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# Aspects of India's Bovine Economy: Some Preliminary Results

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## Introduction

1. Past studies on India's livestock economy[1/] have more or less exclusively centered on whether or not there is surplus cattle in India. Those who assert that the existing stock is far in excess of what is needed, with prevalent technology, to meet current demand for livestock products and services, base their conclusion on essentially the following arguments: (a) The current replacement and growth requirements of adult stock can be met with substantially fewer adult females than the number presently maintained in the country by reducing the mortality rates among young stock. (b) At the same time, a reduction in animal population will increase the feed availability per animal and that better feeding alone, without any other change in technology of the livestock industry, can increase the productivity of milk, work and also calving rates atleast in proportion. While the first argument is indisputable, the empirical evidence for the second is not clearly established. More importantly, one has to recognise that, as in the case of human labour, the removal of redundant animals and the effective utilisation of the reduced stock for meeting the existing demand for work, milk and calves, would require major changes in organisational arrangements in the agricultural sector.

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1/ A select bibliography of earlier work is given in the annex.

Preoccupation with the question of "surplus cattle", important as it is, has unfortunately deflected attention from a study of the reasons why the size and composition of livestock in India are what they are. It has been, of course, recognised that the present pattern of livestock holding and management may be the result of rational decisions in response to economic forces operating within the constraints of the existing socio-economic institutions, rather than of irrational religious prejudice. Marvin Harris[1] has made a forceful statement of this view point. Raj[2] has pointed to the existence of wide variations in the composition of cattle herds between regions which are apparently unrelated to the religious composition of their respective human populations. Misra[3] has suggested the secular trends towards a deceleration in the growth of cattle population, and towards increasing specialisation in the use of cattle for work, and buffaloes for milk, reflect adaptations in response to economic forces. However, these observations have not been followed by a systematic study of the variations in the composition of bovine herds or their productivity across regions, and over time, much less to explore the factors which might explain these phenomena. This paper is a preliminary attempt in that direction.

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1. Marvin Harris, "The Cultural Ecology of Indias Sacred cattle, Cultural Anthropology, 1966

2. K.N.Raj, "Indian Sacred Cattle: Theories and Empirical Findings", Economic and Political Weekly, March 17, 1971.

3. S.N. Mishra, "Some Inferences from Compositional Changes in Livestock Population" IJAE, 1970

We begin, in Section 2, with a general review of some salient facts regarding the size and composition of bovine population as well as its behaviour over time. This is followed by a discussion mostly of an exploratory nature, of the reasons for observed variations over space and time, of selected dimensions of the bovine population. In particular we shall discuss mortality patterns, the use of bovines as draught animals, relative roles of the cattle and the buffalo ; and the pattern of variation in the composition of the bovine herd across States and land holding classes.

## II

## Size and Composition of Bovine Population

The overall picture: India's bovine population in 1972, the year of the latest livestock census, was a little over 235 million. There are thus some 40 bovines for every 100 human beings and about 150 bovines for every 100 hectares (ha) of cultivated area. By either index, the density of bovine population in India is among the highest in the world. About 29 per cent of the total consists of youngstock, i.e. animals age 3 years and less. Among the adult animals, the females slightly outnumber the males. More than three-fourths of the bovine population are cattle; buffaloes constitute a little under a fourth. There are significant differences in the age/sex composition of these two categories of bovines (Table 1)

Table 1

Composition of Bovine Population . India, 1972

(in millions)

| | Cattle | | Buffaloes | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No | % |
| Adult males | 74.5 | 41.8 | 8.1 | 14.1 | 82.6 | 35.0 |
| Adult females | 56.4 | 31.6 | 29.2 | 50.9 | 85.6 | 36.3 |
| Youngstock | 47.5 | 26.6 | 20.1 | 35.0 | 67.6 | 28.7 |
| Total | 178.4 | 100.0 | 57.4 | 100.0 | 235.8 | 100.0 |

Source: GOI, Directorate of Economics and Statistics, Ministry of Agriculture and Irrigation, Eleventh Livestock Census, 1972 based on final figures of 18 January, 1976 (mimeographed).

In the first place, while there are 140 males for every 100 females, among adult cattle, there is an overwhelming predominance of females among adult buffaloes, with less than 30 males per 100 females. Second, cattle account for about 90 per cent of all adult male bovines while their share in adult females is only 66 per cent. These point to (a) the dominance of cattle as a source of draught power; and (b) the relatively high degree of dependence on buffaloes as a source of milk. They also suggest that, unlike in the case of cattle, farmers maintain buffaloes primarily for milk production. Third, the proportion of youngstock is considerably higher among buffaloes than among cattle.

Inter-State Variations

As may be expected, the density of bovine population, as well as its composition, varies widely among the States. The extent of these variations can be seen from Table 2. The overall density of the bovine population relative to cropped area ranges from less than 100 per hundred hectares of gross area sown in Rajasthan to over 200 in Assam. In general, and relative to cropped area, States with a relatively high density of human population (rural) also tend to have a high density of bovine population. Significantly, however, the bovine density does not increase in the same proportion as human density. In fact the rate of increase in the former trends to decline as the latter rises, and eventually levels off. The density of adult males and of adult females also shows a similar relation with human density. But there is hardly any correlation between human density and the number of youngstock per hectare (Table 3).

Table 3: Relation between human and bovine densities

| | | |
|---|---|---|
| Adults/Males/hectare | $0.5619 + \underset{(0.1242)}{0.6796^{*}}\,x - \underset{(.0177)}{0.0897^{*}}\,x^{2}$ | $0.7521\ R^{2}$ |
| Adults females/hectare | $0.0151 + \underset{(0.0756)}{0.2583^{*}}\,x - \underset{(0.0108)}{0.0332^{*}}\,x^{2}$ | 0.5656 |
| Youngstock/hectare | $0.3083 + \underset{(0.0989)}{0.0438}\,x - \underset{(0.0141)}{0.0030}\,x^{2}$ | 0.1399 |
| Total Bovines/hectare | $-0.2149 + \underset{(0.2358)}{=.0317^{*}}\,x - \underset{(0.0337)}{0.1323^{*}}\,x^{2}$ | 0-6825 |

X=Rural population/ha.

Table 2

Human (Rural) and Bovine Population relative to Cropped Area : States, 1972

| STATES | Rural Population $10^6$ | Bovine Population $10^6$ | | | | Cropped area $10^6$ ha. | Density per ha. of cropped area | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adult Males | Adult Females | Young stock | Total | | Rural Population | Bovine Population | | | |
| | | | | | | | | Adult Males | Adult Females | Young stock | Total |
| Andhra Pradesh | 34.99 | 6.83 | 7.73 | 5 | 19.56 | 12.24 | 2.859 | .558 | .632 | .408 | 1.598 |
| Assam | 13.70 | 2.46 | 1.97 | 1.86 | 6.29 | 3.04 | 4.51 | .809 | .648 | .612 | 2.069 |
| Bihar | 50.67 | 8.01 | 6.09 | 4.49 | 18.59 | 11.0 | 4.61 | .728 | .554 | .408 | 1.690 |
| Gujarat | 19.18 | 3.09 | 3.86 | 2.96 | 9.92 | 9.91 | 1.935 | .312 | .390 | .299 | 1.001 |
| Karnataka | 22.15 | 4.10 | 5.54 | 3.59 | 13.23 | 9.93 | 2.231 | .413 | .558 | .361 | 1.332 |
| Kerala | 17.82 | .62 | 1.46 | 1.25 | 3.33 | 3.01 | 5.92 | .206 | .485 | .415 | 1.106 |
| Madhya Pradesh | 34.88 | 10.75 | 10.17 | 10.84 | 32.26 | 20.55 | 1.70 | .523 | .569 | .527 | 1.57 |
| Maharashtra | 34.63 | 6.51 | 6.46 | 5.04 | 18.01 | 17.29 | 2.00 | .377 | .374 | .292 | 1.042 |
| Orissa | 20.13 | 5.29 | 4.48 | 3.12 | 12.81 | 7.94 | 2.54 | .666 | .564 | .393 | 1.623 |
| Punjab/Haryana | 18.46 | 2.69 | 4.32 | 4.58 | 12.15 | 10.68(H) | 1.73 | .252 | .457 | .429 | 1.138 |
| Rajasthan | 21.19 | 4.09 | 7.10 | 5.87 | 17.06 | 17.28 | 1.23 | .237 | .411 | .340 | .986 |
| Tamil Nadu | 28.65 | 5.04 | 5.14 | 3.24 | 13,42 | 7.55 | 3.79 | .668 | .681 | .318 | 1.777 |
| Uttar Pradesh | 76.00 | 15.34 | 13.34 | 10.16 | 38.84 | 23.02 | 3.29 | .665 | .578 | .440 | 1.684 |
| West Bengal | 33.51 | 5.26 | 4.01 | 3.43 | 12.70 | 7.08 | 4.73 | .743 | .566 | .488 | 1.798 |

Source: Rural Population: Census 1971. Bovine Population, Livestock Census 1972.
Cropped area: 3 year average for 1970-1, 1971-2 and 1972-3.

7 A comparison of the regression of coefficients for adult males and adult females suggests that, as population density increases, the number of adult males per hectare tends to rise faster than that of adult females initially, and that, while both of them decelerate, the degree of deceleration is greater among females. In other words, as one moves from areas of low to high human densities, not only does the bovine density rise, but the proportion of adult males in the herd seems to rise and that of adult female to fall.

8. As regards the relative importance of cattle and buffaloes, cattle are seen to outnumber buffaloes in all States except Punjab and Haryana; the degree of their dominance in the bovine population, however, varies a great deal (Table 4). The ratio of cattle to buffaloes is well below the national average in Andhra Pradesh, Gujarat, Rajastan and Tamil Nadu, while in Assam, West, Bengal and Orissa the ratio is much higher than average.

The dominance of cattle is generally more marked among adult males than adult females. In general, the cattle-to-buffalo ratio among the former is higher and is indicative of the overwhelming role of cattle as a source of draught power in most parts of the country. Kerala, and to a much smaller degree, Assam, Orissa and West Bengal, are exceptions to this general pattern. In Kerala, for instance, though the cattle population is about six times that of buffaloes, there are only 170 adult male cattle for 100 adult male buffaloes. This reflects an unsually high mortality rate among adult male cattle, as well as the considerably more widespread use of buffaloes for draught purposes.

The proportion of adult females to adult males is much higher for buffaloes than for cattle in a large majority of the States However, in Assam, Kerala, Orissa and West Bengal the proportion of adult males among buffaloes is considerably greater than that of adult females. In these areas the use of buffaloes for draught purposes is at least as important as for milk. Ecological factors might be responsible for this: All these States happen to be areas of relatively high rainfall with rice as the dominant crop;and buffaloes are particularly well suited for ploughing and land preparation for paddy cultivation under these conditions. It is also possible that the buffaloes in these regions are of inferior breeds with relatively low milk yields, and consequently their attraction as milch animals is not as great as in other parts of the country.

The ratio of young stock to total population is generally higher among buffaloes. This is true in all States except again, Assam, Orissa, Kerala and West Bengal. Apart from the differences between the two groups of States mentioned above, there are considerable inter-State variations in the proportion of youngstock both among cattle and buffaloes. Since the number of calves born is a function of the number of adult females, States with a relatively high proportion of adult females may be expected to have a larger proportion of young-stock. The correlation coefficient between these two variables is in fact positive and significant for cattle. (0.4769 , significant at 5%) and even more so, for buffaloes ( + 0.7255, significant at 1%). Nevertheless, this leaves a substantial part of the observed variations

Table 4 - Composition of Bovine Population By States, 1972.

| | Cattle | | | | Buffaloes | | | | Ration of cattle to buffaloes | | | Lactating efficiency | | Sex ratio among young stock | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AM | AF | YS | Total | AM | AF | YS | Total | AM | AF | Total | Cattle | buffaloes | Cattle | Buffaloe |
| Andhra Pradesh | 43.9 | 33.8 | 22.3 | 100 | 19.0 | 49.6 | 31.4 | 100 | 4.09 | 1.21 | 1.77 | 42.4 | 59.8 | 92 | 70 |
| Assam | 45.0 | 31.1 | 23.9 | 100 | 49.1 | 39.9 | 11.0 | 100 | 11.25 | 11.06 | 14.17 | 60.4 | 53.1 | 102 | 95 |
| Bihar | 48.9 | 28.1 | 23.0 | 100 | 19.5 | 51.7 | 28.8 | 100 | 10.16 | 2.20 | 4.05 | 32.8 | 43.1 | 94 | 55 |
| Gujarat | 47.5 | 28.1 | 24.4 | 100 | 1.2 | 58.8 | 40.0 | 100 | 71.28 | .89 | 1.86 | 54.8 | 58.4 | 92 | 20 |
| Haryana | 38.7 | 29.6 | 21.7 | 100 | 2.4 | 50.9 | 46.7 | 100 | 15.29 | .57 | .97 | 58.4 | 66.9 | 92 | 44 |
| Himachal Pradesh | 41.5 | 31.0 | 27.5 | 100 | 2.6 | 66.6 | 30.8 | 100 | 64.43 | 1.56 | 4.00 | 47.0 | 15.1 | 94 | 29 |
| Jammu & Kashmir | 33.5 | 37.2 | 29.7 | 100 | 10.1 | 58.0 | 31.9 | 100 | 13.78 | 2.68 | 4.77 | 53.1 | 57.5 | -- | -- |
| Karnataka | 37.9 | 37.3 | 25.8 | 100 | 9.5 | 56.0 | 34.5 | 100 | 12.44 | 2.07 | 3.12 | 46.1 | 59.5 | 94 | 59 |
| Kerala | 13.7 | 45.5 | 40.8 | 100 | 47.9 | 33.1 | 19.0 | 100 | 1.73 | 8.33 | 6.05 | 51.1 | 60.5 | 50 | 91 |
| Madhya Pradesh | 36.3 | 30.7 | 33.0 | 100 | 19.8 | 45.1 | 35.1 | 100 | 8.37 | 3.19 | 4.57 | 39.3 | 47.4 | 91 | 61 |
| Maharashtra | 42.2 | 31.1 | 26.7 | 100 | 9.3 | 56.4 | 34.3 | 100 | 20.15 | 2.45 | 4.45 | 41.9 | 58.4 | 95 | 44 |
| Orissa | 40.7 | 35.2 | 24.3 | 100 | 45.0 | 31.5 | 23.5 | 100 | 7.40 | 9.16 | 8.22 | 39.9 | 47.0 | 94 | 89 |
| Punjab | 41.7 | 27.2 | 31.1 | 100 | 7.2 | 51.3 | 41.5 | 100 | 5.44 | .54 | .89 | 64.0 | 66.6 | 106 | 46 |
| Rajasthan | 31.6 | 37.0 | 31.4 | 100 | 3.2 | 54.3 | 42.5 | 100 | 26.81 | 1.85 | 2.72 | 48.6 | 54.2 | 90 | 50 |
| Tamil Nadu | 43.9 | 34.6 | 21.5 | 100 | 13.9 | 52.1 | 34.0 | 100 | 11.40 | 2.46 | 3.71 | 52.2 | 64.1 | 94 | 73 |
| Uttar Pradesh | 52.3 | 25.7 | 22.0 | 100 | 12.9 | 52.3 | 34.8 | 100 | 8.43 | 1.02 | 2.08 | 47.6 | 57.0 | 110 | 59 |
| West Bengal | 39.9 | 32.0 | 28.1 | 100 | 63.3 | 24.9 | 11.8 | 100 | 9.08 | 18.57 | 14.42 | 50.9 | 63.0 | 89 | 83 |

Source: Livestock Census 1972.

AM - Adult Males
AF - Adult Females
Ys - Young Stock

Lactating efficiency - Ratio of No. of females in milk to total adult females.

to be explained. The other relevant factors would be the mortality rates among youngstock, the breeding efficiency of female animals, and the rate of growth of adult stock. The first two factors, one expects, will be negatively associated with the proportion of young-stock, while the last should show a positive association.

Variations by size of holdings

11 The relation between human and bovine densities can also be seen from the variations in the pattern of bovine stock in relation to size of landholdings. Such data are available from NSS for the country as a whole relating to 1960-1, and by States for 1972. The all-India data for 1960-1 are set out in Table 5.

12 The average number of bovine stock per unit of cultivated area declines sharply as the size of holding increases. Thus holdings with less than one acre carry over six times as many bovines per unit area as holdings of 30 acres and more. Since the land man ratio is positively related to size of holdings, these data also corroborate the positive association between human and bovine densities shown by the across-State comparisons.

13. The composition of bovine stock held by holdings below 1 acre are quite different from the rest. The proportion of adult males in the bovines owned by them is considerably smaller than the average, and that of adult females and of youngstock correspondingly larger. This pattern holds both for cattle and buffaloes. The preponderance of adult females in the very small holdings would seem to suggest

Table 5 Composition of Cattle and Buffaloe by Size Class of operation holdings, All India 1960-61.

| Size Class (Acres) | Bovines per 100 acre | Cattle | | | | Buffaloe | | | | Adult/Male/Female | | Cattle/Bovine | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Adult Males | Adult Females | Young stock | Total | Adult Males | Adult Females | Young stock | Total | Cattle | Bovines | Adult Males | Adult Females | Total |
| below 0.49 | 270 | 19.4 | 43.8 | 36.8 | 100 | 12.6 | 58.5 | 28.9 | 100 | .44 | .21 | .83 | .71 | .77 |
| 0.5 - 0.99 | 181 | 37.7 | 31.8 | 30.5 | 100 | 17.5 | 52.8 | 29.7 | 100 | 1.99 | .33 | .89 | .67 | .78 |
| 1.0 - 2.49 | 138 | 46.8 | 28.3 | 25.9 | 100 | 26.6 | 45.0 | 28.4 | 100 | 1.69 | .59 | .87 | .69 | .78 |
| 2.5 - 4.99 | 105 | 47.4 | 28.7 | 23.9 | 100 | 21.0 | 48.4 | 30.6 | 100 | 1.65 | .44 | .90 | .72 | .81 |
| 5.0 - 7.49 | 75 | 45.8 | 29.4 | 24.8 | 100 | 21.7 | 46.5 | 31.8 | 100 | 1.56 | .47 | .88 | .69 | .78 |
| 7.5 - 9.99 | 70 | 45.9 | 29.1 | 25.0 | 100 | 21.6 | 46.8 | 31.6 | 100 | 1.58 | .46 | .89 | .70 | .79 |
| 10 -12.49 | 66 | 47.7 | 29.3 | 23.0 | 100 | 19.3 | 47.5 | 33.2 | 100 | 1.62 | .41 | .89 | .66 | .76 |
| 12.5-14.99 | 64 | 44.8 | 29.8 | 25.4 | 100 | 17.7 | 49.0 | 33.3 | 100 | 1.50 | .36 | .89 | .67 | .77 |
| 15 -19.99 | 56 | 47.0 | 29.3 | 23.7 | 100 | 12.4 | 52.3 | 35.3 | 100 | 1.61 | .24 | .92 | .64 | .76 |
| 20 - 24.99 | 42 | 45.1 | 30.6 | 24.3 | 100 | 12.8 | 52.8 | 34.4 | 100 | 1.47 | .24 | .92 | .66 | .77 |
| 25 -29.99 | 39 | 45.1 | 30.8 | 24.1 | 100 | 13.6 | 51.0 | 35.4 | 100 | 1.47 | .27 | .91 | .65 | .76 |
| 30 -49.99 | 32 | 44.2 | 30.5 | 25.2 | 100 | 11.4 | 51.8 | 36.8 | 100 | 1.46 | .22 | .93 | .65 | .76 |
| Over 50 | 28 | 42.2 | 31.2 | 23.3 | 100 | 12.7 | 53.3 | 34.0 | 100 | 1.35 | .24 | .92 | .65 | .78 |

Source: Cabinet Secretariat, National Sample Survey Report No.113, New Delhi, pp.79 & 97

that they concentrate more on producing milk. Beyond the one acre limit, the pattern changes: both among cattle and buffaloes the ratio of adult males shows a mildly falling trend, and that of adult females a rise as one moves up the scale of land holding. There is some indication that larger holdings have a somewhat larger proportion of buffaloes as youngstock; there is no clear trend in the proportion of youngstock among cattle.

14 The relative importance of buffaloes doesnot seem to vary much between different landholdings. However, it would appear that larger holdings tend to have a higher proportion of adult males as cattle, while the ratio of cattle to buffaloes among adult females seems negatively correlated to size of holding. Larger holdings apparently depend to a greater extent on buffaloes as a source of milk. The ratio of cattle youngstock to total youngstock also seems to be the lower in larger holdings, though the relationship is less pronounced, and more erratic, in the adult female category. But since the cattle-buffalo ratio is highly variable between regions, one should be cautious in drawing conclusions from all-India data.

Trends in total population

15 The total bovine population has risen by about 19 per cent over the last 2 decades (Table 6); Most of this increase however took place during the fifties, especially between 1956 and 1961. (The reasons for the exceptionally large increase in the latter period need to be examined). Since 1961, the population has risen by barely 4 per cent, most of it between 1966 and 1972. The adult male and youngstock popula-

Table-6

Trends in Bovine Population, All India, 1951-1972

(Nos. in millions)

| | 1951 | 1956 | 1961 | 1966 | 1972 | % change 1956/51 | 1961/56 | 1966/61 | 1972/66 |
|---|---|---|---|---|---|---|---|---|---|
| Adult Males | | | | | | | | | |
| C | 61.87 | 64.87 | 72.53 | 73.32 | 74.49 | 4.85 | 11.2 | 1.1 | 1.6 |
| B | 6.78 | 6.51 | 7.68 | 8.20 | 8.07 | -4.0 | 18.0 | 6.8 | -1.6 |
| T | 68.65 | 71.38 | 80.21 | 81.52 | 82.56 | 4.0 | 12.4 | 1.6 | 1.3 |
| Adult Females | | | | | | | | | |
| C | 49.37 | 49.93 | 54.20 | 54.68 | 56.40 | 0.1 | 8.6 | 0.9 | 3.1 |
| B | 21.86 | 22.35 | 25.02 | 26.16 | 29.24 | 2.2 | 11.9 | 4.6 | 11.8 |
| T | 71.73 | 72.28 | 79.22 | 80.84 | 85.64 | 0.8 | 9.6 | 2.0 | 5.9 |
| Youngstock | | | | | | | | | |
| C | 43.58 | 43.81 | 48.83 | 48.05 | 47.49 | 0.5 | 11.5 | -1.6 | -1.2 |
| B | 14.76 | 16.09 | 18.50 | 18.59 | 20.12 | 9.0 | 15.0 | 0.5 | 8.2 |
| T | 58.34 | 59.90 | 67.33 | 66.64 | 67.61 | 2.7 | 12.4 | -1.0 | 1.5 |
| Total | | | | | | | | | |
| C | 155.26 | 158.67 | 175.62 | 176.06 | 178.38 | 2.2 | 10.6 | 0.3 | 1.3 |
| B | 43.40 | 44.95 | 51.20 | 52.92 | 57.43 | 3.6 | 13.9 | 3.3 | 8.5 |
| T | 198.69 | 203.61 | 226.82 | 228.98 | 235.81 | 2.5 | 11.4 | 0.95 | 2.98 |

Source: Livestock Census

C = Cattle

B.= Buffaloes

T = Total

tion seems to have grown considerably faster than adult female during fifties. In the sixties, while there was hardly any rise in the former two categories, the number of adult females continued to grow.

16 Throughout the period, the population of buffaloes has consistently grown faster than that of cattle, the difference being most marked in the adult female and the youngstock categories. Significantly, and in sharp contrast with buffaloes, cattle youngstock population has been declining in absolute terms during the last decade inspite of the reduction in mortality rates. The decline is especially marked among male youngstock and presages a reduction in the number of adult male buffalo population is rather erratic. After declining some 5 per cent between 1951 and 1956, it rose sharply in the subsequent decade, but fell again during 1966-1972.

17 The steady rise in the ratio of buffaloes to cattle among adult female shows that farmers have been progressively shifting to buffaloes as a source of milk. In 1951, there were 44 adult female buffaloes for every 100 adult cows; by 1972, the ratio had risen to 52. The lactating efficiency of cattle seems to have remained remarkably stable; that of buffaloes rose sharply between 1951 and 1956, fell in subsequent decade and despite a recovery in 1972, still remain well below the 1956 level (Table 7)

Table-7

Trends in Adult Female Bovine Population

All India, 1951-1972

| | 1951 | 1956 | 1961 | 1966 | 1972 |
|---|---|---|---|---|---|
| Breeding Cattle | | | | | |
| Total | 46.38 | 47.26 | 51.00 | 51.76 | 54.42 |
| In milk | 18.97 | 20.10 | 20.67 | 20.97 | 22.04 |
| Per cent | 40.9 | 42.5 | 40.5 | 40.5 | 40.5 |
| Breeding Buffaloes | | | | | |
| Total | 21.01 | 21.69 | 24.24 | 25.52 | 28.51 |
| InMilk | 10.22 | 11.82 | 12.46 | 15.92 | 15.07 |
| Per cent | 48.6 | 54.4 | 51.4 | 50.6 | 52.9 |
| Ratio of breeding cattle to buffaloes | 2.28 | 2.18 | 2.10 | 2.02 | 1.92 |

Changes in Land holding classes

18. Some idea of the behaviour of bovine stock, overall and by major categories, by size class of holding is available from the National Sample Survey for 1961 and 1972. The data are summarised in Table 8 Changes in total bovine population, and its major components, obtained from the NSS data are broadly in accord with Livestock Census data: Between 1961 and 1972, there has been a marginal increase in both adult males and adult females, but hardly any change in youngstock population. The increase in adult female population is however, less than in the Livestock Census.

19 The data show total bovine population per household as well as that of adult males, adult females and youngstock, have declined in practically all land holding classes. In the very small holding (with less than 0.2 hectares) there has been a rise in the total bovines and adult males. There was also an exceptionally large change in the 0.4 to 1.00 hectare group in all categories. (This is so much at odds with the general pattern and the numbers for 1972 are so implausibly large as to raise doubts on the accuracy of this estimate.) In the remaining groups, it seems that the decline in total bovine stock and of adult females per household has been somewhat greater than average in the larger holding households, and lower than average among the smaller holdings. But the extent of decline in adult females and youngstock bears no relationship at all to size of holdings

1. In so far as averages for particular land holding classes are subject to larger margins of error than the average for the sample as a whole, all these conclusions should be treated cautiously.

Table 8 - Size and Composition of Bovine stock per (%) households by size class of operational holdings in Rural areas, 1961-62 and 1970-72.

| Size class (in acres) | Total Bovines 1961-2 | Total Bovines 1972 | Adult Males 1961-2 | Adult Males 1971-2 | Adult Females 1961-2 | Adult Females 1972 | Youngstock 1961-2 | Youngstock 1972 | Ratio of cattles to buffaloes. 1961-62 | Ratio of cattles to buffaloes. 1972 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.01 - 0.49 | 66.30 | 73.80 | 12.72 | 21.58 | 29.94 | 29.35 | 23.64 | 22.87 | 2.79 | 4.66 |
| 0.50 - 0.99 | 159.83 | 153.00 | 58.36 | 58.04 | 60.40 | 58.19 | 41.07 | 36.77 | 3.53 | 4.27 |
| 1.00 - 1.24 | 247.63 | 189.74 | 108.80 | 78.71 | 81.92 | 69.56 | 56.91 | 41.47 | 3.81 | 3.74 |
| 1.25 - 2.49 | | 2520.54 | | 1186.79 | | 792.84 | | 540.91 | | 4.30 |
| 2.50 - 4.99 | 364.81 | 365.70 | 161.89 | 164.70 | 117.74 | 111.37 | 85.18 | 81.71 | 4.21 | 3.59 |
| 5.00 - 7.49 | 500.69 | 475.10 | 208.08 | 200.91 | 173.19 | 158.20 | 119.42 | 115.99 | 3.91 | 3.79 |
| 7.50 - 9.99 | 580.17 | 540.93 | 235.46 | 230.76 | 191.10 | 186.06 | 153.61 | 123.41 | 3.57 | 3.37 |
| 10.00 - 12.49 | 627.22 | 621.82 | 255.13 | 246.46 | 217.29 | 225.47 | 154.30 | 149.89 | 3.35 | 3.18 |
| 12.50 - 14.99 | 724.06 | 677.65 | 276.28 | 262.07 | 255.01 | 253.07 | 192.72 | 162.51 | 3.45 | 3.18 |
| 15.00 - 19.99 | 787.16 | 721.55 | 304.80 | 282.96 | 276.09 | 267.09 | 206.27 | 171.50 | 3.20 | 3.36 |
| 20.00 - 24.99 | 841.72 | 777.46 | 317.74 | 294.80 | 305.97 | 288.77 | 218.01 | 203.89 | 3.41 | 2.99 |
| 25.00 - 29.99 | 931.21 | 907.85 | 340.28 | 342.15 | 345.23 | 329.66 | 2450.70 | 236.04 | 3.07 | 3.42 |
| 30.00 - 49.99 | 1131.71 | 1003.15 | 438.46 | 376.85 | 385.86 | 373.20 | 263.09 | 254.06 | 2.45 | 3.26 |
| Over 50 | 1636.19 | 1401.42 | 603.21 | 528.04 | 603.00 | 529.61 | 429.98 | 343.77 | 2.92 | 3.35 |
| All sizes | 307.64 | 278.22 | 121.61 | 111.94 | 107.62 | 98.66 | 78.41 | 67.43 | 3.51 | 3.47 |

Source: 1961-62, GOI, Cabinet Secretariat, National Sample Survey. Report No.144 Tables with notes on some Aspects of Land Holdings in Rural Areas. 17th Round September 1961 - July 1962. (Delhi, 1961)

1971-72, GOI, Department of Statistics, National Sample Survey Number 215, 26th Round, July 1971 September 1972, Tables on Holdings, All India, (February 1976).

20 The overall decline in cattle to buffalo ratio is largely concentrated in the middle size holdings (from 1.00 to 10 hectares); holdings below one hectare, and those above 10 hectares, appear to have substantially increased the share of cattle in their bovinestock. There is also a pattern to the improvement in breeding efficiency. There has been hardly any improvement in the small holdings; the extent of improvement seems to increase with the size of holdings till about 10-12 hectares, before tapering off in the largest 2-3 landholding class. A more disaggregated state-wise analysis of the change in the pattern of bovine stock by different classes of holdings would help understand whether the patterns revealed by the all-India data are widespread or whether they reflect shifts in the spatial distribution of bovinestock.

## III

## The Pattern of Mortality

21. A closer examination of the sex composition of youngstock (see table 5) reveals some rather puzzling features. Since the rearing of bovines from birth to adulthood involves substantial costs, one would expect the marked plurality of male cattle at the adult stage, and of females among buffaloes, to be reflected in the sex ratios of young-stock as well. This is indeed the case for buffaloes whose sex ratio (males per hundred females) is below 100 in all three age groups for which data are available and declines steadily from 0-1 to the 3+ age group. (Table 9) The latter suggests that the sex ratios are progresively adjusted from birth to adulthood to achieve the desired sex distribution of adult stock. The behaviour of sex ratios among

Table - 9

Sex Composition of Cattle and Buffaloes
in Different Age groups
All India, 1966

| | Cattle | | | Buffaloes | | |
|---|---|---|---|---|---|---|
| | 0-1 | 1-3 | 3+ | 0-1 | 1-3 | 3+ |
| Males (millions) | 11.2 | 12.1 | 73.3 | 4.0 | 2.4 | 8.2 |
| Females (millions) | 11.1 | 13.6 | 54.7 | 5.9 | 6.3 | 24.1 |
| Males/100 Females | 100.7 | 89.6 | 136.2 | 67 | 39 | 32 |

Source:- G O I, Ministry of Agriculture, Diredtorate of Economics and statistics, Indian Livestock Census, 1966, Vol. II Detailed Tables, Part I, (mimeo. 1972)

cattle across age groups is very different and seems to be erratic. The sex ratio is close to 100 in 0-1 age group, declines substantially in the 1-3 age groups, before shooting up to over 1300 among the adult animals. Prima facie, it is difficult to see why the sex ratio among young cattle should be so far out of line, not just in magnitude but directionally as well, with the ratio among adult stock.

This pattern seems to prevail in most parts of India. It will be seen from Table 10 that in most States, as in all-India, survival rates of buffaloes calves from birth to age 1 and then on to adulthood,, are considerably less than those of cattle. Most states also conform to the all-India pattern in that, the survival rate for cattle calves through the first year of birth are roughly the same for both males and females, the major exception being Gujarat and Kerala. Again, in most States, as in all India, more females aged one year survive to adulthood than males of the same age even though males are predominant in the adult population. The significant exceptions to this pattern are Gujarat, Punjab and Uttar Pradesh. In all these cases, fewer females calves survive to adulthood compared to males and this pattern is consistent with the observed sex ratios among adults. In Kerala, again, the relative survival rates of male and female cattle through the young age is consistent with the sex ratio of adult stock. The deviations from the all-India pattern are fewer in the case of buffaloes: In most cases the relative survival rates in the young ages are consistent with the observed sex ratios of adult stock which generally show a marked plurality of females.

Table-10

Survival Rates of young Bovine Stock by States, 1966

| STATES | Cattle | | | Buffaloes | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0-1 | | 1-3 | 0-1 | | 1-3 | | |
| | Male | Female | Male | Female | Male | Female | Male | Female |
| Andhra Pradesh | .976 | 1.000 | .472 | .530 | .681 | .869 | .227 | .369 |
| Assam | 1.000 | .931 | .388 | .437 | .985 | .932 | .409 | .451 |
| Bihar | .943 | 1.000 | .612 | .752 | .821 | .997 | .292 | .594 |
| Gujarat | 1.000 | .837 | .581 | .553 | 0.300 | .963 | .073 | .580 |
| Haryana | 1.000 | .906 | .375 | .504 | .673 | 1.000 | 0.101 | .572 |
| Jammu & Kashmir | 0.967 | 1.000 | 0.630 | .629 | .385 | .860 | .135 | .461 |
| Kerala | 0.692 | 1.000 | .245 | .594 | .514 | .616 | .372 | .303 |
| Madhya Pradesh | 0.982 | .996 | .783 | .962 | .689 | .873 | .400 | .796 |
| Maharashtra | 0.984 | .988 | .600 | .633 | .437 | .750 | .150 | .386 |
| Mysore | 1.000 | .986 | .446 | .494 | .520 | .805 | .148 | .322 |
| Orissa | 1.000 | 0.987 | .490 | .514 | 1.000 | .944 | .443 | .492 |
| Punjab | 1.000 | .998 | .567 | .533 | .579 | .865 | .130 | .565 |
| Rajastan | 0.993 | .948 | .497 | .717 | .708 | .999 | .214 | .799 |
| Tamil Nadu | .999 | 1.000 | .455 | .461 | .695 | .840 | .209 | .297 |
| Uttarpradesh | 1.000 | .990 | 0.461 | .424 | .629 | .987 | .143 | .372 |
| West Bengal | .936 | 1.000 | 0.570 | .508 | .712 | .737 | .292 | .345 |

Note: Computed from livestock Census data for 1966 using the same assumption as for all-India (See Table 3). In the case of cattle, the number of calves in C-1 group exceeds the number of cows in milk in most States. Therefore, the calculations are based on the number of males or females in 0-1 group, which ever is higher.

In the case of buffaloes, the number of calves born is, in all states except Orissa, taken as equal to the number of females in milk. In Orissa since the population below 1 year is greater than buffaloes in milk, the number of males below 1 year is taken as the starting point.

23. Relative mortality rates, and therefore sex ratios, follow this general pattern throughout the last 2 decades, with indications of some secular trends. (Table 11) Among cattle there has been a steady decline in the number of male to female calves below 1 year suggesting that the mortality rate of females has fallen relatively to that of males. The mortality rates in the 1-3 age group seems to have fallen for both sexes, but the fall is considerably greater and more sustained among females. While the number of males per female in the 0-3 group has steadily fallen between 1951 and 1966 ( the data for 1972 are not yet available), the ratio has moved in the opposite direction among adult cattle. The apparently odd pattern of mortality as between sexes of cattle at different ages has been intensified over time.

24. Among buffaloes, there has been some decline in the number of males per female in the 0-1 age group suggesting that a rise in male mortality in the first year of birth relative to female mortality. Female mortality has definitely fallen in the 1-3 age group; the decline of mortality among adult males is less pronounced and apparently not sustained. As a result, the sex ratio in this group moves rather erratically from census to census. In the adult age group, there was a slight rise in the number of males per female between 1956 and 1966, but the ratio has since fallen rather sharply.

Table-11

Trends in Sex Ratio of Cattle and Buffaloes by Age Group
All India, 1951-1972

| | | 1951 | 1956 | 1961 | 1966 | 1972 |
|---|---|---|---|---|---|---|
| Cattle | | | | | | |
| Sex Ratio | 0-1 | 104.8 | 103.2 | 101.2 | 100.7 | n.a. |
| | 1-3 | 97.8 | 95.9 | 90.3 | 89.6 | n.a. |
| | 3+ | 124 | 131.8 | 135.6 | 136.2 | 132.1 |
| Mortality Rate | | | | | | |
| | 1-3 Male | n.a. | .547 | .441 | .443 | n.a. |
| | Female | n.a. | .423 | .381 | .378 | n.a. |
| Buffaloes | | | | | | |
| Sex Ratio | 0-1 | 68.6 | 68.6 | 69.7 | 67.5 | n.a. |
| | 1-3 | 45.2 | 37.9 | 41.1 | 38.7 | n.a. |
| | 3+ | 31.0 | 29.9 | 31.5 | 32.3 | 27.6 |
| Mortality Rate | | | | | | |
| | 1-3 Male | n.a. | .820 | .790 | .802 | n.a. |
| | Female | n.a. | .524 | .489 | .488 | n.a. |

Source: Livestock Censuses.

Sex Ratio is defined as number of males per 100 females.

25 Assuming that at birth there is an approximate parity between males and females, changes in sex ratios across age groups are essentially a reflection of differential mortality (whether due to natural causes or to slaughter). We have made rough calculations of the average mortality rates in 0-1 and 1-3 age group on the basis of data from the 1966 livestock Census. (Table 12) They show that in both age groups, the overall mortality rate is much higher for buffaloes than for cattle. It seems unlikely that this is due to greater natural susceptibility of young buffaloes to fatal infection and disease than cattle; more likely, it is a reflection of deliberately greater neglect of buffaloe youngstock by farmers. Of greater significance from the view point of the sex ratio is the differential mortality of males and females. In the case of buffaloes, the rate of male mortality is higher than that for females in both age groups, the difference being particularly pronounced in the first year of birth. In the case of cattle, there seems to be little difference between the mortality rates of the two sexes in the first year of their life. But between 1 and 3 years of age, the mortality rate among males is significantly higher than among females. It seems highly implausible that this change in the mortality pattern between 0-1 and 1-3 age groups could be the result of any natural factors. If, on the other hand, it is the result of deliberate decision on the part of farmer, it seems rather odd that they should let fewer males survive to adulthood relative to females, when at the adult stage they have to carry a lot more males than females.

Table-12

Rough Estimates of Survival Rates of Cattle and Buffaloes in different age groups, All India, 1966

| | | Cattle | Buffaloes |
|---|---|---|---|
| 0-1 | Male | 1.0 | .615 |
| | Female | 0.994 | .912 |
| 1-3 | Male | 0.557 | .198 |
| | Female | 0.622 | .512 |

Assumption:

1. The number of calves born in any census year equal to twice the number of male and of female calves in the 0-1 age group or the number of breeding females in milk whichever is higher.

2. Number of calves born in the inter-censal years estimated by linear interpolation.

3. Mortality rate in the 0-1 age group does not change over time.

4. Surviving calves of 1-3 years age in year t(pt-3) should have born in t-1 and $t_{-2}$

   Survival rate = $pt \frac{(1-3)}{\frac{b^o}{t-1} + \frac{b^o}{t-2}}$

Where, $b^o$ refers to the number of calves born in year t.

Notes: a. Since the number of calves in 0-1 exceeds the number of breeding cattle in milk, we have taken the number of male calves in this age group as the basis for survival rate calculates.

b. In the case of buffaloes, since the number of calves in 0-1 is very much lower than the number of breeding females in milk, the number of calves born is assumed to be equal to the latter, and divided evenly between male and female. Note that these are only crude approximations of the number of calves born.

26. It is possible that the observed sex ratio at the adult stage does not reflect famer's perference so much as the differential mortality rates of the sexes at different stages of adulthood. There is indeed some indication that the mortality rates of adult males and females follow divergent patterns. Dandekar has estimated (See Table 13) on the basis of data collect in 1950-51 that, among adult cattle, females have a consistently higher mortality rate than males and that the difference increases sharply within age. Thus between 3 and 6 years, the average mortality rate for females is some o 40 per cent higher than for males; in the 6-8 age group, it is over 300 per cent. Thereafter, the mortality rates of the two sexes seem to converge rapidly. By contrast, the mortality rate among adult buffaloes is consistently higher for males, the difference reaching a maximum inthe 5-6 age group, falling off quite rapidly thereafter.

27. Since there is no strong reason to believe that the adult female cattle is inherently more prone to disease and death than the buffalo or the male cattle, the differential mortality pattern can only be explained in terms of differential care and attention given to different categories of animals. Dandekar's estimates suggest that the mortality rate among females cattle is not very different from that for female buffaloes in the 3-6 age group; but thereafter former rises sharply while the latter shows but a marginal rise till about 9 years. Neglect of the cow, which usually takes the form of indifferent or inadequate feeding and

Table-13

Annual death rate of cattle and buffaloes at different ages: All India, 1950-51

(Average death rate per 000 animals)

| Age group | Cattle | | | Buffaloes | | |
|---|---|---|---|---|---|---|
| | Bullocks | Cows | Calves | He-Buffaloes | She-buffaloes | Calves |
| Below 1 | | | 263.2 | | | 386.5 |
| 1-2 | | | 84.5 | | | 194.7 |
| 2-3 | | | 55.2 | | | 154.8 |
| 3-4 | 60.9 | 85.9 | | 149.3 | 83.2 | |
| 4-5 | 60.9 | 85.9 | | 149.3 | 83.2 | |
| 5-6 | 60.9 | 85.9 | | 198.7 | 74.9 | |
| 6-7 | 41.0 | 94.1 | | 151.8 | 88.6 | |
| 7-8 | 26.6 | 94.1 | | 151.8 | 88.6 | |
| 8-9 | 26.6 | 126.0 | | 151.8 | 88.6 | |
| over 9 | 128.6 | 174.0 | | 164.4 | 136.4 | |

Source: Dandekar V.M., Second Report on the Poona Schedule of the National Sample Survey, 1950-51, (Poona, 1954) P.67.

Note: 1. The basis for these estimates are explained thus:

"Data on distribution by age of different animals as well as on deaths and slaughter in four weeks prior to the interview were collected. The latter related to the former gives four weekly death rates in different age groups. In order to derive annual death rates from the above data, the following procedure was adopted for the age groups 0-1 and 1-2: For the age group 0-1, the weekly death rates for successive 13 periods were obtained from the four weekly death rates for 0-1 and 1-2 (namely, 35.7 and 8.6 for cattle) by taking weighted averages, the weights being 13, 0; 1, 72; 2, 11; .... 12, 1. These death rates were then successively applied to survivals at the end of each to get annual death rates of the 0-1. This measures the proportion of calves below 1 year age which will die in the course of the year. (This is rather different from infant mortality rate as usually measured namely, the number of live-born calves which live to year 1) The death rate for 1-2 is derived on the basis of four weeklydeath rates for this age group successively 13 times to the survivals at the end of each four weekly period.(p.63)

2. The above estimates of mortality are based on sample data on age distribution which seem defective, especially in the young age groups; the ratio of youngstock aged less than one year to those of 1-2 years age derived from the Gokhale Institute data is much less than obtained from Livestock Census and subsequent NSS Reports. Also on the basis of data on birth rates given on PP 75-76- of the report, and the data on the population in the 0-1 age group, the infant mortality rates would seem to be very much higher than shown in the above table.

and makes it difficult for the animal to withstand the stresses of successive pregnancies, seems to become pronounced after the second lactation. Clearly at this stage the bullock is given much greater care and attention. One has to probe deeper into the reasons for this apparent difference in the care of cows and bullocks. Perhaps the milk yields of cow drops off sharply after the second/third lactation; perhaps the calving interval and/or the dry period increases with the age of the animal; perhaps the lack of specialisation across land holding classes intensifies the competition for limited feed resources in the smaller farms thus forcing them to choose the bullock in preference to the cow. As between the cow and the she-buffaloe, it is possible that the latter receives greater care partly because of it is more valuable as a milk animal and also because its biological character demands more careful attention. All this is, however, speculative and, even if true, still does not explain why farmer should not take better care of the young male cattle. For by reducing the male mortality rate in the 1-3 age group, the farmer in fact can make do, as far as reproductive function is concerned, with fewer cows than at present. This whole question needs to studied in greater depth using more recent data.

## IV

## Draught Animals

28 At the time of the Livestock census of 1972, there were about 83 million working bovines in the country: 75 million of them were cattle, the remain being buffaloes. Almost all (97 percent) of working animals in both categories were males.[1/] The number of adult male bovines therefore provides a close approximation to the size of the draught animal population.

29 The number of draught animals p r hectare of cropped area varies a great deal across states, as well as between land holdings of different size. In general, states with relatively high density o rural population relative to cropped area also tend to have more draught animals per unit area; but the rate o increase in the latter falls off as one moves up the scale of human density. The relation is much the same when we view the dis-tribution of human and draught animal population by size of holdings. These are summarised by the following regression equation.

1. State Gros s Section[2/] 1972 $Y_1 = 0.5619 + 0.6796\ X_1^* - 0.0697\ X_1^2$ $(R^2 = 0.75)$

[2/] State Regressions based on Population and Livestock Census Data

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[1/] There were 2.1 million working cows and 0.4 million working she buffaloes. The use of female cattle for work seems to be pronounced in the three Southern States of AP, Karnataka and Tamil Nadu. They accounted for over half of the total number of working cows in the country. In all these States the ratio of working cows to working cattle was considerably higher than the national average and reaches a high.12 percent in Tamil Nadu.

3. Landholding[b/] Cross Section 1972 $Y_1 = .292201 + .157352^{*} X_2 - .002299^{*} X_2$

(.013825) (.000266)

($R^2 = .95$)

Notes: $Y_1, _2$ = Adult Male bovines per hectare of cropped (operated) area; $X_1$ = Population per hectare of cropped area; $X_2$ = No. of persons per hectare of operated area in different size classes.

[b/] Based on NSS 26th round data

30 The more densely populated regions, like the relatively small holdings, are generally also areas where natural factors like soil and climate, and or the availability of man-made irrigation facilities permit intensive cropping involving higher inputs of both human and animal power. Over most of India, the soil is so hardened by prolonged dry spell and high temperatures of the summer that the preparation of land for sowing cannot be done by human labour alone. The use of animals or machines is indispensable. Animals are also used in other agricultural operations (like weeding and inter culture) as well as in transportation of inputs and outputs. Clearly more intensive cultivation is associated with larger input of human labour; but it is not obvious that there is any strong or invariable technological reason compelling a higher level of animal power input along with higher human labour input. Animal power can be substituted by machines over practically the whole range of operations; and there is scope for using human labour in at least some of the operations currently being done by animals. In parts of Kerala where adequate pre-sowing rainfall is available, even land preparation is done wholly by human labour.[1/] Thus one has to look for a complex of factors to explain the observed variations in the extent of draught

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[1/] This is one of the interesting findings of a survey conducted by P. Nityanan Nair. He also found a well-developed bullock hiring system.

animal power in relation to cropped area.

31 The fact that more intensive cultivation generally associated, in India, with relatively high population densities and small holdings- may require a relatively high input of animal power does not explain why small farms and farms in densely settled areas should carry relatively large stock of draught animals per unit area. The usual explanation in terms of the indivisibility of animal units is not wholly convincing because this limitation can be, in principle, overcome by a system of leasing of animal services. In fact if, as seems to be the case, the available stock of animals is in excess of the requirements during the critical periods, or periods of peak demand,[1/] a leasing system should lead to greater efficiency in the sense of meeting all the demand for animal labour with a smaller stock of animals. The potential gain from leasing or sharing is likely to be the greater because smaller farms tend to use the draught animals less intensively.

32 As a matter of fact, however, the extent of leasing seems quite limited: The ratio of hired to total bullock labour was less than 5 percent in the Punjab and Orissa, 10 percent in Madhya Pradesh, and 10 percent in Madras.[2/] This is the more surprising because some recent surveys report that a sizeable proportion of farmers, especially those with very small holdings, do not have any working bovines. Thus, the NSS reports that in 1971-72, about a third of the rural households

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[1/] Farm Management Survey data show that bullocks are unemployed for upwards of 40 percent of available time even during the peak season: For instance in Orissa bullocks were employed only 57% of the time in June-July (the peak season for that state); 60% of the time in Gujarat (May) and 50-60% in Uttar Pradesh (April-May and October). These date are all from surveys conducted in the mid-fifties.

[2/] Figures relate to mid-fifties.

operating land did not have any working bovines; and 65 percent of farms with less than 0.40 hectares did not have any working bovines.[1/]

The absence of well developed lease market could be an indication that the critical period when animal power is imperative may be much shorter than a month and that average utilisation rate over a month or two does not give a correct picture of the conditions during the critical season. If this were so, and the penalty in terms of loss of output of not getting the animals at the right time is large, the willingness farmers to carry an apparently excessive stock of draught animals, operated for only a fraction of the time, may be more explainable.

33 Since, prima facie animals and machines are substitutable, one would expect that as the intensity of machine input per unit area increases that of animal power per unit will fall. We tested this hypothesis as well as the relation between holding size and draught animal stock per hectare[2/] on the data from the livestock census in respect of a

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1/ The proportion of households operating land but not owning any working bullocks or buffaloes varies widely. It is around 15 percent in Punjab, 40-50 percent in AP, Karnataka and Tamil Nadu and close to 90 percent in Kerala.

2/ This is meant as a rough test of the indivisibility hypothesis. If, for whatever reason, farmers wish to hold some draught animals irrespective of size and given that these animals are indivisible units the no. of animals per hectare should increase as the holding size decreases. In this regression, the no. of animals in each size class of holdings were averaged over all holdings in that class (including those without any work animals). Since the proportion not owning any work animals is inversely related to holding size, this introduces a systematic bias in the estimated relations.

cross-section of states in 1961 and 1971) as well as on NSS data (in respect of a crosssection of holdings of different sizes for all India and for a few states). The only significant variable explaining the variations in draught animals per hectare, and that too not consistently, was the average size of holding. The coefficients for mechanical power had mostly the expected negative sign but were statistically insignificant in the inter-state cross-section as well as across land holding classes for all India and in three out of the five States for which the latter were tried. (Table 14)

34. Over time also, the relation between mechanical and animal power in agriculture remain clouded: At the all India level, the stock of the adult male bovines, has grown considerably slower than cropped areas consequently (except during 1951-56,) the number of adult male bovine per hectare of cropped area has been consistently falling; Over the same period there was a sharp rise in the quantum of mechanical power per hectare (Table 15) At first sight this would seem consistent with the hypothesis that animal power per hectare is being substituted with mechanical power mostly for irrigation and to a lesser degree for land preparation and, perhaps, transport.

35. But this neat picture vanishes when we look at State level data: of the five selected States, all show a rapid and sustained rise in mechanical power per hectare, but only three recorded of decrease in the number of draught animals per unit area (Table 15). The latter

Table 14 Relation between Drought Animals per hectare (Y) Average holding size ($X_1$) and Mechanical Power per hectare ($X_2$)

All India

State Cross Section $Y = 139.07 - 26.8X_1^{*} - .066X_2$ ($R^2 = .777$)
(4.64) (.321)

Landholding classes: States

Punjab Log $Y = 4.95 - .089X_1^{*} - .883X_2^{*}$ ($R^2 = .90$)
(.013) (.405)

Kerala $Y = 12.357 - 1.288 X_1 + 3.971X_2$ ($R^2 = .258$)
(.954) (10.897)

Karnataka $Y = 111.569 - 4.299 X_1^{*} - 297.302X^{**}$ ($R^2 = .561$)
(1.27) (152.82)

Andhra Pradesh Log $Y = 4.434 - 0.056 X_1^{*} + .832X_2$ ($R^2 .548$)
(.016) (3.904)

Tamil Nadu $Y = 231.26 - 2.527X_1 - 334.26X_2^{*}$ ($R^2 = .623$)
(2.486) (115.691)

Sources: The data underlying these regressions are all from the NSS, 26th round land holding survey.

Note: We tried 3 functional forms in all cases, namely linear, semi-log and log linear. In general the R is lowest in the linear from and largest in the log linear form. But as a rule the change in functional form seems to increase the value of the coefficient for landholding size, but not that of the mechanical power which remains insignificant except in a few cases. But in the case of Punjab either coefficient for the linear from is significant, but both are significant in the semi log form. In the case of AP; both coefficients are insignificant in the linear form, but one of the coefficients is significant in the semi log form.

* Significant at 5%

Table- 15

Trends in animal and Mechanical power
Used in Agriculture, All-India, 1951-1972

| | 1951 | 1956 | 1961 | 1966 | 1972 |
|---|---|---|---|---|---|
| Number of working animals 1/ (million) | 67.3 | 70.7 | 80.4 | 81.4 | 82 |
| Gross Sown area 2/ ($10^3$ ha.) | 127.9 | 145.7 | 155.2 | 156 | 164 |
| Number of tractors (000) | 8.6 | 17.73 | 27.3 | 54 | 148 |
| Number of pumpsets (000) | 108.6 | 169.2 | 390.1 | 886. | 3176 |
| Number of cane crushers (000) | 21.3 | 23.3 | 33.3 | 45 | 87 |
| Total House power3/ (000) | 782 | 1227 | 2527 | 5465 | 18535 |
| Working animals/ha | .526 | .485 | .518 | .515 | .500 |
| Mechanical power (hp/ha) | .006 | .008 | .016 | .035 | .113 |

1. Including working adult females, and, hence not strictly equal to adult males.
2. Three year average centre around year at head of each column.
3. Assuming that a tractor has an average power of 15 hp. and all other equipment 5 hop. each.

Source: Livestock Census data.

index behaves quite erratically in Andhra while in Karnataka it has shown a sustained rise from 1956 to 1972. And there is obviously no consistent between the rate of increase in mechanical power per hectare and the rate of change of draught animal per hectare.

Table 17

Trends in draught animal and mechanical power in HP per ha. of cropped area, Selected States, 1956-1972

| | 1956 | 1961 | 1966 | 1972 |
|---|---|---|---|---|
| Andhra Pradesh | | | | |
| Draught Animal | .469 | .552 | .548 | .586 |
| Mechanicall Powe: | .023 | .025 | .047 | .116 |
| Karnataka | | | | |
| Draught animals | .369 | .387 | .391 | .411 |
| Mechanical power | .007 | .013 | .032 | .113 |
| Kerala | | | | |
| Draught animals | .303 | .355 | .297 | .206 |
| Mechanical power | .009 | .015 | .027 | .054 |
| Tamil Nadu | | | | |
| Draught animals | .679 | .817 | .783 | .706 |
| Mechanical power | .042 | .102 | .254 | .402 |
| Punjab | | | | |
| Draught animals | .276 | .282 | .266 | .245 |
| Mechanical power | .013 | .022 | .048 | .291 |

Notes: Computed from Livestock Census data. Draught animals include working male and female animals: in computing the mechanical power, we have taken the no. of pumpsets, power operated cane crushers and Tractors and assumed the average horsepower per unit of equipment and at 5 HP per pumpset and crush and 15 HP per tractor. The per hectare calculations are based on the 3 year averages of gross sown area in each State centred around each year indicated at the head of the column.

V

## Milch Animals

36 As noted earlier, the total number of adult female bovines relative to crop area is positively associated with the human population density; small holdings, which on the average have less land per capita than larger holdings, tend to carry on larger number of adult female bovines per unit area; and, during the last decade, the adult female population seems to have grown rather faster than the total. It is, however, difficult to interpret, and even more so to explain, the significance of the variations in numbers and density unless we also take account the variations in productivity of female animals in their dual role as producers of milk and of calves.

37 The reproductive efficiency of bovines, measured by the number of adult female stock required to meet a given demand for calves, depends on the age at first calving and the interval between successive calvings: The lower the age at first calving and the smaller the inter-calving interval, the greater the reproductive efficiency. The productivity of milk, on the other hand, is a function of the inter-calving interval, the length of lactation and the average daily yield per animal in milk. Nationwide data on inter-calving intervals are not readily available. But we do have considerable data on the proportion of adult females which are in milk[1/] as well as on the average milk yields. These, set out in Table 17, show that (a) both in terms of lactating efficiency and of milk yields, the buffalo is consistently

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1/ This index which we have called Lactating efficiency, approximates the ratio of lactation length to calving interval. Differences in reproductive efficiency are thus partially reflected in this index.

Table-17

Productive Efficiency of Cows and Buffaloes, all India and States

| State | Year | Cows | | Buffaloes | | Density of human population. * |
|---|---|---|---|---|---|---|
| | | Proportion in milk | Average daily yield kg. | Proportion in milk | Average daily yield kg. | |
| Andhra Pradesh | 1966-67 | 33 | 0.79 | 52 | 1.40 | 2.86 |
| Bihar | 1965.66 | 43 | 1.23 | 51 | 3.19 | 4.61 |
| Gujarat | 1963-64 | 46 | 1.67 | 61 | 3.08 | 1.94 |
| Kerala | 1964-65 | 45 | 1.11 | 59 | 2.01 | 5.92 |
| Madhya Pradesh | 1966-67 | 35 | 0.51 | 40 | 1.77 | 1.70 |
| Tamil Nadu | 1965-66 | 43 | 1.22 | 53 | 1.96 | 3.79 |
| Maharashtra | 1964-65 | 32 | 0.61 | 53 | 2.26 | 2.00 |
| Mysore | 1965-66 | 46 | 0.72 | 51 | 1.32 | 2.23 |
| Orissa | 1960-61 | 42 | 0.50 | n.a | n.a. | 2.54 |
| Punjab | 1965-67 | 54 | 2.28 | 62 | 3.99 | 1.73 |
| Rajastan | 1962-65 | 34 | 2.12 | 52 | 3.02 | 1.23 |
| East U.P. | 1962-63 | 33 | 0.62 | 46 | 1.91 | 3.29** |

Source: Daroga Singh et.al, Monograph on estimates of milk Production, Indian Council of Agriculture Research, New Delhi(undated), pages, 16 and 21. Average milk yield relates to yield per animal in milk.

* Rural population per ha of cropped area, 1972

** Relates to U.P.

superior to the cow, though the degree of superiority is by no means uniform; and (b) both indices of productivity for cows and buffaloes taken separately vary a great deal across states.

38 Livestock census data also show that the buffalo is more efficient in terms of the proportion of breeding females which are in milk in practically all states. This difference between cows and buffaloe has persisted throughout the last two decades and in fact, seems to be somewhat greater now compared to 1951. Excluding 1956 (which shows an abnormal change from 1951) there would appear to be hardly any change in the proportion by cows which are lactating while there is some rise in the ratio for buffaloes. The patterns shows much variation between states: Again excluding 1956, the lactating efficiency of the cow seems in contrast to the all India pattern, to have increased appreciably at any rate in the southern states and Punjab. The index for buffalos shows, as in all India, a rise though of varying degrees. It is also apparent that the sustained reduction in the ratio of cows to she buffaloes observed at the all India level, has not occured in all parts of the country. While the reduction is marked in the Punjab, the ratio shows hardly any change in Andhra, and has actually increased in Kerala and Tamil Nadu. (Table 18 ).

39 In an attempt to explain the inter-state variations in the indices of efficiency of milch animals, we examined the relation between them and the extent of human population pressure on land. One might expect that the less densely populated areas can afford to feed the animals better and, to the extent better feeding reduces the inter-calving interval and, or increases

Table: 18 : Trends in Ratio of Breeding Cattle to Breeding Buffaloes, India and selected states 1951 to 1972

| | | 1951 | 1956 | 1961 | 1966 | 1972 |
|---|---|---|---|---|---|---|
| Andhra Pradesh | a | 1.29 | 1.26 | 1.20 | 1.23 | 1.21 |
| | b | 30.6 | 40.8 | 36.8 | 33.7 | 35.8 |
| | c | 47.2 | 57.2 | 50.0 | 49.6 | 53.3 |
| Karnataka | a | 2.70 | 2.94 | 1.89 | 1.87 | 2.07 |
| | b | 36.6 | 40.7 | 36.6 | 39.1 | 40.8 |
| | c | 48.0 | 54.2 | 47.4 | 50.1 | 54.7 |
| Kerala | a | 7.92 | 7.78 | 9.03 | 9.38 | 8.39 |
| | b | 35.6 | 40.7 | 37.6 | 39.9 | 47.1 |
| | c | 46.7 | 48.8 | 46.8 | 51.9 | 56.1 |
| Tamil Nadu | a | 1.85 | 1.92 | 2.42 | 2.32 | 2.46 |
| | b | 38.7 | 42.7 | 42.3 | 41.9 | 46.0 |
| | c | 51.2 | 56.1 | 54.3 | 55.9 | 58.4 |
| Punjab | a | .91 | .84 | .74 | .57 | .55 |
| | b | 58.9 | 59.7 | 58.0 | 58.8 | 61.3 |
| | c | 55.4 | 62.0 | 55.4 | 57.9 | 64.7 |
| All India | a | 2.28 | 2.18 | 2.10 | 2.02 | 1.92 |
| | b | 40.9 | 42.5 | 40.5 | 40.5 | 40.5 |
| | c | 48.6 | 54.4 | 51.4 | 50.6 | 52.9 |

a = No. of breeding cows per breeding buffalo

b = Proportion of breeding cows in milk

c = Proportion of breeding buffaloes in milk

Source: Livestock Census Reports for various years

lactation period, this would imply that the ratio of animals in milk to total breeding females as well as average milk yields should be higher in such areas. As a matter of fact, however, there is no systematic relation between productiveefficiency (defined as above) of either cattle or buffaloes on the one hand and population density on

the other. Nor is there a significant relation between population density and average milk yields.[1] This could well be a reflection of the defects in the data and, in particular, the inadequacy of cropped area per capita as a measure of relative pressure of population on land. Since land quality across states does vary a great deal on account of differences on soil, rainfall and irrigation, a proper measure of relative population pressure on land should make allowances for these differences.

40 The limitations of using per capita land area may be less severe when we compare holdings of different sizes. For, while larger holdings have on the average, poorer quality land, they also generally tend to have larger incomes both per family and per capita. One might therefore expect that larger holdings, by virtue of their superior command over resources relative to the human population they support, will be able to hold superior quality animals. If this were so, the calving efficiency,

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[1] It might be noted that W.Burns in his famous report entitled Technological possibilities of Agricultural Development in India (Lahore, 1946) claimed that the average animal milk yield per cow tended to be higher in areas with lower rainfall. The milk capacity per animal in regions of 30" or less rainfall being more than twice that of animals in areas with over 70 inches rain. Since there is a positive association between rainfall and population density, this could also imply an inverse relation between population density and milk yields. However, a more disaggregate analysis bring more recent data on milk yield do not support the hypothesis. (See Ashok V. Desai, "the Livestock situation", Economic Weekly, Annual Number 1965). The lack of such a relationship can also been seen from Table 14.

Table- 19

Size and breeding efficiency of Adult female stock by class of holdings 1961-2 and 1971-2

| Size Class (in acre) | No. of Adult Females per 00 households | | Proportion of adult females in milk | | | |
|---|---|---|---|---|---|---|
| | | | Cows | | Buffaloes | |
| | 1961-62 | 1971-72 | 1961-2 | 1971-72 | 1961-2 | 1971-2 |
| 0.01-0.49 | 12.72 | 21.58 | .508 | .449 | .529 | .553 |
| 0.50-0.99 | 58.36 | 58.04 | .423 | .470 | .620 | .526 |
| 1.00-1.24 | 108.8 | 75.71 | .400 | .355 | .544 | .595 |
| 1.25-2.49 | | 1186.79 | | .490 | | .610 |
| 2.50-4.99 | 161.89 | 164.70 | .434 | .495 | .511 | .612 |
| 5.00-7.49 | 208.08 | 200.91 | .386 | .511 | .501 | .647 |
| 7.50-9.99 | 235.46 | 230.76 | .409 | .512 | 0554 | .617 |
| 10.00-12.49 | 255.13 | 246.46 | .407 | .500 | .510 | .632 |
| 12.50-14.99 | 276.28 | 262.07 | .376 | .493 | .506 | .631 |
| 15.00-19.99 | 304.80 | 282.96 | .403 | .531 | .496 | .625 |
| 20.00-24.99 | 317.74 | 294.80 | .385 | .610 | .487 | .671 |
| 25.00-29.99 | 340.28 | 342.15 | .381 | .582 | .463 | .554 |
| 30.00-49.99 | 462.46 | 376.83 | .409 | .537 | .504 | .648 |
| Over 50 | 603.21 | 528.04 | .385 | .540 | .502 | .641 |
| All sizes | 121.61 | 111.94 | .415 | .505 | .578 | .619 |

Source: NSS, Report No. 144, Tables with notes on some aspects of Land-holdings in Rural areas, 17th Round, Sept. 1961, July 1962 (Delhi-1961)

NSS, No.215, 26th Round July 1971-Sept 1972 Tables on holdings, all India (Feb. 1976)

the lactation length as well as milk yields of large holdings should be well above the average small holdings. In point of fact, (See Table 14) there seems to be no systematic relation between size of holding and the ratio of lactating to total breeding females.[1] Scattered data from the Farm Management Surveys also do not show any marked or consistent trend for milk yield torise worth holding size.[2]

41 The greater, and increasing, prominance of buffaloes among adult females than among adult males is usually to be explained in terms of the superior efficiency of the buffalo as a milch animal. It should be noted however that the differences in efficiencies are not unifrom as been regions: In Tamil Nadu, for instance, the ratio of milk yield per cow in milk and that per buffaloe in milk is around 1.6 while in Maharashtra it is nearly 3.7. Similarly the lactating efficiency of the buffalo is only 10-15% better than that of the cow in N.F, compared to 65-70% in Maharashtra. Ecological conditions suitable for the rearing of buffalo and their use as work animals are not present in all parts of the country. Moreover higher milk yields of buffaloes also involve larger cost because they require higher feed inputs (especially concentrates) and buffaloes need greater care and attention. And finally the extent of reliance on buffaloes for milk is constrained by the limited demand for the species as a source of draught power.

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1/ It would however, seem from Table that, while the overall breeding efficiency of both cows and buffaloes increased between 1961 and 1972, the increase was apparantly more in larger holdings. If true, this is a significant fact which needs to be explored further.

2/ We looked at FMS Data from the mid-fifties for Maharashtra, Madras, UP and Punjab. There is no systematic relation between holding size and milk yield per animal in 3 of the states. The Punjab data however show a strong positive relation between the two variables.

42 A satisfactory explanation of the factors determining the size composition and productivity of adult female bovines clearly calls for a more complex model. Such a model will have to take cogninance of the fact that, on the supply side, efficiency is partly determined by inherent genetic characteristics of the animals, and partly by the quality of management (as reflected in amount and type of feed, care for animal health etc.).. The former as it were sets the upper limits to be various parameters (such as calving interval, age at first calving, lactation length, and efficiency in converting feed into milk), while the latter determines their actual values. The quality of management again cannot be viewed independently of the demand and price conditions facing producers. And any model has to recognise that the demand for milk and for calves are determined by quite different sets of factors: the former by population and real incomes; the latter by the requirement for replacement of animals lost by death or slaughter, and for growth of the herd.

## VI

## Composition of the Bovine herd

43 Another important aspect of the bovine population relates to its age and sex composition. The review of available data in section 2 revealed large variations across states in the ratio of adult males adult females and young stock to bovine population. The data seem to suggest a systematic relation between age-sex composition of bovines and human density. More specifically, the proportion of adult male stock tends to increase, and that of adult females to fall, as one moves up the scale of human density. It is tempting to rationalise this by saying that as the pressure of population on land increases, and the competition between human and bovines intensifies, farmers tend to restrain the number of adult females in order to accommodate the requisite number of draught animals. But such an explanation could be an over-simplification because there are large differences in land quality, cropping patterns and the availability of alternate sources of power, and also because the proportion of different categories of animals reflect the net result of adjustments of herd composition to condition of demand, for different animal products and serries, costs of feed and maintenance, and productive efficiencies.

44 Interestingly, when one views the composition of bovine stock accross land holding classes, it is found that, for the country as a whole, the differences are no where near as striking. Of course, the very small land holdings do have a distinctly different pattern from the rest of the population: The bovine stock held by them consists of a smaller proportion of adult males and a noticeably larger proportion of adult

females than the average. Except for this, the percentage distribution of total bovine stock as between adult males, adult - females and youngstock, is surprisingly stable in different size class of holdings,

45 It is possible that the all-India data, aggregating as they do regions with very different agro-climatic and institutional conditions, give a distorted picture. In order to check possible distortions on this account, we have compared the size and composition of bovine population by size of holdings in 4 selected States, viz., Maharashtra, Punjab, Tamil Nadu and Uttar Pradesh. (Table ). There are of course significant differences in the average composition of bovinestock as well as in the behaviour of the total bovine population per ha. and its composition relative to the landholding size as between these States. Thus, Tamil Nadu has 280 bovines per ha. of operated area, compared to 107 in Maharashtra; buffaloes comprise less than 15% of bovine stock in Tamilnadu, and Maharashtra, compared to 53 per cent in Punjab; and, while differences in the proportion of adult females to total are not marked, there is a great deal of variation in the shares of adult males and youngstock with Punjab having an exceptionally low proportion of adult males and large proportion of youngstock.[1/]

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1/ It is also noteworthy that while in all States, the overall bovine density per ha. of operated area falls as holding increases, the strength of the relation is by no means uniform: the fall is very sharp and sustained in Punjab and Uttar Pradesh, somewhat less pronounced in Maharashtra, and least pronounced and rather erratic in Tamil Nadu.

46 The share of adult males in total stock is generally much lower than average, and that of adult females much higher, in the very small landholding class. (Tamil Nadu being an exception). The tendency for the proportion of adult males to fall as landholding increases is evident in Maharashtra, Punjab and Tamil Nadu but no clear trend is visible in Uttar Pradesh. The proportion of adult females shows a tendency to rise with holding rise in Tamil Nadu and to a lesser extent in Punjab. But in the other two States, the relation is erratic even if we exclude the smallest farms. The proportion of youngstock seems to be positively associated with holding size in Tamil Nadu, Uttar Pradesh and Punjab, but no clear trends are visible in Maharashtra. In none of the four States do we find any systematic relation between breeding efficiency of either cattle or buffaloes with holding size. These diverse patterns of relation between holding size and composition of bovine stock in different States clearly argue for a disaggregated analysis, by regions, in order to satisfactorily explain the variations. Even so, the State-level data do seem to broadly reinforce the conclusion based on all India data that, except for very small holdings, there seems to be no striking difference across landholding classes in terms of either the nature or the degree of specialisation.

47 This is prima-facie rather surprising in a situation where the availability of, and access to, resources needed for maintenance of animals is unequal as between different classes of farmers. A farmer with 1 acre has obviously much less home grown forage and feed compared to one with 10 acres. The latter being on the average much better off

in terms of per capita income and wealth is likely to have access to much larger resources (by way of own savings or borrowings) for live-stock rearing. Under these conditions, it would seem rational (in the sense of securing maximum returns per unit of resources spent on live stock husbandry) for the small farmer to maintain as high a proportion of his bovine stock in the productive categories (like drought animals or animals in milk) and keep the proportion of unproductive animals (calves, dry cows or dry buffalos) to a minimum. Indeed, since many of them are not likely to have sufficient work for draught animals, it would seem more economical for them to have as few of this category as possible. On the other hand, a large farmer by virtue of his superior command over resources (in terms of quantum and of terms) as well as high level of his own requirements for animal products, and services, might be able to afford a larger number of bovine stock, of better quality and of a more diversified composition. But in actual fact there seems be no such specialisation; on the contrary the remarkable similarity in the composition of bovine stock across land holdings seems to suggest that farmers seek to be self reliant in meeting their requirements off all major categories of bovines.

40 Farmers could ofcourse find it advantageous, or even necessary, to aim at such self-reliance if there were no well developed markets for animals. But this is evidently not the case in India. There is in fact a widespread, and well organised, trade in bovines through out the country. As early as 1950, Dandekar reported that the majority of adult male bovines owned by farmers (60% of cattle and 72% of buffaloes), over a fifth of cows and close to 40 per cent of she

buffaloes were purchased. On the other hand, the Survey showed that most (95%) of the youngstock were home-bred.[1]

49 Perhaps the data, which, by necessity are aggregated, conceal considerable degree of specialisation within different classes of farmers That this may be happening is suggested by the extra ordinarily high proportion of farmers, especially with small holdings, who do not own any draught animals. Another indication of this is given by the sample verification of the 1966 Livestock Census[2] which suggests that a little over half of the sample house holds had no cattle whatsoever, 65% had no working bullocks, and as many as 83 per cent had new cows in milk.

50 Another possible explanation could be that the availability of draught animals at the right time is so critical to the farming operations (which could be the case if the preparation and sowing operations have to be completed within a very short time during which animals can either not be leased at all or only at high cost), that even small farms find it worthwhile to maintain draught animals alone with others. The possibility of getting some supplementary income from milk and of rearing calves for sale at maturity with little or no real cost (on account of the availability of surplus family labour, combined with the possibility of finding free grazing on public lands) may also contribute to a more diversified pattern of bovine stock in small holdings. Again without

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1/ V.M. Dandekar, op.cit. p.66

2/ GOI, National Sample Survey, No.183 Tables with Notes on Post Census Survey of Livestock Numbers 1961 (Rural Sector)
Delhi 1971, Op.56, 59 & 62

more detailed data and further careful analysis, no definitive conclus ions can be hazarded.

## VII

## Conclusion

51 The purpose of this paper, as mentioned at the outset, is rather modest: It has sought to marshalled some of the available information on the structure of India's bovine population, and its behaviour across regions and over time. In the process, certain interesting patterns have been noticed and some of these are at odds with expectation. The pattern of mortality by age and sex among cattle, the lack of any strong substitutive relation between animal and mechanical power, the seeming lack of pronounced specialisation in the bovine economy of small and large farms and the existence of a systematic relation between human density on the one hand and the level and composition of the bovine stock on the other these are some of interesting findings of this review. Our attempts to explain these apparent puzzles are far too crude and simplified to provide definitive answers. But they do raise several questions which deserve to be pursued in greater depth inorder to better understand the factors determining the size and productivity of a resource which next to land and irrigation, is the largest resource of India's rural economy.

Table- 20.

Size and composition of bovine stock in different classes of land holdings in 4 States-1972.

| Size of holding (acres) | No. of bovine/100 ha. | | | | Proportion of Adult Males | | | | Proportion of Adult Females | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mah. | Punjab | Tamil Nadu | U.P. | Mah. | Punjab | Tamil Nadu | Uttar Pradesh | Mah. | Punjab | Tamil Nadu | Uttar Pradesh |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 0.01-0.49 | 464.35 | 1335.48 | 635.42 | 954.44 | [illegible] | 11.[illegible] | 5[illegible].7 | [illegible]8.6 | 59.5 | 47.6 | 28.[illegible] | 36.2 |
| 0.50-0.99 | 633.57 | 446.60 | 406.81 | 570.1[illegible] | 36.[illegible] | - | 53.8 | 47.5 | [illegible]29.9 | 51.1 | 3[illegible].1 | 34.1 |
| 1.00-1.24 | 323.21 | 1069.10 | 293.19 | 596.35 | 43.6 | 8.3 | 65.6 | 47.4 | 30.[illegible] | 6[illegible].9 | 24.7 | 38.7 |
| 1.25-2.49 | 259.09 | 488.24 | 232.7[illegible] | 393.37 | 43.4 | 36.4 | 60.2 | 5[illegible].4 | 34.5 | 35.2 | 24.9 | 31.5 |
| 2.50-4.99 | 200.41 | 235.[illegible]6 | 241.61 | 263.63 | 43.7 | 37.5 | 52.6 | 48.1 | 32.7 | 38.8 | 29.6 | 34.[illegible]0 |
| 5.00-7.49 | 139.64 | 224.57 | 228.39 | 196.53 | 44.1 | 32.7 | 50.6 | 45.6 | 33.4 | 37.9 | 33.3 | 39.7 |
| 7.50-9.99 | 89.39 | 163.76 | 225.43 | 165.64 | 4[illegible].5 | 39.[illegible] | 39.2 | 44.5 | 38.8 | 37.9 | 4[illegible].5 | 37.[illegible] |
| 10.0-12.49 | 97.02 | 153.1[illegible] | 241.03 | 140.72 | 44.3 | 37.2 | 3[illegible].3 | 4[illegible].6 | 32.3 | 39.3 | 38.7 | 35.5 |
| 12.5-14.99 | 92.28 | 132.90 | 132.50 | 129.20 | [illegible]1.8 | 32.[illegible] | 46.1 | 48.1 | 35.1 | 35.5 | 38.4 | 34.8 |
| 15.00-19.99 | [illegible]3.28 | 103.13 | 154.41 | 123.60 | 3[illegible].5 | 30.3 | 39.8 | 4[illegible].8 | 31.9 | 39.9 | 36.[illegible] | 3[illegible].9 |
| 20.0-24.99 | 68.16 | 9[illegible].19 | 194.79 | 117.78 | 39.[illegible] | [illegible]3.6 | 32.0 | 38.8 | 33.[illegible] | 3[illegible].6 | 4[illegible].8 | 3[illegible].8 |
| 25.0-29.9[illegible] | 7[illegible].56 | [illegible]8.33 | - | 119.95 | 40.[illegible] | 5[illegible].9 | - | 4[illegible].1 | 3[illegible].[illegible] | 3[illegible].7 | - | 27.7 |
| 30.0-49.99 | 65.67 | 65.72 | 112.9[illegible] | 7[illegible].76 | 3[illegible].6 | 26.[illegible] | 31.1 | 43.4 | 36.1 | 4[illegible].4 | 49.8 | 3[illegible].9 |
| Over 5[illegible] | 119.73 | 41.88 | 2[illegible].82 | 21.9 | 3[illegible].8 | - | 45.8 | 6[illegible].2 | 35.8 | - | 42.[illegible] | 11.9 |
| All classes | 106.7[illegible] | 203.5[illegible] | 282.1[illegible] | 243.49 | 4[illegible].6 | 25.6 | 5[illegible].4 | 44. 5 | 35.3 | 35.9 | 31.7 | 35.5 |

Source: Government of India, National Sample Survey, 26th Round July 1971, September 1972, Tables on Holdings (State Volumes)

Table 20 contdd...

| Size of holdings (Acres) | Proportion of Youngstock | | | | Lactating Efficiency: Cattle | | | | Lactating Efficiency: Buffaloe | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mah. | Punjab | Tamil Nadu | Uttar Pradesh | Mah. | Punjab | Tamil Nadu | Uttar Pradesh | Mah. | Pun. | Tamil Nadu | U.P. |
| | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| 0.01-0.49 | 31.5 | 42.4 | 12.3 | 30.2 | .29 | .50 | .54 | .47 | .64 | - | 1.00 | .57 |
| 0.50-0.99 | 34.1 | 46.2 | 16.1 | 18.5 | .77 | 1.00 | .18 | .49 | .62 | - | .88 | .57 |
| 1.0-1.24 | 26.0 | 21.8 | 9.3 | 13.8 | .89 | .74 | - | .34 | .85 | .14 | - | .61 |
| 1.25-2.49 | 22.1 | 27.5 | 15.3 | 18.1 | .54 | .32 | .64 | .50 | .80 | .78 | .79 | .59 |
| 2.5-4.99 | 23.6 | 24.2 | 17.8 | 17.8 | .63 | .56 | .42 | .53 | .82 | .64 | .55 | .57 |
| 5.0-7.49 | 22.6 | 29.4 | 16.1 | 20.8 | .64 | .53 | .34 | .51 | .78 | .57 | .81 | .63 |
| 7.5-9.99 | 12.5 | 24.0 | 20.3 | 18.2 | .61 | .57 | .29 | .52 | .72 | .73 | .47 | .57 |
| 10-0-12.49 | 23.4 | 23.5 | 22.1 | 19.9 | .57 | .49 | .25 | .48 | .90 | .57 | .57 | .62 |
| 12.50-14.99 | 23.9 | 31.7 | 15.5 | 17.1 | .53 | .53 | .18 | .32 | .74 | .68 | .36 | .63 |
| 15.0-19.99 | 20.5 | 29.9 | 24.2 | 20.3 | .53 | .59 | .32 | .49 | .58 | .68 | .69 | .58 |
| 20.0-24.99 | 26.8 | 27.8 | 23.1 | 26.5 | .59 | .57 | .29 | .70 | .73 | .68 | .18 | .80 |
| 25.0-29.99 | 22.7 | - | - | 25.4 | .58 | .83 | - | .52 | .55 | .83 | - | .32 |
| 30.0-49.99 | 24.2 | 33.2 | 19.1 | 22.7 | .52 | .66 | .76 | .51 | .63 | .67 | .67 | .76 |
| Over 50 | 11.9 | 37.2 | - | 12.1 | .48 | .18 | - | 1.00 | .97 | .53 | - | .77 |
| All Classes | 24.2 | 38.5 | 17.9 | 20.0 | .57 | .54 | .39 | .50 | .72 | .61 | .68 | .59 |

Annex

The following are some of the principal contributors to the discussion, the main highlights of which are well summarised in SN Mishra. "Surplus Cattle in India: A Critical Survey Sociological Bulletin, Vol. 22, No.2., 1973.


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