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SUPPLY RESPONSES IN THE LIVESTOCK ECONOMY OF KERALA

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The quantitative and qualitative changes taking place in livestock population over the years would be due to the changes in demand for livestock products. The changes in livestock population and its components would be effected through changes in birth rates, mortality rates and disposal rates of the animals. Therefore a study on the birth rate and death rate of livestock population over the years is of utmost importance for understanding the pattern of supply responses to variations in demand for services of livestock and livestock products. It is with this objective that we are undertaking a study on the birth rate and death rate of cattle population in Kerala. The analysis is divided into two sections: Section I contains a discussion of the methods and an attempt to estimate the birth and death rates and Section 2 contains the interpretations of the results.

I

Methods for estimating death rate

Four methods have been used in India for estimating death rate of cattle:

1. To use the statistics of production and exports of skin and hides and the average life span of cattle;

2. to use the number of cattle slaughtered and the life span of cattle;

3. to use the information collected through sample surveys;

4. to use the age distribution of animals obtained from Livestock Census.

The first method was used by the Indian Munition Board and the Imperial Veterinary Research Institute in the years 1922 and 1929 respectively. The second method was used by the Directorate of Marketing and Inspection of the Government of India (in the years 1948 and 1958 respectively). These methods provide some rough estimates of death rates of cattle and buffaloes in India.[1]

Detailed estimates of birth rate and death rate of cattle and buffaloes are available for the first time from the Poona Schedules of the National Sample Survey.[2] This survey gives for cattle and buffaloes respectively single age mortality rates upto 9 years of age and the mortality rate for animals in the age group 9+. The all-India young and adult stock mortalities work out to be 12 and 9 per cent for cattle and 24 and 12 per cent for buffaloes.

Estimates of livestock mortality rates are available for a few States from the I.C.A.R. study on milk yield and other bovine and goat practices in India. The only estimate of mortality rate for cattle and buffaloes available for Kerala is from this sample survey,[3] by the I.C.A.R. in 1964-65 which covered 14 villages and a total of 2324 households. According to this Survey the mortality rates are the following.

Table No.1

Mortality rate for cattle and buffaloes according to their classification (per thousand)

Classification	Cattle	Buffaloe
Young stock	119	480
Adult stock	22	33
Overall	52	72

Source: Indian Council of Agricultural Research. Sample Survey for the estimation of annual Production of milk and study of bovine and goat practices in Kerala 1964-65, Table No.9.04.

According to this survey, the annual mortality rate for adult stock comes to about 2.2 per cent and 11.9 per cent for young stock cattle and mortality rate of 5.2 per cent for the entire cattle population. The mortality rate of adult buffalo population comes to about 3.3 per cent and the mortality rate of young stock buffalo population is around 48 per cent. The overall mortality rate for buffalo population is around 7.2 per cent. No estimates of birth rate are available from this survey.

The estimates of death rate obtained through sample survey have the following limitations. In Kerala, livestock trade is a well-organised business involving a large number of livestock markets scattered over all the regions in the State. A significant proportion of the animals moved from the rural areas to urban areas is for slaughter. Since the urban slaughter houses are situated at long distances from the sample villages from which the information is collected, the estimates of death rates obtained through the sample survey are likely to be under-estimates. Another drawback of the estimate of death rate by this method is that they cannot be used to estimate the death rate for future years. Birth and death rates are subjected to change depending on a number of factors like changes from time in the slaughter policies of Government, in demand for meat, etc. This calls for the development of a standard method for estimating mortality rates based on the size and age distribution of livestock population reported by the quinquennial Livestock Census.

For the first time in India, Professor V.M.Dandekar tried to estimate the mortality rate for cattle in Maharashtra using the 1961 Livestock Census data.[4] This method

was later modified and standardised by S.S.Srivastava and he estimated the birth rate and death rate of cattle and buffaloes for 1960-61 for all the States in India.[5] We will be mainly using this method with a slight modification in one of the assumptions in the earlier approaches.[6] Estimates of birth and death rates are made for the years 1960-61, 1965-66 and 1971-72. We have developed a method for estimating the birth rate of cattle in the State using the Livestock Census data and the data on the inter-State movement of cattle collected from the Renderpest Eradiction wing of the Animal Husbandary Department.

Estimation of Death rate

Death rate of young stock cattle:- The Census report gives population figures for cattle and buffaloes in the age groups (0-1), (1-3) and 3 and above. The first two categories comprise the young-stock and the third the adult stock. It seems to us that if there were no mortality in the young stock, the size of the young stock population comprising the age groups 1 to 2 and 2 to 3 will be exactly twice the size in the single age group (0-1), in the state or district level. Generally the population in the (1-3) group is found to be much less than the (0-1) group. This may happen due to different reasons like the high mortality rates, interdistrict or inter-state movements, and annual fluctuations in birth rates, etc. In order to estimate the young-stock mortality at the State level we may start with the following assumptions:

(a) the annual number of births remains unchanged in consecutive years;

(b) the annual survival rate is the same for the youngstock in consecutive years;

(c) there is cattle movement into Kerala from the neighbouring States, but no cattle movement from the State to outside the State.

These assumptions then mean that if x is the number reported in the (0-1) group and if r is the proportion that survives after a year, xr will be the number in (1-2) age group and xr^2 will be the number in the(2-3) age group. So the number reported in the (1-3) age group will be $xr+xr^2$. Let Y be the size of the population in the age group (1-3) as reported by the Census. If Y_b is the (1-3) population moved into the State from outside the State then $(Y-Y_b)$ will give the number of youngstock cattle born in the State. Therefore, the relationship $xr+xr^2 = Y-yb$ (1) will be valid and the solution of (1) will give the value of r, the survival rate of young-stock cattle.

It may be observed that the number of births in consecutive years may or may not be equal. Therefore the size of the (0-1) population determining the value of r will be different for different years. Let x1 and x2 be the size of the (0-1) population in consecutive years and let R be the survival rate of young stock cattle. Then the value of R will be determined by the equation $x1R+x2R^2 = Y-Yb$ - (2). But in the absence of any idea on the number of births in these years it is not possible to obtain the value of R. The only method in this situation is to interpolate for x_1 and x_2 between the census periods assuming that the (0-1) population will grow at a geomatric progression. It can be shown that under this assumption the

new survival rate will be R=r (1+g) where g is the growth rate of (0-1) population. If R is the survival rate of young-stock cattle then (1-R) will give the mortality rate for young-stock cattle.

Death rate of adult cattle

A part of the adult stock at any point of time will be in the age group 2+, a year before. The balance are the survivors of the previous years stock of adults. That is the (2-3) age group population joins the group of adults after a lapse of one year. The procedure here is a direct extension of the method we used for the estimation of the survival rate of the young stock, with the same kind of assumptions, namely:

(1) the (2.3) population is the same in consecutive years;

(2) annual survival rate is the same for the adult stock-in consecutive years;

(3) there is movement of adult cattle into Kerala but no movement from the State into outside the State.

Let r^1 be the annual survival rate of the adult stock. Then, r^1 of the population in the (2-3) age group will join the (3-4) age group after a year. The population in the (2-3) age group has already been estimated to be xr^2. Therefore the population in the (3-4) age group will be xr^2r1. Similarly the population in the subsequent age group will be xr^2r1^2, xr^2r1^3 etc. If z is the size of the adult stock population reported in the

census and if zb is the size of the adult cattle population that is moved into the State then the adult stock cattle population born in the State will be $(z-zb) = xr^2r1+xr^2r1^2+\ldots = \frac{xr^2r1}{1-r1}$ (3). The solution of (3) will give the value of r_1.

If we change the assumption of a uniform flow of population in the (2-3) age group, the annual survival rate for the adult stock will be equal to R=r1 (1+g) where g is the growth rate of (0-1) population. Here R1 is the average proportion of survival of animals in the age (2-3) onwards, i.e. from the age group 2.5 and above. (1-R1) is the corresponding mortality in the years 2.5 and above.

The mortality rates for the young and adult stock, obtained through the above method, are valid to cattle in the age group, .5 to 2.5 and 2.5 and above respectively. In the actual calculation of death rates, however the young stock mortality rate and the adult stock mortality rate are applied to the young and adult stock cattle in the years 1960-61, 1965-66 and 1971-72 respectively. This can introduce some error in the estimate of the number of deaths for young and adult stock cattle. But this will not affect the total number of death in cattle in the State.

Methods for estimating Birth rate

For the estimation of the number of birth for cows in the State we have used two methods. The first method is based on the number of cows in milk and the average lactation length of cows in the State. The second method is based on size of the (0-1) population and the survival rate of youngstock cattle.

Method I:

In the total number of breeding cows in the State at any point of time, a certain number of cows will be in milk, and the rest will be dry. The number of cows in milk and the number of cows that are dry will be reported in the Census. Let Y be the number of cows reported in the Census and let L be the average lactation length of cows in the State. Then the M cows might have calved with in the period L. In the year preceeding the date of Census some cows which had calved and were in milk might have gone dry. So the number of cows calved in the State in the year preceeding the date of the Census = the number of cows that calved within the period L + the number of cows that calved during the year but had gone dry - (4)

The total number of births of cattle in the State is equal to the total number of calving by breeding cows in the State. Since there are no data available regarding the number of cows which calved during the year but have gone dry during the year it is not possible to use (4) for estimating the number of calving by breeding cows in the State. In order to get over this difficulty we adopted the following method. Since M is the number of cows that might have calved over the period L the average number of calving per day by breeding cows in the period L will be (M/L). Since the lactation period of cows will be always greater than 2/3 of a year we have assumed that the average number of calving per day over the lactation period as the average number of calvings per day per year. So the total number of calving by breeding cows in the year will be (M/L)365.

Since the calving of breeding cows is subjected to seasonal fluctuations, the validity of the above estimation method is questionable. Generally the number of cows in milk is found to be the maximum from July to September and the minimum in the months of April and May and November and December. Since the Census count is usually taken in the month of April the number of calving over the period L will include cows claved both in the low and peak periods in the State. This fact suggests that our estimate will give at least the minimum number of births in cattle in the State.

Method II:

In this method the number of births is estimated in the following way: If B is the number of births in a year then the number of births in the period between t and t + Δt will be B. Δ t. The number of calves born in this period will be exposed to the risk of mortality for a period (1-t) if Δt is sufficiently small. Hence B Δ tr^{1-t} when Δt$\rightarrow$ o will give the number surviving at the time of enumeration of birth BΔt and the integral of this from 0 to 1 will be the observed (0-1) population.

$$\int_0^1 Br^{1-t}\, dt = x \quad - (5)$$

The solution of (5) will give the value of $B = \frac{-x \log_e r}{1-r}$. where r is the survival rate of cattle in the age group (0-1).

This method of estimation will be valid only if survival rate of young stock in the first year of life is known. In the absence of any idea on the survival rate of (0.1) population, the survival rate calculated for the young stock has been used as an approximation to arrive at the estimate of their birth rate. However in Kerala the mortality in the first year of life is generally much lower than during the next two years because of the high incidence of slaughter of young stock cattle in the age group (1-3). Hence the survival rate used to estimate the number of birth is likely to be lower than the actual rate and this will lead to an over-estimate of the birth rate.

The estimate of the birth and death rates for the years 1960-61, 1965-66 and 1971-72 are given in Table I and 2 in the Appendix. Estimates of infant mortality rate are obtained by subtracting the observed (0-1) population on the date of the Census from the estimated number of births in the one year period preceeding the date of Census.

II

Discussion of Results

According to our estimates the number of deaths in the young-stock cattle comes to about three lakhs in 1960-61. By 1971-72 the number of deaths increased to 5 lakhs. The number of deaths of adult cattle during 1960-61 was 1.52 lakhs and by 1971-72 this increased to 1.94 lakhs. The percentage of death of young-stock cattle was about 38 during 1960-61 and 49 by 1971-72. The percentage of death of adult cattle was around 8 per cent in 1960-61 and 10 in 1971-72.

According to method I the number of deaths of cattle in the State works out nearly 5.35 lakhs during 1960-61. Method II gives the number of births as 6.59 lakhs. The birth rate calculated by the second method is 23 per cent higher than that obtained through the first method. During 1971-72 the number of births according to the first method works out 7.57 lakhs and according to second method to 8.79 lakhs. The number of births obtained by the second method during 1970-71 is 18 per cent higher than that obtained by the first method. Since the former gives only the minimum number of births the actual number of births would lie in between these two extreme values.

The first method gives the number of infant deaths of cattle as 1.8 per cent of the total infant cattle population in 1960-61, where as by the second method it comes to about 19.8 per cent. The death rate of infant cattle in 1970-71 was around 14.2 per cent and 27.0 per cent according to the first and second methods respectively.

The main results obtained from the estimates of birth and death rates are summarised below:-

(1) The death rate of young-stock cattle is significantly higher compared with the death rate of infant and adult cattle in the State.

(2) Over the years the death rate of infant, young and adult cattle have increased.

(3) Birth rate of cattle have been increasing in the sixties.

Reason for high death rate:-

Investigations carried out by the I.C.A.R. survey in to the Causes of death of young and infant cattle in the State revealed that the cause of nearly 92 per cent of death among infant cattle and 27 per cent among the young-stock cattle was due to a variety of deseases. Around 70 per cent of the young-stock cattle died due to slaughter and nearly 8 per cent of the infant cattle and 3 per cent of the young-stock died due to accidents.

The high death of infant and young-stock cattle due to different disease as well as the differential pattern of mortality observed among cattle belonging to the different age-groups suggests the possibility of very low level of feeding of cattle in the State. An examination of the available data on feed intake of cattle can give some evidence of the extent of under-feeding.

The per capita daily consumption of different feeds by milch animals, draught animals, dry cows and young-stock cattle with different body weights are available from the I.C.A.R. survey. In order to estimate the extent of underfeeding of cattle in the State, the actual per capita daily food intake by cattle with different body weight is converted into its energy equivalents and it is compared with the recommended energy intake for cattle for corresponding body weight as per morrison feeding standard. The energy supplied by different feeds is expressed in terms of total digestable nutrients which is the commonly accepted unit of measuring animal energy.

Estimation of underfeeding of cattle by this method has got several limitations. These limitations arise from the difficulties in collecting accurate information of the quantity and quality of feed fed to cattle. The quantity and quality of feed given to cattle is difficult to measure accurately. In households where there is joint feeding of cattle it is difficult to estimate separately the quantity of feed consumed by each animal. Another limitation of these data is that they do not include the quantity of grass consumed by cattle by grazing. Since the availability of grazing land is limited in the State and the quality of grazing land is poor, this factor is likely to affect our results only insignificantly. Though available data on feed-consumption by cattle has got these limitations, an analysis of these data can provide a broad dimensional estimate of the extent of underfeeding of cattle in the State.

The estimated intake of T.D.N. by different types of cattle with different body weights and the recommended intake of T.D.N. for the corresponding body weights are given in tables 3, 4 and 5 in the appendix. Table (3) gives the T.D.N. intake by milch cows with different body weights and different levels of milk yield. The recommended intake of T.D.N. by milch cows is computed with the assumption that the fat content of cow milk in the State is 5 per cent. It is seen from our estimates that the level of feeding of milch cows in the State is on the average 40 to 30 per cent less than the recommended intake for milch cows with different levels of milk yield and body weight.

The estimated intake and the recommended intake of T.D.N. for young-stock cattle are given in table 5 in the appendix. The recommended T.D.N. in this table is the T.D.N. needed to meet the requirement of growth of young-stock cattle with different body weights. It is seen that the actual intake of T.D.N. is considerably less than the recommended intake. The level of underfeeding is found to vary between 40 to 60 per cent less than the recommended intake for different body weights.

Generally, breeding cows in the State and particularly milch cows are betterfed than draught animals and young-stock cattle. This reflects the relative importance of the different types of cattle in the livestock economy of the State. It is also seen that more better-quality feed is fed to milch animals.

Another point that emerges from our analysis is the inverse relationship between body weight and level of under-feeding which is found to be true for all types of cattle. This reveals that cattle with higher value is betterfed than cattle with low value.

The low level of feeding of cattle in the State may be due to lack of sufficient feed resources in the State. In a situation where demand for milk and beef is increasing, one way of meeting the rising demand is by increasing the number of cattle. But increase in numbers necessarily means increase in the demand for feeds, which are limited in the State. An alternative method, therefore, will be to adopt selective growing of cattle by eliminating the non-functional categories of animals so that maximum benefit could be achieved out of the available feed supply. It seems that the high incidence of

slaughter of young cattle and reduction in the life span of adult cattle due to an increase in death rate by natural reasons is mainly due to this consideration.

Increase in Birth rate:

Another important point emerging from our analysis is the increase in the birth rate of cattle over the years in the State. It implies an increase in productivity of milch cows in terms of the number of calves born. During 1960-61 the number of births per 100 breeding cows was around 47 as per our estimate by the first method. During the period 1961-66 there was only a slight increase in productivity of cows in terms of the number of births. But between 1966 and 1972 a sharp increase is noticed in the productivity of breeding cows in terms of the number of calves. The number of calves per 100 breeding cows in 1971-72 was around 59, an increase in productivity of nearly 26 per cent. This increase may be primarily due to an increase in feed input of milch animals. Besides, there are a number of other factors which might have contributed to this increase in productivity, like the expansion of the size of the village markets for milk, expansion of the marketing facilities for milk, improvement in the genetic quality of cattle due to an increase in the number of cross-bred cows, and change in the organizational structure of dairy industry in the State. The contribution of each of this factors to the increase in productivity calls for a detailed analysis which we are attempting separately.

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Appendix

Table: 1: Estimated number of death in cattle in Kerala.

	Infant cattle				Young cattle		Adult cattle	
	No.of death		Death rate		No.of death	Death rate	No. of death	death rate
	Esti-mate I	Esti-mate II	Esti-mate I	Esti-mate II				
1960-61	1.31	0.07	19.8	1.3	3.03	37.7	1.52	8.1
1965-66	1.47	0.52	20.7	8.4	3.52	38.8	1.88	9.8
1971-72	2.48	1.08	27.6	14.2	5.01	49.4	1.94	10.4

Note: Number of death is given in lakhs. Death rate is given as percentage of the Cattle population in each age group.

Table 2: Estimated Number of Birth and total number of death in cattle and productivity of breeding cows in terms of number of calves in Kerala

	No.of death (in lakhs)		Death rate		No.of birth (in lakhs)		irth rate		Productivity of cows	
	Est.I	Est.II	Est.I	Est.II	Est.I	Est.II	Est.I	Est.II	Est.I	Est.I
1960-61	4.62	5.86	16.2	20.6	5.35	6.59	18.5	23.0	46.9	57.8
1965-66	5.92	6.89	19.6	22.9	6.14	7.09	20.4	23.6	49.9	58.5
1971-72	8.03	9.43	25.8	30.3	7.57	8.97	24.3	28.8	58.8	69.7

Note: (1) Estimate I is obtained by using the estimated number of birth by method I and estimate II is obtained by using the estimated number of birth by method II.

(2) Birth rate and death rate are given as percentage to total Cattle population.

(3) Productivity of breeding cows is given in terms of number of birth per 100 cows used for breeding and milk production.

Table 3: Per Capita daily in take of T.D.N. by Milch cows in Kerala.

Actual in take of T.D. N.	(kg.)	Recommended intake (kg.)	Body weight (kg.)	Milk yield (kg.)	Level of uner-feeding
1.(a) Green grass	0.24				
(b) Paddy straw	0.31				
(c) Concentrate	0.42				
Total T.D.N.	0.97	1.63	150	1.10	40
2.(a) Green grass	0.29				
(b) Paddy straw	0.25				
(c) Concentrate	0.49				
Total T.D.N.	1.04	1.73	200	1.21	39.8
3.(a) Green grass	0.38				
(b) Paddy straw	0.26				
(c) Concentrate	0.62				
Total T.D.N.	1.26	2.11	250	1.26	38.7
4.(a) Green grass	0.38				
(b) Paddy straw	0.46				
(c) Concentrate	0.74				
Total T.D.N.	1.58	2.50	300	1.38	39.2
5.(a) Green grass	0.56				
(b) Paddy straw	0.39				
(c) Concentrate	1.03				
Total T.D.N.	1.97	2.94	350	1.69	32.9
6.(a) Green grass	0.42				
(b) Paddy straw	0.80				
(c) Concentrate	1.48				
Total T.D.N.	2.70	3.83	400	2.21	29.5
7.(a) Green grass	0.57				
(b) Paddy straw	0.68				
(c) Concentrate	1.56				
Total T.D.N.	2.81	4.32	450	2.62	35
8.(a) Green fodder	0.56				
(b) Dry fodder	0.86				
(c) Concentrate	1.73				
Total T.D.N.	3.15	4.70	500	2.79	33.1
9.(a) Green fodder	0.71				
(b) Dry fodder	0.98				
(c) Concentrate	1.94				
Total T.D.N.	3.63	4.92	550	3.21	26.2

Level of underfeeding = $\left(\frac{R-A}{R}\right) 100$ where

A = actual in take of T.D.N.
R = recommended in take of T.D.N.

Table 4: Per capita daily in take of T.D.N. by draught animals and dry cows in Kerala.

Actual T.D.N. in take			Recommended T.D.N.		Body weight		Level of underfeeding	
	A	B	A	B	A	B	A	B
1.(a) Green fodder	0.08	0.13						
(b) Paddy straw	0.32	0.27						
(c) Concentrate	0.18	0.24						
Total	0.58	0.64	1.27	1.27	150	150	54.4	49.3
2.(a) Green fodder	0.12	0.23						
(b) Paddy straw	0.38	0.46						
(c) Concentrate	0.26	0.17						
Total	0.74	0.86	1.66	1.66	200	200	47.2	48.1
3.(a) Green fodder	0.29	0.18						
(b) Paddy straw	0.48	0.53						
(c) Concentrate	0.36	0.41						
Total	1.09	1.12	2.02	2.02	250	250	46.0	44.5
4.(a) Green fodder	0.39	0.36						
(b) Paddy straw	0.53	0.58						
(c) Concentrate	0.26	0.38						
Total	1.18	1.32	2.36	2.36	300	300	50.8	43.8
5.(a) Green fodder	0.44	0.30						
(b) Dry fodder	0.62	0.68						
(c) Concentrate	0.42	0.58						
Total	1.48	1.56	2.70	2.70	350	350	45.1	41.4
6.(a) Green fodder	0.37	0.39						
(b) Dry fodder	0.65	0.88						
(c) Concentrate	0.62	0.72						
Total	1.87	1.79	3.03	3.03	400	400	38.2	34.3
7.(a) Green fodder	0.39	0.62						
(b) Dry fodder	0.87	0.68						
(c) Concentrate	0.96	0.98						
Total	2.22	2.38	3.57	3.57	450	450	37.8	33.3
8.(a) Green fodder	0.48	0.87						
(b) Dry fodder	0.74	0.68						
(c) Concentrate	1.26	0.98						
Total	2.48	2.53	3.89	3.89	500	500	36.2	34.9
9.(a) Green fodder	0.46	0.61						
(b) Paddy straw	.76	0.89						
(c) Concentrate	1.16	1.08						
Total	2.46	2.68	4.17	4.17	550	550	35.7	35.7

A - Draught Cattle : B - Dry cows.

Table 5: Per capita daily T.D.N. intake of young-stock Cattle

Actual in take		Recommended in take	Body weight	Level of underfeeding.
1.(a) Green fodder	0.08			
(b) Dry fodder	0.16			
(c) Concentrate	0.06			
Total T.D.N.	0.30	0.80	45	62
2.(a) Green fodder	0.20			
(b) Paddy straw	0.29			
(c) Concentrate	0.12			
Total T.D.N.	0.61	1.03	70	53
3.(a) Green fodder	0.26			
(b) Paddy straw	0.56			
(c) Concentrate	0.16			
Total	0.98	1.09	100	48.1
4.(a) Green fodder	0.30			
(b) Paddy straw	0.72			
(c) Concentrate	0.32			
Total	1.36	2.6	150	47.6
5.(a) Green fodder	0.72			
(b) Paddy straw	1.16			
(c) Concentrate	0.42			
Total	2.30	4.0	200	42.3

NOTES AND REFERENCES

1. A review of the earlier attempts have been brought out in the paper by K. Seshagiri Rao and P.N.Choudhary, "A study on Supply position of Raw Hides in India", Central Leather Institute.

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3. Indian Council of Agricultural Research. Sample Survey for the estimation of annual production of Milk and study of bovine and goat practices in Kerala 1964-65.

4. V.M. Dandekar, "An economic approach to cattle development in India", Published in Nalin Mehta: Fiscal Policies and economic growth, Sarva Seva Sanga, New Delhi.

5. S.S. Srivastava, Problem of Estimation of Mortalities in Cattle and Buffaloes, Indian Journal of Agricultural Economics, Vol.XXV, April/June 1970.

6. For the estimation of death rate, three assumptions are made in the earlier approaches. They are: (a) There is a uniform flow of birth in cattle in consecutive years; (b) The annual survival rate is the same for the young-stock; (c) There is no inter-regional cattle movements. Assumption number three is found to be completely irrelevant in the case of Kerala because of the high magnitude of the inter-State cattle movement. So we changed this assumption with another assumption that there is cattle movement into Kerala from the neighbouring States and there is no cattle movement from the State to outside the State.
