Growth of Livestock GDP in India: Analysis and Estimates

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Abstract—*Since the 1990's, though the agricultural sector in India has been showing a decreasing trend as regards its contribution to total GDP, the contribution of animal husbandry sector in agricultural GDP is increasing at a faster rate. Excessive population pressure on land, lack of alternative employment opportunities in secondary and service sector, growing demand for livestock products etc. are instrumental behind this trend. It has been observed that growth of crop husbandry or measures taken for the growth of this sector are acting directly or indirectly as a conducive factor for the development of animal husbandry sector. Present study aims at evaluating how far the development or measures taken for the development of primary subsector i.e agriculture has been influential behind the development of subsidiary subsector namely animal husbandry and also attempts to estimate the livestock GDP growth model using econometric method. In order to explain the variation in livestock GDP growth, a regression analysis is done taking the livestock GDP growth as a dependent variable. Different parameters of crop husbandry like agricultural GDP, agricultural credit, credit linked schemes on livestock development, budget expenditure on agriculture and livestock, subsidy on fertilizer, usage of fertilizer, rainfall, area under coarse cereals, area under meadows and pastures, area under irrigation etc. has been chosen as independent variables in the estimation. Annual time series data, from 1980-81 to 2012-13 has been used to construct a simple linear regression model following ordinary least squares (OLS) method. The regression result reveals that non-monetary factors are, to some extent, conducive for the growth of livestock sector. But several monetary factors have impedimental effects on the growth of livestock output. In sum, the regression results reveal that growth of crop husbandry or measures taken for the growth of this sector are directly or indirectly conducive for the development of animal husbandry sector.*

Keyword*: Agriculture, Animal husbandry, Livestock Development, GDP, Rural Credit.*

1. INTRODUCTION

Since the 1990's, the agriculture and allied activities sector in India has been showing a decreasing trend as regards its contribution to total GDP. However, inspite of a fall in its share, the importance of this sector has not diminished due to two major reasons, firstly, to combat deficiency in food production at the macro level and secondly, the dependence of the rural workforce on agriculture for employment has not declined in proportion to the sectoral contribution to GDP. Under these circumstances, sustained agricultural growth, facilitated through constant policy and institutional support, has the potential to augment growth in the rural economy and associated secondary activities like food processing and retail trading.

Apart from agriculture other allied sub sectors of the agricultural sector of Indian economy should also be reviewed at this backdrop. In this context it should be mentioned that the livestock subsector or animal husbandry plays an important part of our agricultural system. Two reasons could be identified behind this. Firstly, next to crop husbandry, animal husbandry is the single largest source of both agricultural GDP and agricultural employment of the country and the share of this subsector in our agricultural GDP is increasing continuously whereas crop husbandry has been exhibiting diametrically opposite scenario in this regard. Secondly, in order to maintain its sustainability, what contemporary Indian agricultural system requires is an "Integrated Farming Systems" without wastage which means by-product of one system becomes the input for other. Moreover, the system helps poor and small farmers possessing very small land holdings for crop production and a few heads of livestock to diversify farm production by increasing cash income, improving quality and quantity of food produced and exploiting unutilized resources. Population growth, urbanization and income growth have been instrumental in fuelling a substantial increase in demand for food of animal origin. The paper has been divided into a number of sections which are organized as follows:

Section 1 deals with the contribution to GDP and agricultural GDP of both of these subsectors in real terms. This section also depicts the pattern of growth of these sectors. Growth of different factors that affect productivity of these two sectors like institutional credit, public expenditure, usage of land, irrigation facilities, rainfall etc. have been dealt with in section 2. The next section 3 estimates the livestock GDP growth model using econometric method. Section 4 concludes the discussion.

Pattern of growth- crop and animal husbandry

Since independence, India has made commendable progress in agriculture. The sector which used to grow at the rate of less than 1 percent per annum prior to at least fifty years before independence started growing at the rate of about 2.6 percent per annum in the post-Independence era (Kurosaki, T., 2007). Table 1 reveals composition of GDP and agricultural GDP and growth of crop and animal husbandry output in terms of compound annual growth rate.

Table 1: composition of GDP and agricultural GDP and growth of crop and animal husbandry output in terms of CAGR.

Share in GDP (%)			Share of Animal husbandry in Agri-cultural GDP(%)	Growth of Output in Crop Husbandry and Animal Husbandry (CAGR)			
year	Agri.	Animal husbandry			Food grain	Milk	Egg
1980-81	34.72	4.82	13.88	1980-81 - 1990-91	3.50	5.48	7.69
1990-91	28.30	6.45	22.78	1990-91 - 2000-01	2.06	4.11	5.67
2000-01	21.24	5.44	25.61	2000-01 - 2010-11	2.50	4.22	5.58
2010-11	15.77	3.94	24.99	2010-11 - 2012-13	1.98	4.25	5.19
2012-13	15.10	4.11	27.25				

Source: Basic Animal Husbandry Statistics, Department of Animal Husbandry, Ministry of Agriculture, GoI.

National Accounts Division, Central Statistical Office, MoSPI, Government of India

During the 80s an annual growth rate of 3.5 percent in food grains was the hallmark of Green Revolution enabling India to become not only self-sufficient but a marginal exporter as well. But this pace of growth slowed in the 90s which was even slower than the population growth rate. Further, during the 9th Five-Year Plan (1996-97 to 2001-02), Government of India envisaged an annual growth rate of 4 percent in agriculture and allied sector. As the crop sector constitutes over three-fourth of total food grain output, its growth performance assumes great importance in achieving this target. But, the growth of food grain production was only 2.06 per cent, which was not very high from the annual population growth of 1.64 per cent as per Census 2011. In the next decade this growth rate increased slightly and at the early part of the present decade it shows a growth rate of around 2 percent. During this reference period the agricultural and allied sector has been showing a steady declining trend in its share in GDP.

On the other hand, the growth rate and share of animal husbandry sub-sector in overall agricultural sector has increased considerably. Milk production, which was almost stagnant for two decades until 1970, grew by over 5 percent per annum in the 80s. Similarly, production of eggs increased at the rate of about 7.5 percent during the same period. Consequently, share of output as part of animal husbandry within total agricultural production increased from about 14 percent till early 80s to 27 percent by 2012-13.

Above findings ascertains the commendable progress of animal husbandry production in India after the 80s and prompts one to probe into the underlying causes. Decision of institutional and infrastructural reforms, strategic reorientation trickled down from the concept of Green Revolution and successive agricultural policies have played pivotal role in development of the Indian agrarian economy. These parameters are listed as: (i) institutional credit flow to agricultural and credit linked Scheme on animal husbandry sector, (ii) budgetary expenditure on crop husbandry and animal husbandry sub sector, (iii) Irrigation facilities to crop production system, (iv) usage of fertilizer (N+P+K) in crop cultivation, (v) area of land under coarse cereals cultivation and (vi) rainfall.

2. FACTORS AFFECTING LIVESTOCK GDP GROWTH

2.1. Institutional Credit

A review of performance of agricultural credit in India (Mohan, R., 2006) reveals that though the overall flow of institutional credit has increased over the years, there exists phenomenal gaps in the system like inadequate provision of credit to small and marginal farmers, paucity of medium and long-term lending and limited deposit mobilisation and heavy dependence on borrowed funds from major agricultural credit purveyors. These gaps have major implications on agricultural development also on the well being of the farming community as well.Loans to animal husbandry sub sector falls under the “Direct Lending to Agriculture” category. In India this sub-sector does not receive credit for production activities in general. No short-term credit normally is given for meeting the recurring expenditure of milch cattle, sheep or goat units. However, under the various rural development programmes the financial institutions have been providing term loans for induction of the animals which constitutes above 10 per cent of the total term loans in the agriculture sector. These are basically credit linked scheme on animal husbandry activities.Animal husbandry production system in India is mostly based on traditional knowledge, low cost agricultural residues and agro-byproducts leading to lower productivity. Mainly for this reason the typical perception of bankers is that

the financing of animal husbandry activities is a risk proposition and are most likely to become bad loan.

2.2. Budgetary Expenditure

The period from the early 1970s to late 1980s may be described as a phase of "pulling up" agriculture, a process driven by the adoption of seed–fertilizer–water technology packages associated with the so-called Green Revolution. Substantial public expenditure was incurred in this phase to promote the green revolution package, which was limited to a few regions and crops in the 1970s, but became much more widespread in the 1980s. A point worth emphasising here is the relative stagnation in overall public expenditure on rural and agricultural development since the early 1990s. There has been a noticeable decline in expenditure in the period of economic reform as compared to the pre-reform period (Jha 2007 and 2009, Golait *et al.* 2008, Chand 2010, Mahendra Dev and Sharma 2010).

2.3. Irrigation

India's irrigated cropped area was about 22.6 million hectares in 1951, which increased to a potential of 90 million hector at the end of 1995, inclusive of canals and groundwater wells. According to the World Bank, only about 35% of total agricultural land in India was reliably irrigated in 2010. **E**xtension or introduction of irrigation facilities encourage crop production but whether it will be conducive to livestock production or not that depends upon the soil characteristics, agro-climatic condition of the region, availability of feed for animal etc. Kumar and Sing (2008) postulated that in India the importance of livestock farming is much greater in marginal areas like arid and rainfed regions because of higher concentration of poor, limited benefits of green revolution technologies, climatic uncertainties etc. However, introduction of irrigation and accompanying technological progress ease condition of cultivation to a great extent and subsequently production of commercial crops as well as livestock become prosperous and productivity improves.

2.4. Usage of fertilizer in crop husbandry sub sector

The role of chemical fertilisers for increased agricultural production, especially in developing countries, is well established. Some argue that fertiliser was as important as seed in the Green Revolution contributing as much as 50 percent of the yield growth in Asia (Hopper 1993 and FAO 1998). Others have found that one-third of the cereal production world-wide is due to the use of fertiliser and related factors of production (Bumb, 1995).The pertinent question associated with the usage of fertiliszer in Indian crop husbandry sector is that how far it is conducive for the growth of crop husbandry and animal husbandry sub sector. There exists a complimentary relation between usage of fertilizer and irrigation facility (Devkota,M. and others,2015) and irrigation is inversely related to the growth of animal husbandry which has been discussed in earlier section. This study aims to assess degree of association between growth of fertiliser usage or any interacting variable with fertiliser and growth of animal husbandry sector in India

2.5. Coarse Cereals

Coarse grains are dual purpose crops (grains and fodder). These are important cereal supplement in the staple diet for a large section of subsistence farmers and the rural poor. In India a vast cultivable land is unirrigated and mixed crop–livestock systems are the dominant form of agricultural production. Besides, in India, livestock farming system are mostly organized by poverty stricken marginal and small farmers who can hardly manage their own household consumption from agriculture, cannot bear extra cost for maintaining the herd they posses as an insurance against crop production risks, a coping mechanism against livelihood shocks as well as a vital source of dietary protein. Here coarse cereals play an important role in supplying food for farmers and feed and fodder for their herds. Crop residues from dual-purpose crops, particularly from coarse cereal and leguminous crops, are, by far, the most important feed source available to in semi-arid, tropical India.

2.6. Rainfall and Climate Change

Weather, particularly, rainfall and temperature is the key source of uncertainty affecting crop yield especially in the context of climate change. Tthe effect of climate change on crops is well known, but much less is known about the effects of climate change on livestock (Reilly *et al.*, 1996; McCarthy *et al.*, 2001; Seo & Mendelsohn, 2006). Smith *et al.*, (1996) reveals that climate change will affect animal production in four ways: the impact of changes on livestock feed-grain availability and price; the impact on livestock pastures and forage crop production and quality; changes in livestock diseases and pests; and the direct effects of weather and extreme events on animal health, growth and reproduction.

Table 2. reveals the Compound Annual Growth Rate of some of the parameters as discussed above. Institutional credit to agriculture and fertilizer usage show opposite but consistent trend in their growth pattern. From 1980-81 to 2009-10 growth rate of budgetary expenditure and livestock was in same direction but from 2010 onwards agriculture shows a negative growth and budgetary expenditure on livestock depicts a positive and higher rate of growth. This implies that since 2010 more priority is being given on livestock subsector. In the reference period of the study, the growth rate of the area under coarse grain cultivation never showed positive trend and during 2010-11 and 2012-13 it recorded the lowest level.

Table 2: Compound Annual Growth Rate (CAGR %)

Decade / Year	flow of Institutional credit to agriculture	Budgetary expenditure on agriculture	Budgetary expenditure on livestock	Fertilizer usages	Area under coarse grain
1980-81 - 1989-90	5.06	4.75	0.82	7.71	-0.99
1990-91 - 1999-00	7.44	-4.53	-2.60	3.80	-2.10
2000-01 - 2009-10	13.45	14.52	8.10	3.26	-0.93
2010-11 - 2012-13	13.91	-4.38	7.23	1.61	-4.78

Source: computed from data released by ministry of agriculture, Govt. of India, Fertiliser Association of India, Basic Animal Husbandry Statistics

3. ECONOMETRIC SPECIFICATION OF MODEL AND RESULTS

The study aims to evaluate how far the development or measures taken for the development of primary subsector is influential for the development of subsidiary subsector and attempts to estimate the livestock GDP growth model using econometric method. In order to explain the variation in livestock GDP growth, a regression analysis by treating the growth of livestock GDP as a dependent variable and different parameters of crop husbandry as independent variables is carried out in this paper. Annual time series data, from 1980-81 to 2012-13 has been used to construct a simple linear regression model following ordinary least squares (OLS) method.

It has been hypothesized that the growth rate of livestock GDP is a function of Growth of several parameters like agricultural GDP, agricultural credit, credit linked scheme on livestock development, budget expenditure on agriculture and livestock , subsidy on fertilizer, usage of fertilizer, Rainfall, area under coarse cereals, area under meadows and pastures, area under irrigation etc. moreover, some interacting parameters has also been taken into account in the hypothesis – the interaction between growth rates of agricultural GDP and agricultural credit, agricultural GDP and rainfall, agricultural GDP and budget expenditure on agriculture, agricultural GDP and usage of fertilizer, agricultural GDP and area under irrigation, agricultural credit and usage of fertilizer. Among a large number of factors considered in the study, the following variables were finally used in the model based on their statistical significance and stability of the functional relationship. The empirical model for the growth rate of livestock GDP is specified as follows:

$$= \alpha + \beta_1(gdpagri_t) + \beta_2(creditgri_t) + \beta_3(fertiliser_t) + \beta_4(\exp agri_t) + \beta_5(gdpagri_t * creditgri_t$$
$$agri * rainfall) + \beta_7(gdpagri * irrigatedland) + \beta_8(gdpagri_t * fertiliser_t) + \beta_9(fertiliser_t * cred$$
$$dpagri_t * \exp agri_t) + \varepsilon_t$$

Where, gdpls is growth rate of livestock GDP. The following independent variables were hypothesized to influence the growth of livestock GDP positively (+), negatively (-), or either negatively or positively (+/-) gdpagri = growth rate of agricultural GDP (+),

creditagri = growth rate of direct institutional credit to crop husbandry (-),

fertilizer = growth rate of chemical fertilizer (N+P+K) usage (+),

expagri = growth rate of budgetary expenditure on agriculture (+/-),

landcereals = growth rate of area under coarse grain production,

gdpagri*creditagri = interaction between growth rate of agricultural GDP and credit to crop husbandry (+), gdpagri*rainfall = interaction between growth rate of agricultural GDP and rainfall,

gdpagri*irrigation = interaction between growth rate of agricultural GDP and area of land under irrigation, gdpagri*expagri = interaction between growth rate of agricultural GDP and budgetary expenditure on agriculture (-),

gdpagri*fertilizer = interaction between growth rate of agricultural GDP and chemical fertilizer usage (+), fertiliser*creditagri = between growth rate of chemical fertilizer usage and credit to crop husbandry(+).

Present study attempts to predict the effect of growth of agricultural production on that of livestock production for different levels of fertilizer usages. In this context, introduction of interaction variables between growth of agricultural production and fertilizer usage is very much relevant. *in order to assess how and to what extent institutional credit to agriculture affects the growth of agricultural production and finally the growth of livestock sector, the interacting terms of growth of institutional credit flow to agriculture, growth of fertiliser usage and growth of agricultural GDP should be taken into consideration. Further, to avoid the spurious results these terms should be tagged with each other. Same reasoning holds good for the interaction between growth of budgetary expenditure on agriculture and growth of agricultural GDP.* The positive roles of rainfall and irrigation are manifested through their impact on growth of agricultural production hence while evaluating the impact of rainfall and irrigation on growth of livestock development at first their impact on agricultural growth should be taken into consideration which necessitates the framing of interaction

variables taking into account growth of agricultural GDP and that of irrigation facilities and rainfall. Hence, for a proper understanding of regression result inclusion of the interacting effect has been necessary for the present study.

The growth rates of monetary variables such as gdpls, gdpagri, creditagri and expagri has been calculated on their real values taking 1994 as base year (1994=100).

Table 3: Estimating Factors affecting Growth of Livestock GDP

Explanatory variables	Model-1	Model-2	Model-3	Model-4	Model-5
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
gdpagri	.1973856 (1.36)	.1722013 (0.97)	.138723 (0.93)	.2076105* (1.19)	.3879628** (2.08)
creditagri	-.1476165 (-1.51)		-.293058** (-2.70)		-.1599914* (-1.67)
fertilizer	.3987584** (3.31)			.34245** (2.26)	.3390891** (2.75)
landcereals				.0224119 (0.10)	
gdpagri*creditagri	.0197673* (1.77)		.020877* (1.79)	.008802 (0.96)	.0159822 (1.43)
gdpagri*rainfall					-.0125698** (-1.57)
gdpagri*irrigated land				.0463293 (0.83)	
gdpagri*expagri		-.016776* (-1.99)			
gdpagri*fertilizer		.0715283** (3.42)			
fertiliser*creditagri			.0243283** (2.85)		
Constant	3.983016** (2.45)	5.122007*** (4.96)	6.673067** (4.63)	2.9596** (1.85)	4.467894*** (2.77)
Adjusted R Square	.2995	.2638	.2422	0.2338	0.3358
F	4.31	4.70	3.48	2.89	4.13
Root MSE	4.4115	4.5223	4.5883	4.6134	4.2956

(***), (**) and (*) indicate significant at 1%, 5% and 10% level respectively and figures in parenthesis are‘t’ values.

Out of all these explanatory variables, only fertilizer and interacting variable of fertilizer with creditagri show higher correlation coefficient though they are below 0.5. The adjusted R^2 values as shown in inferential analysis of the study through table 2.7 show as 0.29, 0.26 , 0.24, 0.23 and 0.33 for model-1, model-2 , model-3, model-4 and model-5 respectively.

It should be noted that values of adjusted R^2 in all the three models apparently indicate that the models are not good fitted. But, we would justify our results by arguing that in the present situation a high R-squared is not necessary or relevant, because the present study is trying to find out the relationship between variables rather than going in for prediction. Hence, the value of R-squared in this case is of lesser importance and in the lower range is reasonable. The results show that growth of agricultural GDP has a positive impact on the growth of livestock GDP. Three factors have to be taken into consideration while interpreting the impact of agricultural GDP on livestock GDP. First, in India, till now, animal husbandry activities are organized by marginal and small farmers who, being resource poor, are keen to invest their surplus from crop husbandry subsector to animal husbandry subsector. This is because due to their risk averse attitude the small and marginal farmers have no other avenue to invest their surplus fund elsewhere or in non-farm sector. Secondly, animal husbandry is a labour intensive activity and most of the small and marginal farm households are labour surplus. So, the farmers would always try to invest their fund in such a venture where they can employ their family labour to the highest extent. Thirdly, most of the small and marginal farm households keep livestock as a source of their insurance and convertibility to cash of this asset is more prompt than any other assets which this farming community can reach. All the above factors explain sufficiently the positive role of growth of agricultural GDP on growth of livestock GDP.

The regression result shown in table 3 reveals that growth of institutional credit to agriculture has a negative impact on the growth of livestock GDP. In support of this trend it can be safely asserted that the need for institutional credit for agriculture is so high that most of the farmers attempt to avail the opportunity of getting such credit. In Indian agricultural economy most of the small and marginal farmers’ principal occupational status is associated with crop husbandry and this subsector is the subsistence source of their income. They take animal husbandry as a subsidiary occupation. Our livestock rearing activities can hardly expect credit support from institutional sources whereas the crop loan or short term institutional credit to agriculture is unbelievably cheap. Under such circumstances a rational farmer should always opt for the venture where easy credit facility is available and it is more pertinent if the facility goes in favour of subsistence sector. Therefore, the regression result reveals a realistic picture in the context of institutional credit facilities to agriculture and growth of livestock GDP.

Out of the given explanatory variables, usage of fertilizers has the most impressive positive impact upon the growth of animal husbandry sector. The coefficient is significant at 5% level with the value 0.40. The reason behind this trend is very obvious. In India mixed crop–livestock system is the dominant form of agricultural production and crop residues from dual-purpose crops, particularly from coarse cereal and leguminous crops, are by far the most important feed source available to in semi-arid, tropical India. Application of more fertilizers implies production of more crop output including crop residues on which most of the Indian livestock owners depend for feeding their herd. So naturally this abundant supply of animal feed and fodder encourages investing more in animal husbandry farming.

Table 3 reveals an interesting picture that when a new explanatory variable expressed as an interaction between growth of agricultural GDP and institutional credit for agriculture is introduced in the model the absolute value of coefficient falls drastically. Following results of model-1 and 2 it is said that the coefficient of this interaction term is as low as .02 but it is significant at 10 percent level in both of the models. The negative impact of institutional credit growth has outweighed the positive impact of agricultural output growth on dependent variable and the resultant effect is a very low value of coefficient with positive sign. Due to the same kind of reasoning, in model-2 introduction of an explanatory variable interacting between agricultural GDP and budgetary expenditure on agriculture generates negative coefficients with a very low value of .017 which is significant at 10 percent level. The value of coefficient generated by interacting variables between growth of agricultural output and fertilizer usage as revealed in model-2 of table 2.7 is puzzling. It needs to be interpreted with considerable caution because inter-correlation between livestock GDP and growth of agricultural output and also with fertilizer consumption are as high as 0.2 and 0.4, respectively as shown in model-1. There is no evidence that in Indian agriculture fertiliser usage has acted as an impediment for the growth of crop output, however, in some cases uncontrolled usage of fertilizer resulted a low level of factor productivity of fertilizer per acre.

4. CONCLUDING REMARK

From the above discussion it can be asserted that non-monetary factors like growth of crop husbandry sector, fertilizer usage etc. is, to some extent, conducive for the growth of livestock sector. But several monetary factors like flow of institutional credit to agriculture, budgetary expenditure on agriculture, any subsidy granted for only crop production sector etc. have impedimental effects on the growth of livestock output. The above regression results reveal that growth of crop husbandry or measures taken for the growth of this sector are directly or indirectly conducive for the development of animal husbandry sector. So there should not be any trade off between crop husbandry activities and animal husbandry activities. Government policy should be framed in such a balanced way that both of these sub-sectors can emerge as complementary to each other.

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