availability in different states and agro-climatic regions are prepared on the above basis. Availability of all; green and dry fodder for the livestock for maintenance and production as well as concentrates required for production purpose is considered to be much smaller than requirements. This is shown in Table 6 and 7.

Direct water consumption requirement is estimated variously. As stated above, the NIWRCD has put the need at between 18 and 30 lpcd of animal head. This itself amounts to 4-5 bcm per year. However, the need for animals in milk is much higher. It is estimated that lactating dairy animals take up to 5 litres of water for every kilogram of dry matter they consume. A regression equation[1] estimating water requirement reveals that

*Water intake (kg/day) = 16 +1.58*DMI +0.9 * milk produced (kg/day) +1,2 * minimum temperature.*

(While this equation is for Europian conditions, a similar relation can presumably exist for Indian conditions as well.)

On the assumption that on an average minimum temperature is 17-18 degrees C , average milk production is about 3 litres per lactating animals and that 3 kg dry mass is needed for producing 1 litre of milk, , this equation if applied to Indian conditions gives a water need of

[1] www.grandvalley.com/grist.html

50-60 litres per lactating animal. Clearly, the water requirement of animals during their lactation period is much higher than the 18-30 lpcd assumed by the Commission.[2]

3.2 Divergence of actual feeding rates from the normative recommendations

Taking maintenance or production rations as defined by animal nutritionists and blowing them up to compute total national need for fodder or water overestimates the demand for these commodities. Since all these commodities have either cash or opportunity costs associated with them, livestock owners apply them only when they believe that economic returns to application of feeds or fodder exceed these cash or implicit costs. There is a wide prevalence of selective feeding. Common observation reveals that bullocks are given proper ration only prior to and during the time they are harnessed for tillage. Male buffalos and old buffalos are culled or sent to the butcher but laws as well as religious sentiment in India inhibits people from sending cows or bullocks to the butcher. But dry and old cows are not only not given any fodder, they are shooed away in preference to other animals from common grazing lands as well. Almost entire goat and sheep herds live almost exclusively off "free materials" from common lands, forest lands and wastelands.

The level of fodder and feeds as well as water requirement is determined by the size of the livestock and the intensity of livestock production. Substantial cattle is kept essentially as farmers need bullocks for tilling. As Table 8 shows, even the poorest households report keeping drought animals. Bullocks have a certain economic life span. Thus farmers need to ensure that they are in a position to substitute an aged bullock with a young and healthy one. While animal markets do function, there is a tendency for farmers to engage in self-provisioning. The cattle herd to be kept then becomes a function of the frequency with which cows conceive and deliver and the expectation of a male progeny. The former in turn is determined by the nutrition status and health of the cow and the availability of studs for servicing it etc. As a consequence, the cattle herd rises substantially. Force of religious sentiments as well as laws prevent slaughter of unproductive cows and hence there is no mechanism to keep the cattle strength to a manageable level. As the market for livestock products rises, slow substitution between animal types and between different breeds of the same animals occurs in India

The actual feeds and fodders as well as amount of water given by a household to different categories of livestock strongly reflects the objective of the household behind livestock rearing. We submit that these concrete objectives at household level rather than scientific ration etc determine the need for feed and fodder in the livestock sector. To generate this information we believe that a household level investigation is a must.

[2] There are many issues intricately involved. The first is the relationship between water need and the temperature in Indian context. Second is the assumption of livestock composition (in terms of proportion of livestock in dairy production and proportion of that in lactation) as made by the Commission and as is seen to exist. In fact there is a need for studying the relationship between variables used in the equation referred in Section 3.1 above under Indian conditions.

4. LIVESTOCK PRODUCTION AND IRRIGATION: DEFINING THE PATTERN

A rain fed area in India has a livestock herd dominated by cattle, sheep and goat. For instance, Chhatisgarh and Jharkhand, two states with dominantly rain fed agriculture show that 80% or more of the livestock is made up of these two categories. With advent of irrigation, buffalos become more and more numerous. Thus Punjab and Haryana show that buffalos account for over two thirds of the livestock in those states. Possibly some of the following developments cause such a pattern:

- ? Advent of irrigation sees cultivation of the "second crop" on a much larger area than earlier
- ? This generates "extra" biomass for application to livestock. Simultaneously, commons become increasingly privatized.
- ? At the same time, income levels go up pushing up consumption of livestock products, particularly milk and ghee
- ? Farmers find traditional ways of ploughing using bullocks to be constraining as the bullocks no longer match the frequency and speed of operations called for
- ? As such tractors and other mechanical devices appear reducing the need for bullocks
- ? Thus the draught driven livestock becomes a livestock product driven livestock

What one would expect to see at household level is that households with access to irrigation would have both the opportunity and the incentive to engage in more intensive, market driven livestock production while households engaged in rain fed farming would tend to show more traditional, subsistence oriented, commons based low input intensive livestock rearing.

5. LIVESTOCK AND WATERSHED MANAGEMENT

Watershed management is a compact of activities of soil and water management in a well defined area that has a strong salutary impact on conservation of soil and moisture, improvement of carrying capacity of the lands and increase in net biomass production in a region. The most commonly adopted "ridge to valley" approach of watershed development tends to undertake soil conservation measures including bunding, Continuous Contour Trenches, plantation etc in the ridge areas. Most often ridges are under a system of common ownership and the biomass growing there supports livestock, often of the poor. Controlled grazing or in fact a complete stoppage of grazing in ridge area hits the poor livestock owners hard since quite a few of them may have no interest in farm land improvement as they have none.. Thus watershed development programmes potentially have the social bias against owners of small livestock that is raised by free grazing. The extent to which the livestock owners are compensated by alternate mechanisms varies across water sheds. At the same time, if watershed development is done with a balanced view, water availability for livestock consumption improves. Some excellent watershed development projects[3] have seen salutary

[3] Farington J and Lobo C "Scaling up participatory watershed development programmes in India: Experience of Indo-German Watershed Development Programmes, http://www.odi.org.uk/nrp/17.html
also see Livestock-Environment Interactions Study - Findings related to Vaiju Babhulgaon, *Watershed Family, Fourth quarter, 2004*

impact of the bio-physical activities on livestock. A study on one such watershed has concluded that

- ? Sustainability of the dairy production in the watershed is linked with the dairy development process of the area and hence with institutional coordination
- ? Building watershed linkages with the market and that too the market managed by the cooperative institutions *helps better impact on livestock*
- ? Strict enforcement of rules regarding grazing and cut and carry by the watershed institutions in the village to stop degradation *is possibble*
- ? Watershed focus on wasteland development to provide land for fodder/grass cultivation *is necessay for sustaining livestock and livelihoods based on it*
- ? Technically efficient water harvesting processes and access for all to the surface and underground water during stress periods *is required*. [4]

However, it can not be stated that all water sheds projects have favourable impact on livestock, particularly those owned by landless or marginal land-holders.

6. WATER QUALITY AND LIVESTOCK

Quality of water certainly impacts on livestock health, productivity and quality of production. Bowman goes so far as to state "if you do not drink the water that you offer to your cows, then it is too dirty for them"[5]. The aspects of water quality that have relevance to livestock are the same as have relevance to human health: total salt content, presence of coli form bacteria and other organisms, presence of contaminants etc. Poor water quality can lead to poor health through infections of the gastro-intestinal tract, poor intake of nutrients and lower as well as poor quality milk production[6]. The impact on water quality on livestock production is an emerging subject on which not much research has been done in India. In turn livestock itself affects the quality of water in the region it lives and moves. This is due to mixing of excreta and urine of the livestock, by their agency in transporting microbial and other contaminants to water etc. This effect is likely to be quite intense in areas where livestock is watered from free access surface sources such as ponds and tanks.

The third area of interest is the impact of water quality on quality of livestock products. Pesticide residues such as DDT do find their way in milk via both the crop residue they consume and the water they drink. Poor microbial quality of milk due to poor hygiene and poor water quality results in great problems in making milk products that can meet the tough international standards. The NDDB has undertaken a clean milk production drive that stressed, inter-alia, control on quality of water given to animals.

[4] words in italics added by us.
[5] Bowman, *op cit*
[6] Faries, FC, Sweeten JM and Reagor JC; Water Quality: its relationship to livestock, extension note L2374, Texan Agricultural Extension Service, Texas A and M University.

7. SOCIAL EQUITY, ACCESS TO WATER AND LIVESTOCK

While water is essential for all living beings including livestock, some categories of water sources tend to be held and controlled as private property. Streams, rivers, village ponds and tanks are all in the public domain and livestock belonging to all classes of people of an area have access to them. But ground water is accessed only through dug wells and tube wells and these are in the private domain. The problem of access to adequate water is manifest mainly in regions which do not have reliable year round public water sources. In these areas, poor livestock owners must depend on either water made available to them by those who have their own wells or tube wells or on arrangements made by public agencies. Regions with perennial water scarcity at times also come up with social institutions that facilitate collective survival. For examples the institution of "jeevdaya" (pity on all living forms) has strong social legitimacy in Western parts of India. In several districts of Rajasthan for instance, those with control on their own source of water ensure that they provide for human and livestock direct consumption needs mainly out of this institution. In fact we may see the sharing of water for survival as being a residual legacy of the "immediate return system"[7] in regions where society has evolved well beyond the stage of hunting and gathering. However, force of such institutions is neither universal nor always effective. While exploiting those who seek water for quenching the thirst of their family members may still be considered extremely obnoxious, demanding a consideration for providing water for the livestock has much no such stigma attached to it in many regions. Whether consideration exchanges hands explicitly or not, those who need water for their livestock are necessarily at the mercy of those who can provide and this provides one more weapon for the play of raw social and economic power.

Herdsmen who migrate with their livestock face this problem all the time. It may be argued that long term social sustainability of the community would perhaps compel even the powerful to ensure that subsistence needs such as water for livestock of the poor people in their community,. no such compulsion would operate so far as livestock of nomads who migrate are concerned. There are many communities who have a well established pattern of nomadic life. They migrate with their herds of cattle, camel or small ruminants over long distance. This pattern has symbiotically evolved for both the parties. The migrant livestock owners are helped by way of crop residue and water for maintaining their herds while the resident farmers are benefited by the arrival of migrant herds by way of manures necessary for maintaining soil quality. The symbiotic pattern has in turn evolved into fairly stable economic exchange arrangements between herd owners and farmers. Yet, when difficult times come, competition for scarce water makes the farmers look after their own first and puts the migrants in difficulty. Research reveals an increasing frequency of clashes between migrants and inhabitants over these scarce resources[8].

[7] Pfeffer,G; Hunters, Tribes, Peasants:Cultural Crisis and Comparison, National Institute of Social Work and Social Sciences, Bhubaneswar, 2003

[8] Field notes of Vivek Kher. ITP Anand

8. ISSUES FOR RESEARCH

Four issues for research are taken up at this stage.

8.1 Assessment of Actual Livestock water needs: Rather than depending upon "text book" figures of maintenance ration and ration for production, it is important to assess how much water is actually given to livestock of different categories. An attempt therefore needs to be made to assess how much water is given by whom, from which source and to which animals. This exercise can also be aimed at finding out if the water given varies across types of animals, breeds and stages of life (young ones, lactating animals etc.)

8.2 Assessment of indirect water needs: When livestock consumes biomass, they are in effect consuming "virtual water". As suggested above, some livestock lives mainly off biomass growing in common lands, forests and wastelands. The virtual water consumed here is perhaps mainly "green water". Other livestock consumes crop residues, specially grown fodders and concentrates. This water is perhaps blue water. Seckler[9] has stated that between 200 to 1000 kg of water is needed by way of evapo-transpiration for producing 1 kg (dry weight) of biomass and this depends upon the ambient conditions (temperature, humidity) as well as the plant species in question. Considering that Indian livestock consumes at least 240 million MT dry matter (see Table 6, green fodder is provisionally taken as having 15% dry matter), the virtual water consumed by Indian livestock would be of the order of 120000 million MT, (120 BCM). This is on the conservative assumption of 500 litres of water per kilogram of dry matter. Since we have taken just the weight of the material actually given to the animals, this should not raise the question of allocation at this stage. This is clearly far larger than the water need for direct consumption and merits closer scrutiny and assessment.[10]

8.3 How do the poor and the underprivileged manage the water needs of livestock: Livestock contributes a significant proportion of income to the poor and the underprivileged. Yet they do not have their own sources of water for their livestock. How do they manage the water needs of their livestock? How do the migrant livestock owners manage their water needs? What social institutions and economic exchanges come in the picture? Are these "fair" or "exploitative"? What do the public agencies do in this regard? Finally,

8.4 What is the current state regarding quality of water available to animals and what impacts does it seem to have on their health and productivity.

---

[9] Seckler,D.; "*Note on Transpiration*" in JW Kjine, R Barker and D Molden (eds) Water Productivity in Agriculture CABI, Cambridge, MA, USA, 2002

[10] Two issues are involved here: if the dry matter concerned is mainly from crop residue, then it is in the nature of "joint product" with grains etc. Since the Commission has accounted for water needs for grains, some of these needs are presumed to be already considered in their figure. Secondly, with high amb ient temperatures in India, water requirement for milk production are likely to be much higher than the regression equation quoted in Section 3.1. Thus there is a need to make a detailed analysis of the issue. It is suggested that this needs to be attempted in this research

Table 1: Livestock Population (Millions)

Species	1951	1956	1961	1966	1972	1977	1982	1987	1992	1997*
Cattle	155.3	158.7	175.6	176.2	178.3	180	192.45	199.69	204.58	197.71
Adult Female Cattle	54.4	47.3	51	51.8	53.4	54.6	59.21	62.07	64.36	NA
Buffalo	43.4	44.9	51.2	53	57.4	62	69.78	75.97	84.21	88.83
Adult Female Buffalo	21	21.7	24.3	25.4	28.6	31.3	32.5	39.13	43.81	NA
Total Bovines	198.7	203.6	226.8	229.2	235.7	242	262.36	275.82	289	NA
Sheep	39.1	39.3	40.2	42	40	41	48.76	45.7	50.78	56.77
Goat	47.2	55.4	60.9	64.6	67.5	75.6	95.25	110.21	115.28	120.77
Horses & Ponies	1.5	1.5	1.3	1.1	0.9	0.9	0.9	0.8	0.82	0.59
Camels	0.6	0.8	0.9	1	1.1	1.1	1.08	1	1.03	0.88
Pigs	4.4	4.9	5.2	5	6.9	7.6	10.07	10.63	12.79	13.58
Mules	0.06	0.04	0.05	0.08	0.08	0.09	0.13	0.17	0.19	0.11
Donkeys	1.3	1.1	1.1	1.1	1	1	1.02	0.96	0.97	0.64
Yak/Mithuns	NC	NC	0.02	0.03	0.04	0.13	0.13	0.04	0.06	0.05
Total Livestock	292.8	306.6	335.4	344.1	353.6	369	419.59	445.29	470.86	479.93
Poultry	73.5	94.8	114.2	115.4	138.5	159.2	207.74	275.32	307.07	352.02
Dogs	NC	NC	NC	NC	NC	NC	18.54	17.95	21.77	NA

Abbr.: NC : Not Collected., NA : Not Available. Note : * : Based on Provisional results from States/UTs.
Source: Basic Animal Husbandry Statistics 2002, Ministry of Agriculture, Dept. of Animal Husbandry & DairyingGovt. of India.

Table 2: Share of Livestock Products in National Economy

Year	GDP- Total	GDP-Agriculture		GDP-Livestock Sector	
	(Rs in Billion)	(Rs. in Billion)	% to total GDP	(Rs. in Billion)	% to total GDP
1980-81	1224	425	34.72	59	4.82
1985-86	2338	700	29.94	139	5.95
1986-87	2600	744	28.62	156	6.00
1987-88	2949	835	28.31	183	6.21
1988-89	3527	1041	29.52	217	6.15
1989-90	4087	1154	28.24	275	6.73
1990-91	4778	1352	28.30	308	6.45
1991-92	5528	1593	28.82	375	6.78
1992-93	6307	1779	28.21	432	6.85
1993-94	7813	2218	28.39	507	6.49
1994-95	9170	2552	27.83	577	6.29
1995-96	10733	2778	25.88	650	6.06
1996-97	12435	3340	26.86	747	6.01
1997-98	13900	3535	25.43	819	5.89
1998-99	16160	4233	26.19	896	5.54
1999-2000	17865	4439	24.85	984	5.51

Source: Government of India (Undated), *Dairy Development Perspective Plan, 2010*, Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries. http://dahd.nic.in/dairyplan.htm

Table 3: Share of Agriculture and Livestock Sector in GDP (At Current Price)

Year	GDP- Total	GDP-Agriculture		GDP-Livestock Sector	
	(Rs in Billion)	(Rs. in Billion)	% to total GDP	(Rs. in Billion)	% to total GDP
1980-81	1224	425	34.72	59	4.82
1985-86	2338	700	29.94	139	5.95
1986-87	2600	744	28.62	156	6.00
1987-88	2949	835	28.31	183	6.21
1988-89	3527	1041	29.52	217	6.15
1989-90	4087	1154	28.24	275	6.73
1990-91	4778	1352	28.30	308	6.45
1991-92	5528	1593	28.82	375	6.78
1992-93	6307	1779	28.21	432	6.85
1993-94	7813	2218	28.39	507	6.49
1994-95	9170	2552	27.83	577	6.29
1995-96	10733	2778	25.88	650	6.06
1996-97	12435	3340	26.86	747	6.01
1997-98	13900	3535	25.43	819	5.89
1998-99	16160	4233	26.19	896	5.54
1999-2000	17865	4439	24.85	984	5.51

Source: Government of India (Undated), *Dairy Development Perspective Plan, 2010*, Ministry of Agriculture, Department of Animal Husbandry, Dairying & Fisheries. http://dahd.nic.in/dairyplan.htm

Table 4: Land Use Pattern and Livestock

State	Geographic Area 000ha	Net Sown Area 2001 000 Ha	Gross Cropped Area 2001 000 Ha	Livestock population 000 no	Cattle population 000 n0	Buffalo population 000 no	Goat population 000 no	Sheep population 000 no	Forest Area 000 ha
AP	27507	10410	12756	48195	9300	10630	6277	21736	6199
Arun	8374	164	268	1261	462	12	231	17	5154
Assam	7844	2734	3957	13431	8641	659	2783	75	1932
Bihar	9416	5664	7897	9688	4469	1795	2912	149	622
Chattisgarh	13519	4800	5595	13487	8882	1598	2336	121	6247
Goa	370	141	168	212	76	37	63	13	125
Gujarat	19602	9622	10734	21168	7317	7006	4368	2021	1706
Haryana	4421	3566	6318	8864	1539	6035	460	633	45
HP	5567	550	956	5183	1953	847	1232	1039	1099
JK	22224	748	1106	10345	3014	1046	2097	3045	2747
Jharkhand	7972	1769	2088	15478	7553	1305	4843	679	2333
Kar	19179	10031	11677	25621	9539	3991	4484	7256	3070
Kerala	3886	2191	2992	3629	2254	65	1222	5	1082
MP	30825	14859	19044	35365	18782	7549	8056	546	8683
Mah	30771	17619	22381	35770	16072	5739	10274	3122	5217
Manipur	2233	140	216	971	418	77	33	6	602
Megh	2243	230	277	1552	767	18	327	18	951
Mizo	2108	118	118	280	36	6	17	1	1626
Naga	1658	333	378	1349	451	34	175	4	863
Orissa	15571	5845	8799	23410	13903	1413	5803	1620	5813
Punjab	5036	4250	7985	8608	2039	5995	278	220	280
Raj	34224	16765	20598	49146	10853	10446	16808	10032	2645
Sikk	710	95	132	426	248	2	124	6	257
TN	13006	5172	6226	24126	9046	2741	6416	5249	2132
Tripura	1049	280	423	1458	759	14	472	3	606
UP	24093	16812	25816	57869	19121	21550	12416	1660	1689
Utt	5348	793	1223	4943	2188	1228	1158	296	3466
WB	8875	5522	9779	41619	18913	1086	18774	1525	1184
India	328726	141345	190278	464472	178938	93225	114594	61507	69089

Source: compiled from various tables from indiastat.com

Table 5: Livestock and Tractors

State	NSA 2001	Tractor	cattle 000n0	buffaloes 000no	Lpopden no/ha	tractor/nsa no/1000 ha	second crop 000 ha
AP	10410	67400	9300	10630	1.75	6.47	2346
Arun	164	400	462	12	0.15	2.44	104
Assam	2734	1400	8641	659	1.71	0.51	1223
Bihar	5664	42000	4469	1795	1.03	7.42	2233
Chattisgarh	4800	30000	8882	1598	1.00	6.25	795
Goa	141	100	76	37	0.57	0.71	27
Gujarat	9622	69500	7317	7006	1.08	7.22	1112
Haryana	3566	207000	1539	6035	2.00	58.05	2752
HP	550	3500	1953	847	0.93	6.36	406
JK	748	1300	3014	1046	0.47	1.74	358
Jharkhand	1769		7553	1305	1.94	0.00	319
Kar	10031	57100	9539	3991	1.34	5.69	1646
Kerala	2191	4000	2254	65	0.93	1.83	801
MP	14859	90000	18782	7549	1.15	6.06	4185
Mah	17619	49600	16072	5739	1.16	2.82	4762
Manipur	140	500	418	77	0.43	3.57	76
Megh	230	0	767	18	0.69	0.00	47
Mizo	118	0	36	6	0.13	0.00	0
Naga	333	0	451	34	0.81	0.00	45
Orissa	5845	3500	13903	1413	1.50	0.60	2954
Punjab	4250	359000	2039	5995	1.71	84.47	3735
Raj	16765	158600	10853	10446	1.44	9.46	3833
Sikk	95	0	248	2	0.60	0.00	37
TN	5172	41800	9046	2741	1.85	8.08	1054
Tripura	280	0	759	14	1.39	0.00	143
UP	16812	310000	19121	21550	2.40	18.44	9004
Utt	793	30000	2188	1228	0.92	37.83	430
WB	5522	15300	18913	1086	4.69	2.77	4257
India	141345	1551500	178938	93225	1.41	10.98	48933

Table 6. Balance-Sheet of Animal Feeds and Fodders

Feeds and fodders	Availability	Requirement	Deficit
Green fodder	224.08 m tonnes	611.99 m tonnes	387.91 m tonnes
Crop residues	231.05 m tonnes	869.79 m tonnes	638.74 m tonnes
Concentrates	31.6 m tonnes	65.4 m tonnes	81.8 m tonnes

Table 7: Supply and Demand of Green and Dry Fodder in India (1995-2025 Estimated)

(in Million MT)

	Supply		Demand		Deficit as % Demand	
Year	Green	Dry	Green	Dry	Green	Dry
1995	379.3	421	947	526	59.95	19.95
2000	384.5	428	988	549	61.1	21.93
2005	389.9	443	1025	569	61.96	22.08
2010	395.2	451	1061	589	62.76	23.46
2015	400.6	466	1097	609	63.5	23.56
2020	405.9	473	1134	630	64.21	24.81
2025	411.3	488	1170	650	64.87	24.92

Source : State Planning Board, Govt. of Kerala.

Table 8: Number per 1000 of Households Possessing Drought Animals by MPCE

(MPCE in Rs. 1993-94 prices)

SN	MPCE class	A pair or more	Single	None
1	less than 120	183	63	750
2	120-140	207	76	706
3	140-165	214	79	705
4	165-190	220	83	695
5	190-210	227	92	679
6	210-235	235	93	671
7	235-265	218	85	696
8	265-300	234	86	686
9	300-355	226	79	693

Source: NSSO, 50th Rounds, Report 424