Indian Journal of Animal Sciences **88** (2): 233–238, February 2018/Article

Impact of livestock production on poverty – evidence from rural Tamil Nadu*

G SENTHILKUMAR[1], K N SELVAKUMAR[2], M PRABU[3], A SERMASARAVANA PANDIAN[4], C VALLI[5] and P THILAKAR[6]

Tamil Nadu Veterinary and Animal Sciences University, Chennai, Tamil Nadu 600 007 India

Received: 25 January 2017; Accepted: 11 August 2017

ABSTRACT

The present study was undertaken in rural Tamil Nadu to quantify the impact of livestock production on poverty using randomly selected 540 sample respondents. The data were collected through personal interview using pre-tested interview schedules from sample respondents undergoing various occupations in the six districts covering four agro-climatic zones of Tamil Nadu. The per capita income function of households was fitted to explore the impact of livestock production on poverty. The results implied that the value of assets, education, employment in mandays, livestock occupation had a significant positive impact on the per capita income in contrast to the variables, viz. family size, family dependency ratio and illiteracy, which had negative impact. The per capita income with and without the particular occupation was estimated using the concerned co-efficients. Further, the poverty ratios were worked out in presence of an occupation and in absence of an occupation. The poverty indices were found to be higher for the income with occupation, when compared to the income without occupation for all the chosen occupations, except agricultural labourers. It could be concluded that the presence of agricultural labourer occupation increased the head count ratio (P_0) by 0.0370, poverty gap index (P_1) by 0.0208, poverty severity index (P_2) by 0.0125 and the Watts index (W) by 0.0317. Among all the occupations, the presence of livestock farming decreased the poverty indices by the greatest extent (0.1852 of P_0, 0.1002 of P_1, 0.0593 of P_2, and 0.1562 of W).). Following livestock, fishing had the greater potential of poverty reduction with the reduction values of 0.1852 (P_0), 0.0844 (P_1), 0.0492 (P_2) and 0.1306 (W). Further, it could be revealed that the presence of livestock occupation, decreased the exit time for poverty by 5.22 years and it was 4.35 years for fishing occupation, 3.60 years for non-farm occupation and 2.05 years for cropping activity. Based on the results of the study, it could be concluded that the any poverty alleviation programme should comprise a livestock component.

Key words: Fixed effect regression, Impact, Livestock, Poverty, Poverty ratios

Poverty is the *"incapability to maintain a minimum living standard anticipated with respect to basic consumption needs or some amount of income required for satisfying the people"* (World bank 2006). Poverty is multi-dimensional and encompasses low income, inability to acquire basic goods and services necessary for survival, low level of health &education, poor access to clean water and sanitation, inadequate physical security and insufficient opportunity to better one's life. The multifaceted phenomenon of poverty is multifaceted, encompassing different dimensions of physical, psychological, economic and socio-cultural factors. For most of the rural poor, livestock constitutes an important part of their livelihood. Role of livestock is multifunctional, as they play important role in household nutritional security; serve as important source of supplementary income and farmyard manure; provide draught power; and also serve as capital assets, thus providing insurance against any future exigencies. Livestock, thereby, plays a major role offering pathways to the rural poor to come out of poverty. However, studies related to quantification of poverty reduction through livestock and its impact is a study area that has received scant research attention in the Indian context.The milk, egg and meat production in Tamil Nadu were estimated to be 7.243 million tonnes, 16.13 billion numbers and 0.545 million tonnes, respectively in Tamil Nadu and thereby the livestock sector contributed was 4.31% to the Gross State Domestic Product (GSDP) and 41.84% to the Agriculture and allied activities (Animal Husbandry Policy note, 2016–17, Government of Tamil Nadu). As there is significant

*Part of Ph.D. thesis of the first author submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai.

Present address: [1]Assistant Professor (senthilkumargtanuvas @gmail.com), Department of AHSCA; [4]Assistant Professor (pandian23@gmail.com), Department of AH Economics; [6]Assistant Professor (drthilakar2005@gmail.com), Department of V&AH Extension, Madras Veterinary College, Chennai. [2]Dean (knselva@gmail.com), Veterinary College and Research Institute, Orathanadu. [3]Professor and Head (mprabu23@gmail.com), Department of AH Economics, VCRI, Namakkal. [5]Professor and Head (valliviba@yahoo.co.in), Institute of Animal Nutrition, Kattupakkam.

contribution of livestock sector to the economy of Tamil Nadu, the present study was carried out in rural Tamil Nadu to quantify the impact of livestock production on poverty.

MATERIALS AND METHODS

Based on the poverty dimensions, six districts of Tamil Nadu *viz.*,Thiruvannamalai, Villupuram, Dharmapuri, Pudukottai, Ariyalur and Ramanathapuram covering four agro-climatic zones (North-Eastern, North-Western, Cauvery Delta and Southern zones) were selected. A total of 540 rural sample respondents of different occupational groups were randomly selected through multi-stage random sampling. The data pertaining to the objectives of the study were collected through personal interview using structured pre-tested interview schedules. The period of data collection was from August 2013 to October 2014.

Measures of poverty: Major indicators of poverty, viz. per capita income and poverty line were considered in measurement of poverty in the study area. The per capita income of Rs.1081.94 per month, as recommended by Planning commission (2014), was taken as the state specific poverty line for rural Tamil Nadu.

The most commonly used measures of poverty, viz. head count index (P_0), poverty gap index (P_1)&squared poverty gap (poverty severity) index (P_2), the Watts index and average exit time from poverty were calculated by adopting the methodology prescribed in World bank poverty manual (2005).

Most widely used measure of poverty is head count index (P_0), which simply measures the proportion of the population that is counted as poor.

$$P_0 = \frac{N_p}{N}$$

where, N_p is the Number of poor and N is the total population.

Moderately popular measure of poverty is the poverty gap index, which adds up the extent to which individuals on average fall below the poverty line and expressed as percentage of the poverty line. Poverty gap (G_i) is defined as the poverty line (z) less actual income (y_i) for poor individuals; the gap is considered to be zero for everyone else.

$$G_i = (z - y_i).\ I\ (y_i < z)$$

Then the poverty gap index (P_1) was taken as

$$P_1 = \frac{1}{N} \sum_{i=1}^{N} \frac{G_i}{z}$$

Squared poverty gap (Poverty severity) index (P_2) takes into account inequality among poor. It is the weighted sum of poverty gaps (as a proportion of the poverty line), where the weights are the proportionate poverty gap themselves, i.e.a poverty gap of (*e.g.*) 10 per cent of poverty line is given a weight of 10 per cent alone, while that of 50 per cent is given a weight of 50 per cent.This is in contrast with poverty gap index, where they are weighed equally. Hence, squared poverty gap index measure implicitly puts more weight in observations that fall well below the poverty line.

The squared poverty gap index (P_2) was taken as

$$P_2 = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{G_i}{z} \right)^2$$

It may be more generally calculated as proposed by Foster *et al.* (1984) as

$$P_\alpha = \frac{1}{N} \sum_{i=1}^{N} \left(\frac{G_i}{z} \right)^\alpha \quad (\alpha \geq 0)$$

where, α, measure of the sensitivity of the index to poverty; z, poverty line; G_i, poverty gap ($z - x_i$) with $G_i = 0$, when $x_i > z$; x_i, value of per capita income / expenditure for the i^{th} person's household. If $\alpha = 0$, $P\alpha$ becomes head count index; if $\alpha = 1$, $P\alpha$ becomes poverty gap index and if $\alpha = 2$, $P\alpha$ becomes poverty severity index.

The Watts index is the most widely used measurement of poverty index for derivation of poverty incidence curve over different time period / growth rates of income. In the present study, the Watts index was calculated using the following formula:

$$W = \frac{1}{N} \sum_{i=1}^{q} [\ln(z) - \ln(Y_i)]$$

where, N is the individuals in the population which were indexed in ascending order of income and sum was taken over the q individuals whose income (y_i) fell below poverty line (z).

The average time taken to exit from the poverty was calculated as the Watts index divided by the expected income growth rate among poor as presented below:

$$t_g^j \approx \frac{ln(z) - ln\ (xj)}{g} = \frac{w}{g}$$

Based on the Watts index values, average time to exit out of poverty was worked out for scenarios represented by different hypothecated income growth rates. Further, the rate of income growth required to exit out of poverty in a definite period of time was also calculated.

Impact of livestock production on income inequality and poverty: The per capita income function of households used by Cuong (2010) was adopted in the present study to assess the impact of livestock production on income inequality. The model is:

$$\ln(Y_i) = \alpha + \beta X_{ij} + \delta D_{ik} + \mu$$

where, Y_i, per capita income of the i^{th} household; X_{ij}, characteristics of i^{th} household; D_{ik}, binary variables indicating the different occupations i.e., cropping, livestock farming, fishing, agricultural labourer and non-farm occupation; α, constant term; β and δ, co-efficients; μ, random error.

The household characteristics and dummy variables, which were included in the specified model are shown in Table 1. After fitting the above income function which included all occupations, the per capita income function

without a particular occupation say livestock production was estimated as

$$\hat{Y}_{0\,(D=1)} = e\,(\hat{\alpha} + \hat{\beta}xi + \hat{\delta}\,Di + \mu) = e\,(In\,(Yi - \hat{\delta})$$

Then, the impact of the individual occupation on a poverty index of the households was found as below:

$$\Delta P = P_1\,(D = 1, Y_1) - P_0(D = 1, Y_0)$$

where,

Y_1, potential outcomes with the concerned occupation;

Y_0, potential outcomes without the concerned occupation;

P_1, poverty measure of the households of the particular occupation in presence of that occupation;

P_0, poverty measure of the households of the particular occupation, if they had not engaged in that occupation. It was not observed directly and was estimated using predicted income function from fixed effect regression.

RESULTS AND DISCUSSION

In order to explore the impact of livestock production on poverty, per capita income function of households was fitted initially using the variables as mentioned earlier. The estimates of fixed effect regression model of the per capita income of sample respondents are presented in Table 2. The model had the adjusted R^2 of 0.540, which implied that 54 per cent of variations in the per capita income were explained by the variables included in the model. Of the chosen independent variables, livestock occupation dummy, Villupuram location dummy and Ramanathapuram location dummy had significant and positive influence on the per capita income. However, the Ariyalur location dummy was found to be significantly and negatively influencing the per capita intake and had the unstandardized co-efficient of –0.154.

As the selected sample districts belonged to different Agro-climatic zones of Tamil Nadu, which had variations in agro-climatic and institutional factors, it might have influenced variations in the significance of per capita income of the sample respondents among these districts.

The study assumed that the per capita income is dependent upon the value of assets owned by the farmers and accordingly the variable was included. The economic variables *viz*., value of assets owned and employment

Table 1.Variables included in the per capita income function

	Explanatory variables	Specification
D_1	Cropping occupation dummy	1 – If Cropping is the primary occupation; 0 - otherwise
D_2	Livestock farming occupation dummy	1 – If Livestock farming is the primary occupation; 0 - otherwise
D_3	Fishing occupation dummy	1 – if Fishing is the primary occupation; 0 - otherwise
D_4	Agricultural labourer occupation dummy	1 – If Agricultural Labourer is the primary occupation; 0 – otherwise
D_5	Non-farm occupation dummy	1 – If Non-farm is the primary occupation; 0 - otherwise
X_1	Villupuram district	1 – If Villupuram district; 0 - otherwise
X_2	Dharmapuri district	1 – If Dharmapuri district; 0 - otherwise
X_3	Pudukottai district	1 – If Pudukottai district; 0 - otherwise
X_4	Ariyalur district	1 – If Ariyalur district; 0 – otherwise
X_5	Ramanathapuram district	1 – If Ramanathapuram district; 0 – otherwise
X_6	Age of the head of household	in number of years
X_7	Gender of the head of household	1 – If Female; 0– otherwise
X_8	Illiterate dummy	1 – If head of households are Illiterates; 0– otherwise
X_9	Primary education dummy	1 – If head of households are Primary level educated; 0– otherwise
X_{10}	Secondary education dummy	1 – If head of households are Secondary level educated; 0- otherwise
X_{11}	Hindu Religion dummy	1 – If Hindu; 0- otherwise
X_{12}	Muslim Religion dummy	1 – If Muslim; 0- otherwise
X_{13}	Scheduled Castes (SC) dummy	1 – If Scheduled Castes; 0- otherwise
X_{14}	Scheduled Tribes (ST) dummy	1 – If Scheduled Tribes; 0- otherwise
X_{15}	Family size	Members in the family in Consumer Unit Equivalents
X_{16}	Family dependency ratio	Number of dependents / Number of earning members in a household
X_{17}	Distance from nearest town	in kilometers
X_{18}	Distance from nearest primary school	in kilometers
X_{19}	Distance from nearest secondary school	in kilometers
X_{20}	Distance from nearest bank	in kilometers
X_{21}	Distance from nearest hospital	in kilometers
X_{22}	Distance from nearest veterinary hospital	in kilometers
X_{23}	Distance from nearest drinking water source	in kilometers
X_{24}	Landless category	1 – If Landless; 0- otherwise
X_{25}	Landholdings	in acres
X_{26}	Livestock holdings	in Animal Unit Equivalents
X_{27}	Value of assets owned	in Rupees
X_{28}	Employment	in mandays

(measured in terms of number of days employment) had significant and positive influence on per capita income. One per cent increase in mandays of employment was found to increase the per capita income by 0.256 per cent from its mean level. The results also indicated that a unit increase in the family size could decrease the per capita income by 0.265 per cent, from its mean level. Further, it is evident that the family dependency ratio had significant and inverse relationship with the per capita income of the sample respondents. As the family size and dependency ratio increases in a household, more number of persons might be sharing the same total household income, thereby decreasing the per capita income. Out of educational status dummies, the dummy variable for 'illiterates'exerted significant and negative impact on per capita income. This might be explained by the fact that illiterate farmers were more unaware about various latest technological and managemental applications and as such their income generation in any activity might be comparatively less than the literates. Further, illiteracy might have resulted in inadequate employment and thus resulting into decreased per capita income.

Overall, it could be concluded that the value of assets, education, employment level, livestock occupation, Villupuram and Ramanathapuram locality had significant and positive impact on the per capita income.The variables, *viz.*Ariyalur locality, family size, family dependency ratio and illiterate dummy, on the other hand, had significant and negative impact on per capita income.

Based on the co-efficients of various occupation dummies, per capita income was estimated for each occupation as mentioned in the methodology. Further, the

Table 2. Estimates of fixed effect regression on per capita income of sample respondents

	Explanatory variables	Unstandardized co-efficients	Standard error	Standardized coefficients	t value	P value
	Constant	7.287**	0.200	-	36.402	0.000
D_1	Crop occupation dummy	0.094	0.052	0.085	1.799	0.073
D_2	Livestock occupation dummy	0.219**	0.069	0.210	3.162	0.002
D_3	Fishing occupation dummy	0.186	0.110	0.083	1.690	0.092
D_4	Agricultural Labourer dummy	–0.056	0.091	–0.027	–0.618	0.537
D_5	Non-farm occupation dummy	0.157	0.087	0.075	1.809	0.071
X_1	Villupuram district	0.116*	0.055	0.084	2.100	0.036
X_2	Dharmapuri district	–0.066	0.055	–0.048	–1.205	0.229
X_3	Pudukottai district	–0.026	0.060	–0.019	–0.441	0.659
X_4	Ariyalur district	–0.154**	0.059	–0.112	–2.620	0.009
X_5	Ramanathapuram district	0.147*	0.070	0.106	2.082	0.038
X_6	Age of the head of household	0.002	0.002	0.046	1.313	0.190
X_7	Gender of the head of household	–0.067	0.041	–0.057	–1.638	0.102
X_8	Illiterate dummy	–0.260*	0.127	–0.249	–2.057	0.040
X_9	Primary education dummy	–0.197	0.124	–0.184	–1.595	0.111
X_{10}	Secondary education dummy	–0.153	0.125	–0.122	–1.230	0.219
X_{11}	Hindu Religion dummy	–0.061	0.065	–0.038	–0.931	0.352
X_{12}	Muslim Religion dummy	0.059	0.109	0.021	0.541	0.589
X_{13}	Scheduled Castes (SC) dummy	–0.024	0.043	–0.021	–0.549	0.583
X_{14}	Scheduled Tribes (ST) dummy	–0.101	0.053	–0.066	–1.899	0.058
X_{15}	Family size	–0.073**	0.010	–0.265	–7.135	0.000
X_{16}	Family dependency ratio	–0.961**	0.094	–0.375	–10.263	0.000
X_{17}	Distance from nearest town	0.002	0.003	0.019	0.549	0.583
X_{18}	Distance from nearest primary school	0.007	0.007	0.047	1.011	0.313
X_{19}	Distance from nearest secondary school	0.013*	0.005	0.107	2.465	0.014
X_{20}	Distance from nearest bank	–0.011	0.006	–0.083	–1.710	0.088
X_{21}	Distance from nearest hospital	–0.001	0.007	–0.007	–0.143	0.886
X_{22}	Distance from nearest veterinary hospital	–0.008	0.007	–0.049	–1.129	0.259
X_{23}	Distance from nearest drinking water source	0.091**	0.026	0.115	3.448	0.001
X_{24}	Landless category	0.128	0.066	0.124	1.950	0.052
X_{25}	Landholdings	0.010	0.007	0.050	1.420	0.156
X_{26}	Livestock holdings	0.007	0.012	0.020	0.644	0.520
X_{27}	Value of assets owned	0.0000003428**	0.000	0.091	2.634	0.009
X_{28}	Employment	0.001**	0.000	0.256	6.912	0.000
	Adjusted R square	0.540				
Standard error		0.3489				
	F value	20.187 **				
	N	540				

** Significant at one per cent level and * Significant at five per cent level

poverty ratios were worked out for actual income (in presence of specific occupation) and for estimated income (in absence of specific occupation) as mentioned in the design of the study. The results of poverty indices with and without the particular occupation are presented in Table 3. From the table, it could be elucidated that the poverty indices were found to be high for the income with occupation, when compared to the income without occupation for all the chosen occupations, except agricultural labourers. The presence of agricultural labour occupation increased the head count index (P_0) by 0.0370, poverty gap index (P_1) by 0.0208, poverty severity index (P_2) by 0.0125 and the Watts index (W) by 0.0317.

Among all the occupations, the presence of livestock farming decreased the poverty indices by the greatest extent (0.1852 of P_0, 0.1002 of P_1, 0.0593 of P_2, and 0.1562 of W). Following livestock, fishing had the greater potential of poverty reduction with the reduction values of 0.1852 (P_0), 0.0844 (P_1), 0.0492 (P_2) and 0.1306 (W). The present results of poverty reduction potential of livestock farming were akin with the findings of the Cuong (2010). Although cropping and non-farm occupation had the potential of poverty reduction, the magnitude of poverty reduction was more for non-farm occupation when compared to cropping activity. However, the present findings of positive impact of cropping with the poverty reduction contradicted with the findings of Cuong (2010).

From the table, it could be inferred that the presence of livestock occupation, decreased the exit time for poverty by 5.22 years and it was 4.35 years for fishing occupation, 3.60 years for non-farm occupation and 2.05 years for cropping activity. The presence of agricultural labourer had the impact of increasing the poverty exit time by 1.06 years. Thus, the results of the present study clearly exhibited the role of livestock in poverty alleviation in the study area and it concurred with the findings of Ali (2007), Inoni*et al.* (2007), Millar and Photakoun (2008) and Cuong (2010) and contradicts with findings of World bank report (2016)

Table 3. Impact of different occupations on poverty

S.No.	Particulars	In presence of occupation	In absence of occupation	Impact
A.	Cropping			
1	Head count index	0.5907	0.6981	- 0.1074
2	Poverty gap index	0.2070(0.0077)	0.2473(0.0085)	- 0.0403**
3	Poverty severity index	0.0918(0.0005)	0.1150(0.1150)	- 0.0232**
4	The Watts index	0.2802(0.0131)	0.3418(0.0145)	- 0.0616**
5	Duration required to get out of poverty (in years)#	9.34	11.39	–2.05
B.	Livestock farming			
1	Head count index	0.5907	0.7759	- 0.1852
2	Poverty gap index	0.2070(0.0077)	0.3072(0.0084)	- 0.1002**
3	Poverty severity index	0.0918(0.0005)	0.1511(0.0068)	- 0.0593**
4	The Watts index	0.2802(0.0131)	0.4364(0.0153)	- 0.1562**
5	Duration required to get out of poverty (in years)#	9.34	14.55	–5.21
C.	Fishing			
1	Head count index	0.5907	0.7759	- 0.1852
2	Poverty gap index	0.2070(0.0077)	0.2914(0.0087)	- 0.0844**
3	Poverty severity index	0.0918(0.0005)	0.1410(0.0067)	- 0.0492**
4	The Watts index	0.2802(0.0131)	0.4108(0.0153)	- 0.1306**
5	Duration required to get out of poverty (in years)#	9.34	13.69	–4.35
D	Agricultural labourer			
1	Head count index	0.5907	0.5537	0.0370
2	Poverty gap index	0.2070(0.0077)	0.1862(0.0075)	0.0208**
3	Poverty severity index	0.0918(0.0005)	0.0793(0.0055)	0.0125**
4	The Watts index	0.2802(0.0131)	0.2485(0.0125)	0.0317**
5	Duration required to get out of poverty (in years)#	9.34	8.28	1.06
E	Non-farm occupation			
1	Head count index	0.5907	0.7722	- 0.1815
2	Poverty gap index	0.2070(0.0077)	0.2772(0.0089)	- 0.0702**
3	Poverty severity index	0.0918(0.0005)	0.1324(0.0066)	- 0.0406**
4	The Watts index	0.2802(0.0131)	0.3883(0.0152)	- 0.1081**
5	Duration required to get out of poverty (in years)#	9.34	12.94	–3.60

Figures in parentheses indicate standard error ** Significant at one per cent level; # at the income growth rate of 3 per cent per annum.

that growth of agricultural and allied sectors' income benefited poor households.The present findings reinforces the statement of Grace (2017), that small-scale livestock act as a pathway out of poverty.

The importance of livestock in the livelihood of resource poor farmers has been well documented. However, there is a research gap in documenting the extent to which livestock rearing can reduce poverty, especially in the Indian context. This study had provided quantitative evidence regarding the extent to which poverty can be decreased through livestock *vis-a-vis* other livelihood options. Overall, the present study concluded that among various occupations, the presence of livestock farming decreased the poverty indices by the greatest extent. Following livestock, fishing had the greater potential of poverty reduction with the reduction values. Further, the presence of livestock occupation, decreased the exit time for poverty by the greatest extent. Thus the present study concluded and concurred with the statement of *"Livestock must be at the centre of any poverty alleviation programme"* by Gavin Wall, FAO Representative.

ACKNOWLEDGEMENT

The present study is the part of the Ph.D. thesis of the first author submitted to the Tamil Nadu Veterinary and Animal Sciences University, Chennai. The authors thank Tamil Nadu Veterinary and Animal Sciences University, Chennai for giving permission and support for completion of research work.

REFERENCES

Ali J. 2007. Livestock sector development and implications for rural poverty alleviation in India. *Livestock Research for Rural Development.* **19**, *Article 27*. Retrieved May 2, 2013, from http: //www.lrrd.org/lrrd19/2/ali19027.htm.

Cuong N V. 2010. Does agriculture help poverty and inequality reduction? Evidence from Vietnam. *Agricultural Economics Review* **11**(1): 44–56.

Grace D, Lindahl J, Wanyoike F, Bett B, Randolph T and Rich K M. 2017. Poor livestock keepers: ecosystem –poverty – health interactions. *Philosophical Transactions of the Royal Society B* **372**: 20160166.

Inoni O E, Chukwuji C O, Ogisi O D and Oyaide W J. 2007. Alleviating rural poverty: What role for small-holder livestock production in Delta State, Nigeria. *Agricultura Tropicaet Subtropica* **40**(2): 39–43.

Millar J and Photakoun V. 2008. Livestock development and poverty alleviation: revolution or evolution for upland livelihoods in Lao PDR? *International Journal of Agricultural Sustainability* **6**(1): 89–102.

Planning Commission. 2014. Report of the expert group to review the methodology for measurement of poverty under the chairmanship of Dr. C. Rangarajan. *Government of India*, June 2014.

World Bank. 2006. *Summary of Key Finding and Recommendation for Pakistan: Poverty, 2004–05. Islamabad*.

World Bank Poverty Manual. 2005. Introduction to poverty analysis. *World Bank Institute.*

World Bank Report. 2016. The Uganda Poverty Assessment Report 2016. Farms, cities and good fortune: assessing poverty reduction in Uganda from 2006 to 2013. World Bank, Washington DC.