INTRODUCTION

1.1 Background

India ranks first in global livestock population with 485 million livestock and 489 million poultry. Animal husbandry has been an integral part of the socio-economic and cultural fabric of rural India since time immemorial. In more recent years, the Indian livestock sector has undergone a rapid growth, while the contribution of agriculture to GDP is declining with industrialisation; the contribution of the livestock sector to agricultural output is increasing. At present, livestock makes up to 25% of the output of the agricultural sector and is growing at an annual rate of 4.3%, a rate much higher than that for the agricultural sector as a whole. The country has the largest number of cattle and buffalo of the world. She ranks second in goat and third in sheep and seventh in poultry.

India has successfully carried out Operation flood programme. Under this program, rural producers were organised into cooperatives, so that they would have remunerative prices assured market, and inputs and services for the milk production enhancement, such as breed improvement, better feed and fodder, through artificial insemination, and disease control measures. This innovative effort has substantially increased milk production and ushered in a "White Revolution," making India, the world's largest milk producer (Shah, 2009).

Livestock production systems are characterised by low input and low productivity. Excluding the poultry and dairy (up to some extent), by and large, the system of production is extensive. More than 70% of in-milk bovines are raised on small and marginal holdings. With over 80% of livestock production being carried out by small-scale and marginal farmers, the livelihood benefits of livestock are enormous. Hence, one cannot truly envisage sustainable agricultural and rural development in this country without acknowledging the livestock sector as a prime force. Regarding milk production, there is a distinct shift from indigenous cattle to buffalo and crossbred cattle. There has been a significant increase in the female buffalo and crossbred cow populations. The poultry sub-sector is a mixture of intensive and traditional production systems. The intensive system is rapidly gaining in importance. About 60 percent of poultry meat and 56 percent of eggs are produced under this system.
The livestock sector holds special importance to small and marginal farmers because they rear a large proportion of livestock in the country. It is considered as an important source of employment, involving the rural people in various operations. The livestock sector recently emerged as a significant form of diversification of agriculture. It is also an important source of food security as it provides meat, milk and other dairy products, which enrich the nutrition intake (Rollefson, 2001). The animal dung has always been valuable for their usages as domestic fuels as well as manure in many villages of India. This is one sector where poor contributes directly to the growth instead of getting benefit from elsewhere (Eleventh five year plan). The demand for livestock products increased tremendously at global levels because of increasing urbanisation, burgeoning middle-class population and improvement in the level of income and socioeconomic transformation. (Delgado et al., 1999; Rollefson 2001; Chindola and Otte, 2006; Brithal and Taneza, 2006; Padamkumar, 2007). Such a dramatic change in demand and production of livestock and their products is described as Livestock Revolution by International Food Policy Research Institute (IFPRI) analysts (Conroy C., 2004). The Livestock Revolution has given opportunities to the producers to expand in this sector through enhancing production, both in qualitative and quantitative terms. The expanding market for animal food products is a chance for millions of smallholders, who have a sufficient endowment of labour but limited land, to improve their income and employment through livestock (Birthal and Negi, 2012).

The revolution has been accelerated after liberalisation of agribusiness and increasing demand for livestock in the global market due to price competitiveness of livestock products originated in tropical monsoon developing countries where production cost is comparatively low (Padamkumar, 2007). Thus, in this way, the animal based products from tropical countries are in high demand, both in the Asian as well as in the European markets. These products, especially those produced in India, fetch a good competitive price in international markets due to a low production cost after reducing the subsidies on agricultural production and export by developed countries especially OECD group (Allana, 2005; Padamkumar V., 2007). Livestock production offers one of the few rapidly expanding markets in which poor, rural people can participate even if they lack substantial amounts of land, training and
capital. The significance of livestock for women's income in India has been widely emphasised. Dairy cooperatives have been a major means of successfully bringing women in poor areas. Evidence from studies and a pattern from developing countries shows that the poor farmers earn a higher share of income from livestock than do the wealthy ones (Quisumbing et al., 1995). It raises the possibility that the Livestock Revolution will be beneficial for the Poor. The revolution offers two main reasons for optimism. First, the poor can very easily improve their income when they have a major stake in a sector that is growing. Second, the current rapid intensification of animal production comes at a time when the rural poor direly needs higher returns to their shrinking land than field crops alone can offer (Lokollo, 2005).

However, the Livestock Revolution also poses a threat to resource-poor livestock keepers in under-developed countries. Increasing competition with big firms, revenue constraints, environmental issues, disease threat and new trade standards are some of the important factors that put further pressure on this sector. The emergence of livestock industries, as opposed to traditional small farmers, seems to be a threat to poor livestock keepers. Hoffman (1999) argued that this industry has raised four important issues for Asian economies: first, the importance of livestock to the national economy, second, the protection of the environment in the face of increasing intensive farming methodology, third, the protection of human and animal health and fourth, the maintenance of social equity.

The livestock industrialisation has an adverse impact on social equity. The small producers suffer a setback as they lose out in the competition or fail to recover from price fluctuation, disease outbreak that destroyed capital and stock (Rigg, 2005, Tuong, 2007).

Social effects of Livestock Revolution could be negative, and it could crowd out poor livestock keepers. This would eliminate one of the most powerful approaches to rural poverty reduction for more than millions of rural poor, who now have livestock as one of the few possibilities of getting out of the poverty trap. This process has already occurred in many middle-income countries, where there is a strong concentration of production and processing. For example, in Thailand, 80% of the poultry production now comes from only ten large, vertically integrated companies, which supply feed and day-old chicks to medium and large sized producers under
contract (Henry and Rothwell, 1996). Similarly, in Brazil, four integrators cover approximately 40% of the broiler market, and the number of farms with less than 1000 birds decreased by 25% (De Haan et al., 1997). Strong concentration can cause an increase in poverty and social inequity. There is fear that the large-scale livestock production will outcompete the smallholder producers everywhere and eventually provoke their exit from the sector.

A critical issue raised by the trends in the Livestock Revolution is that, for once, a sector in which the small scale farmers are heavily involved is growing. But if they fail to participate, they are condemned to even worse immiseration. If they participate in these developments, farm incomes could rise dramatically, but the conditions under which this could occur are still undetermined. Furthermore, whether the seemingly unstoppable growth of livestock products is a good or a bad thing for the poor will also depend on the government policies regarding the Livestock Revolution. It has given rise to the intensive livestock production, which has already caused numerous problems in developed countries. Its effects are now being seen in ‘developing’ countries also, affecting rural and socioeconomic structures, health, the food security of small-scale farmers, the environment and genetic diversity, as well as causing tremendous animal suffering. Massive increases in production of, and demand for, livestock products are expected in developing countries over the next 20 years, so the situation will worsen unless urgent action is taken (Cox and Varpama, 2000).

1.2 Significance of Research

The livestock sector’s boom which can be extremely helpful in enhancing the income of small and marginal farmers. It raises the possibility that the Livestock Revolution will be beneficial for the Poor.

In the wake of Livestock Revolution, laissez-faire policy will be very dangerous because the bulkiest share of livestock in India is owned by small-scale producers so any repercussion in the sector due to the negligence of policymakers is going to hit hard small scale producers and can swell the rural poverty further. So policy makers should take note of this Livestock Revolution and make efforts as hard as possible to make it a boon rather than a bane for small farmers of our country.
Hence, the study with the following objectives tries to capture the impact of Livestock Revolution on small-scale producers, so that the policy makers can make possible efforts to harness the benefits of the Livestock Revolution for them. Proper policies related to the livestock sector can’t be made without understanding the impact of Livestock Revolution on small-scale producers. Improvement in smallholders` conditions can be served as a key to sustained growth in livestock production.

1.3 Objectives of the Study

The objectives of the study are:

1.3.1. To understand the structural changes in the global livestock sector and examining the significance of the Indian livestock sector in the world.

Sub-objectives:

- To highlight the regions and countries of the world witnessing Livestock Revolution.
- To assess the status of the Indian livestock sector globally
- To show the international competitiveness of Indian livestock products.

1.3.2. To analyse the structural changes in Indian livestock sector due to Livestock Revolution.

Sub-objective:

- To find out the structural changes in Indian livestock sector due to the Livestock Revolution in terms of livestock population, production and consumption and international trade.

1.3.3. To understand the significance of livestock sector for the agricultural economy in general and small scale farmers in particular.

Sub-objectives:

- To analyse the role of livestock sector in the agricultural economy of India.
- To show the impact of the livestock sector on rural poverty alleviation in India.
- To highlight the significance of livestock for small scale farmers of India.
1.3.4. To evaluate the impact of the Livestock Revolution on small scale producers in India.

Sub-objectives:

- To assess the distribution of livestock resources among various farm categories.
- To assess diversity in livestock species kept by Indian farmers.
- To measure the impact of various parameters which are the reflection of Livestock Revolution on the share of livestock kept by small scale producers.

1.3.5. To discuss the issues related to the Livestock Revolution concerning small-scale producers in India.

1.3.6. To identify the constraints faced by the Indian livestock sector and make suggestions to overcome these constraints.

1.4 Review of Literature

The term Livestock Revolution was coined by Delgado et al. (1999c) to bring into light the unprecedented growth in the demand for livestock products due to an increase in income, human population and changing food habits.

The ongoing and projected transitions in the consumption and production of livestock products in developing countries are called Livestock Revolution. This section presents the analysis given by different researchers on Livestock Revolution in the last fifteen years since it was last introduced.

The study by Delgado et al. (1999c) is supported largely by FAOSTAT data and projections made by using IFPRI`s global food model IMPACT.

The term Livestock Revolution first appeared in 1999 in Vision 2020 (Delgado et al., 1996; Delgado et al., 1999c and ILRI, 1999). Although, the main lines of the argument appeared earlier in Delgado et al., 1998.
Some other papers and reports were then published by these authors for extension of this analysis (Delgado et al., 2003a; Delgado, 2003; Poapongsakorn et al., 2003 and Hall et al., 2004).

Delgado et al. (1999c) identified population growth, urbanisation and rise in income as driving fundamental change in the consumption of livestock products. They gave seven characteristics of the Livestock Revolution as rapid worldwide increases in consumption and production of livestock products in developing countries; A major increase in the share of developing countries in total livestock production and consumption; On-going change in the status of livestock production from a multipurpose activity with mostly non-tradable output to food and feed production in the context of globally integrated market; Increased substitution of meat and milk for grain in the human diet; Rapid rise in the use of cereal-based feeds; A greater stress put on grazing resources along with more land-intensive production closer to cities; The emergence of rapid technological change in livestock production and processing in industrial systems.

It will be a demand driven revolution. The growth in demand will be particularly large in the countries like China and India.

They also suggested that increased consumption of livestock products will be associated with major benefits like improved nutrition and health and poverty alleviation, but the challenge will be to meet this growth in demand without negatively affecting the food security of poor and environmental degradation or increasing the number of zoonotic diseases.

This revolution will be experienced differently by different people, at different times and in different places (Sumberg and Thompson, 2013).

Livestock Revolution is demand driven means demand precedes and fuels the supply response. From the supply, i.e. production side the Livestock Revolution may be more appropriately conceptualized as an aggregated out of various developments, with some being more revolutionary than others.

Delgado et al. mentioned three ways in which Livestock Revolution may affect poor people in developing countries by impacting the below mentioned parameters:
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Nutrition: It appears to have many potential benefits for nutrition in developing countries.

Food Security: Livestock Revolution would not be blamed to take the grain out of the mouths of the poor. The Livestock Revolution effect on the food security of poor people through cereal prices is likely to be far lesser important than its effect on the income of poor farmers.

Rise in the Livestock Producers’ Income: Poor people and women earn a greater proportion of their income from livestock as they earn income from Common Property Resources (CPR). Moreover, livestock production offers one of the few rapidly growing markets to the poor. Steinfeld et al. (2006) opined that there is a palpable sense in the Livestock Revolution effect on vulnerability of the sector about environmental issues, particularly if there is to be the significant expansion in "high-intensity industrial systems".

Subsequent Development and Critique of the Argument

The published literature that deals directly with Livestock Revolution falls into four categories (Sumberg and Jhonson, 2013).

1.4.1 Reports and papers which essentially summarize the analysis and arguments put forward in Delgado et al. (1999a), Delgado et al. (1999b), Delgado et al. (1999c), Delgado et al. (2004), Delgado (2003), Delgado et al. (2003a) Delgado et al. (2003c) and Hall et al. (2004).

They are mere re-statements of the original analysis and make only a marginal contribution to something new.

1.4.2 Work which either extends or critiques the original analysis

Pica-Ciamarra (2007) and Pica-Ciamarra and Otte (2009 and 2011) tested at regional and country level, some of the main assertions given by Delgado et al. by using Popperian falsification approach. They included 88 developing countries in their analysis and concluded that there is little consistent evidence for an ongoing
Livestock Revolution and much of the rise in consumption of livestock products happened because of population growth alone, but the policy makers need to be careful about assuming that opportunities and threats associated with Livestock Revolution are distributed evenly. They also suggested that there is a role for supply-side approaches to livestock development, especially where poverty is highest. One important observation they make is that while Delgado et al. stressed the fact that the Livestock Revolution was a nuanced story with the country and regional differences, this nuance has not carried over into policy discourse.

**Studies, which explore the dynamics of change at country level** because of Livestock Revolution for example Upton (2000) analysed the implications of the Livestock Revolution for small scale milk and poultry producers in Kenya. He draws attention to the complementary and interdependent input and product markets for small and large producers. He concluded that large-scale producers might be a tool in contributing to the growth of the smallholder producers because of this complementary and interdependent. He also gave warning against policies that discriminated against larger-scale producers.

Delgado et al. (2003 b and 2004) studied the determinants and implications of scaling up of various forms of livestock production in four fast-growing countries (India, Philippines, Thailand and Brazil) due to Livestock Revolution. They found that independent small farms in India and Philippines typically have higher profits per unit than independent large farms. Large independent farms are relatively more profit efficient than small independents almost everywhere, indicating overtime they will continue to outcompete smallholders and gain further market share. India, where most farms are small and dairy dominates, is a notable exception. They concluded that active policy interventions would be required to make small-scale producers competitive. They also emphasized on the link up of small scale producers to the private sector resources using contract farming arrangements.

Narrod et al. (2010) further analyzed the same cases and concluded that there are evidence where small holders have succeeded in maintaining operations in some developing countries and for few livestock commodities, but small farmers are also losing like in case of broilers and layers, small farmers are being hit hard in all the
four countries. Weak support services, lack of animal disease control and supply chain complexity are creating all the more constraints; hence, the gains particularly to small-scale producers are minimal.

Khan and Bidani (2004) focused on Livestock Revolution in case of India. They gave evidence of the fact that Livestock Revolution is happening in India so the question for policy makers is no longer whether or not the revolution is happening in India rather how it can be tuned for the benefits of small-scale producers. Now the critical question for economic managers and planners in countries like India is no longer whether the Livestock Revolution is manifested in the country or not, but to what extent poor people and smallholders can play a significant role in this enterprise. They also showed the development of the Indian Livestock Revolution and assessed the potential impact of industrialisation of livestock production on small farmers especially. They argued that intensive livestock farming may not be appropriate for India on many grounds. There is a risk that the Livestock Revolution will polarise the inequality between rich and poor. Decisive action needs to be taken to ensure that the poor benefit from such developments.

Khan N. (2010) concluded that ASEAN region is witnessing Livestock Revolution in the form of the dramatic rise in the number of heads of various species of livestock and their products. Livestock species grew up in their number in general, but pig and chicken, non- ruminant group jumped up at a much higher rate during the last decades. The Livestock Revolution appears as a curse along with the blessing and gift to the small scale producers. The growth and intensification of this sector raised different socioeconomic and environmental issues in developing countries of ASEAN.

Kristensen, et al. (2004) discussed two possible scenarios of Livestock Revolution (the dramatic rise in per capita consumption of livestock products especially in ASIA). One scenario is that the demand will be met by large-scale industrialised units, another is that the small scale producers will develop livestock production that can satisfy market demand. He found that large industrial scale production units are growing out of economics of scale, vertical integration and high demand for animal based products. It tends to marginalise small-scale livestock producers. He concluded that a laissez-faire policy would lead to a skewed development which may bypass the commercial potential of small-scale livestock producers.
Zhou (2003) warns that the Livestock Revolution will not affect people equally. Larger farmers in developing countries are likely to benefit, but smaller farmers may find the situation more difficult.

Brown (2003) opined global revolutionary growth has tended to occur in the poultry and dairy sector. Large scale integrated operations may take benefit while there is also hope that the revolution will be instrumental in bringing income gains for millions of poor smallholders.

Chen and Rozelle (2003) used the Research Center for Rural Economy Data (RCRE) and found that the poorer households in increasing livestock production in the early stages of their development, but decreasing livestock activity once household reach a certain level which is termed as the rise and fall of backyard hog production in China (FAO, 1999).

Pica Ciamarra (2007) concluded that the Livestock Revolution has not sufficiently translated into incentives for small holders.

(FAO, 2005a) estimated that large-scale commercial livestock operations are growing twice as fast as traditional mixed farming systems, for example, in ASIA, where the growth of livestock production has been more substantial, large scale industrial production accounts for approximately 80% of the total rise in livestock products since 1990 (FAO, 2005b).

Dijkman (2009) gave a term "livestock ladder" i.e. a gradual intensification and scaling up by small-scale livestock producers. According to his study, livestock ladder which is a pathway to move out of poverty is largely mythological and hence the distribution of the benefits of Livestock Revolution has been very patchy. He suggested that the objective of pro-poor investment in innovation capacity within the livestock sector should not be to promote small scale or punish large scale producers but to mediate the transition.

The idea of pro-poor livestock development through sector transition is further developed by (Dijkman and Steinfeld, 2010; Otte et al., 2012).

Rosegrant and Thornton (2008) and Nelson et al. (2010) based on projections from the IMPACT model, Delgado et al. (1999c) were sanguine about future cereal prices and argued that the Livestock Revolution would not negatively affect poor
consumers by making their staple foods more expensive. Following the food price rise in 2007, new projections of the IMPACT model told a very different story (Rosegrant and Thornton, 2008; Nelson et al., 2010) with the change in climate and rise in demand for meat and milk, maize and other coarse grain prices increased, diverting agricultural production away from food crops and decreasing the availability of cereals for human consumption. Here the balance between the opportunities and the dangers associated with the Livestock Revolution seem to have shifted significantly, and these authors seem much less convinced of the potential benefits of the Livestock Revolution to small-scale livestock producers.

World Bank (2005 and 2009) throws light on the danger of small-scale producers being thrown out so policy makers should support small-scale production (FAO, 2008; Scoones, 2010) highlighted the rising significance of intensive and landless production system in developing countries especially for poultry, pigs and dairy. Their scale and intensity bring the environmental public health and animal welfare problems. It is yet to be seen whether such a gap between the local land base and livestock production gives a problem to sustainability (Slingenbergh et al., 2002; Naylor et al., 2005).

1.4.3 The third very limited, strand of literature includes works that use the notion of the Livestock Revolution as a backdrop against which the dynamics of change around livestock in particular contexts can be examined

Lundstrom (2011) tests whether small-scale producers can be benefitted from Livestock Revolution by using the case of the expansion of pork and poultry production in South Brazil. He argues that small-scale producers had to carry more risks because they are required to invest while reducing their profit potential after getting into the process of vertical integration. He cited the examples of "resistance" to this process of marginalisation with the help of diversification, identification of alternative markets, etc. He put forward the view that small-scale producers will definitely benefit from Livestock Revolution.

1.4.4 Literature focusing only the negative aspects This strand of literature focuses solely on the negative effects of the Livestock Revolution. It argues that it is something which should be stopped, but such type of literature is very limited. A few studies, like (Garces, 2002; Moncrief, 2010) opined that Livestock Revolution should
be stopped. Literature in this section starts with the assumed negative effects on small holders, animal welfare and the environment. They discussed the evils of factory farming in livestock.

1.5 Research Gap

Work done to assess the impact of the Livestock Revolution on small scale farmers in India is limited. Most of the work is descriptive in nature, hardly any study is done to assess the impact of Livestock Revolution in India empirically.

The current study adds to the literature by empirically investigating the impact of the Livestock Revolution on the small scale producers of India by analysing the effect of various factors related to Livestock Revolution on them.

1.6 Research Methodology

The impact of Livestock Revolution on small-scale livestock producers is assessed by assuming that their livelihood and income depend greatly on the share of livestock kept by them. Therefore, first, the distribution of livestock is assessed among four farm size groups i.e. small and marginal (below 2 ha), semi-medium (2.0-3.99 ha), medium (4.0-9.99 ha) and large (10 ha and above). So, that the concentration of livestock among each farm category can be assessed, which is also the reflection of their stake in the livestock sector. Secondly, the diversification in the livestock species kept by various farm categories is assessed which reflects the chances in the growth of farmer’s income and livelihood. Thirdly, the impact of various factors, related with Livestock Revolution is analysed on the share of livestock kept by small-scale producers.

1.6.1 Data

This study is based on secondary data. The data on the livestock production, Gross Production Value (GPV) and consumption of various agricultural products were compiled from the Food and Agricultural Organization Corporate Statistical (FAOSTAT) database of United Nations. Data on livestock population were gathered from livestock census, Ministry of Agriculture, Government of India.
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The data on the value of exports and imports of livestock products were compiled from FAOSTAT and International Trade Centre (ITC) database, Geneva, Switzerland. Data on producer prices of different livestock products were collected from FAOSTAT database.

The data on Gross Domestic Products (GDP), Gross Domestic Products from Agriculture Sector, Gross Domestic Products from livestock sector and value of crops and livestock output were compiled from National Accounts Statistics, Central Statistical Organization (CSO). NSSO (National Sample Survey Organization) reports, GoI, were used to get the data on consumption expenditure of various agricultural items and employment in different agricultural sectors.

The data on consumption of livestock products, share of livestock GDP in agricultural GDP, livestock inventory, producer prices of milk, producer prices of meat, prices of feed crops, livestock production index, production of livestock products, processing of milk, processing of meat were collated from FAOSTAT, while the data on land and livestock holdings of various farm size groups were collected from Input Survey Database, Agricultural Census, Division Department of Agriculture and Cooperation, Government of India (GoI).

1.6.2 Analytical Tools

1.6.2.1 Lorenz Curve: Lorenz curves were drawn to show the distribution of land and livestock among various farm groups. Lorenz curve is a graphical representation of the distribution of income or wealth. It was developed by Max O. Lorenz in 1905 for representing inequality of the wealth distribution. Lorenz curve plots the cumulative percentage of land/livestock holdings against cumulative percentage of number of holdings. The area under the curve as the proportion of total area under the diagonal line shows the degree of inequality, while the diagonal line resembles zero inequality.

1.6.2.2 Gini-Coefficient Index: Gini coefficient index were calculated with the help of Lorenz curve. The Gini coefficient is a way to measure equity and is derived from the Lorenz curve. The Gini coefficient is defined as a ratio of values between 0 and 1The Gini coefficient is the ratio of the area under the Lorenz curve to the area under the diagonal on a graph of the Lorenz curve. Higher the Gini coefficient, greater the inequality.¹

¹ maxi-pedia.com/Gini+coefficient
1.6.2.3 **Simpson Index of Diversity:** Simpson index of diversity was used to measure the diversification among the livestock species kept by various farm groups in India.

The Index ranges between 0 and 1. If there exists complete specialisation, the index moves towards 0. The index is interpreted, as follows

\[
SID = 1 - \sum_{i=1}^{n} P_i^2
\]

Where, SID is the Simpson index of diversity, and \(P_i\) is the proportionate value of \(i^{th}\) livestock species/livestock product or commodity in the total livestock/total livestock production.

Diversification in the livestock production was also gauged with the help of Simpson’s index of diversification. The production values of 19\(^2\) Livestock commodities were included in calculating the index.

1.6.2.4 **Total Livestock:** Total livestock\(^3\) for different farm sizes, was calculated by adding up the livestock (cattle, buffaloes, sheep, goats, pigs and poultry) numbers converted to a common unit by using conversion factors used as: cattle = 0.7, sheep = 0.1, goats = 0.1, pigs = 0.2, chicken = 0.01.

1.6.2.5 **Stepwise Regression** is a semi-automated process of building a model by successively adding or removing variables based solely on the \(t\)-statistics of their estimated coefficients. The stepwise regression puts more power and information than does the ordinary multiple regression, and it is especially useful for sifting through large numbers of potential independent variables and fine-tuning a model by poking variables in or out. It identifies a useful subset of predictors. The process systematically adds the most significant variable or removes the least significant variable during each step\(^4\).

The result of the stepwise procedure is a model containing only those terms with \(t\)-values that are significant at the specified \(\alpha\) level.

\(^2\) Offals; Meat, chicken; Skins sheep, with wool; Meat, goat; Meat, buffalo; Milk, whole fresh cow; Meat, sheep; Wool, greasy; Eggs, hen, in shell; Hides, buffalo, fresh; Hides, cattle, fresh; Milk, whole fresh buffalo; Silk-worm cocoons, reelable; Meat, pig; Skins, goat, fresh; Skins, sheep, fresh; Milk, whole fresh goat; Meat, duck; Meat indigenous, cattle.

\(^3\) http://www.lrrd.org/lrrd18/8/chil18117.htm

\(^4\) people.duke.edu/~rnau/regstep
Thus, in most practical situations, only several of a large number of independent variables remains. Only important independent variables are included in the model, and unimportant ones are eliminated.

The stepwise regression model was used in the study for identifying the best set of predictors impacting the share of livestock kept by small scale producers for the two periods i.e.1980 to 1990 and 1991 to 2011. It was hypothesised that share of livestock kept by small-scale producers livestock over a period had been affected by various factors like consumption of livestock products, share of livestock GDP in agricultural GDP, livestock inventory, producer prices of milk, producer prices of meat, prices of feed crops, livestock production index, diversification in livestock production, processing of milk and processing of meat.

1.6.3 Justification of Model Variables:

- **Consumption of Livestock Products (Kcal/capita /day):** The unprecedented and rapid rise in the consumption of livestock products is called Livestock Revolution. By 2020, demand for milk is projected to be 156 million tonnes, of meat 9.6 million tonnes and eggs 3.7 million tonnes in India. Countries` per capita income grew at an annual rate of 4.8%. The urban population increased at a rate of 2.5% against an overall population growth rate of 1.7%. The factors underlying consumption changes are considered quite robust and are unlikely to subside in the near future, implying a further rapid growth in demand for animal food products. The rise in consumption of animal products is expected to positively impact the small-scale producers` livelihood.

- **Share of Livestock GDP in Agricultural GDP (%):** The livestock sector contributes nearly 28% to the agricultural GDP and has been growing fast. In the last two decades, driven by a very rapid increase in demand for animal food products, the sector grew at an annual rate of about four percent, consolidating its share of agricultural growth from 31% during the 1990s to 36% during the 2000s. Rising livestock production reflected by its increasing share in agricultural G.D.P is one of the characteristics of Livestock Revolution.
• **Livestock Inventory ($)**: Livestock fixed asset is the breeding stock of cattle and buffalo, camels, pigs, goats, sheep and poultry. The concept of inventory is the young livestock stock and those kept for slaughtering (FAOSTAT, 2016). With the rise in production and consumption of livestock products the livestock inventory is also expected to rise and hence is one of the significant indicators of Livestock Revolution.

• **Producer Prices of Milk ($/Tonne)**: The producer's price is the amount received by the producer from the purchaser of a unit of a good or service produced as output minus VAT, or similar deductible tax, invoiced to the purchaser (FAOSTAT, 2016). Small scale producers account for about 80% of milk production. The steady rise in the consumption of milk in the era of Livestock Revolution can increase the prices of milk, thereby going to benefit small scale producers and improve their livelihood.

• **Producer Prices of Meat ($/Tonne)**: Similar to the producer prices of milk the producer price of meat is also going to impact the small scale producers in a positive way.

• **Prices of Feed Crops ($/Tonne)**: In the era of Livestock Revolution, the system is under the continuous pressure to increase the production of livestock products with the optimum use of Inputs. There is likely to be high demand for feed under the Livestock Revolution. Feed is one of the major inputs in livestock production and small-scale producers in India largely depend on common property resources to feed their animals but common property resources are depleting in India so, rise in prices of feed are expected to negatively impact the resource poor small scale producers.

• **Livestock Production Index**: The livestock production index shows the relative level of the aggregate volume of livestock production for each year in comparison to the base period 2004-2006. It is a significant indicator of Livestock Revolution as it indicates the livestock production level, which is expected to be positively associated with the livelihood of small-scale producers.
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- **Diversification in Livestock Production:** Diversification in livestock production is a very important aspect of livestock sector development, especially in India where most of the production is concentrated towards milk. It’s also a very important aspect of the Livestock Revolution and increase in livestock product diversification will lead to the benefit of small-scale producers.

- **Processing of Milk (Tonne):** Processing of livestock products, especially milk, which accounts for about 88% of India’s livestock production is definitely one of the manifestation of the Livestock Revolution and is going to impact small-scale producers in a positive way.

- **Processing of Meat (Tonne):** Similar to the milk processing, meat processing is also one of the factors which are closely linked with the Livestock Revolution and is supposed to impact the small scale producers positively.

1.6.4 Justification of Time Duration

The study took two time periods for study, i.e. 1980 to 1990 (post liberalisation) and 1991 to 2011 (pre-liberalization). The Indian economy had undergone substantial liberalisation since 1991 in which numerous government controls and regulations were removed and a relatively free hand was given to market forces and business sector. This brought huge changes in the economy and with the liberalisation a quantum increase in national income growth took place from around three percent to as high as nine percent per year. Liberalisation resulted in a substantial acceleration in the growth of per capita incomes, and this had an enormous impact on the demand for food and agricultural products, and livestock products were also not the exception. The process of liberalisation also reduced the government involvement in a number of activities and often an encouragement to the private sector was given (Gandhi, 2014) Many Agribusiness activities developed in the conducive environment offered by liberalisation and livestock business was also not an exception. The revolution has been accelerated after liberalisation of agribusiness and globalization of agricultural sector which resulted in increasing demand for livestock in the global market due to price competitiveness of livestock products originated in India where production cost is comparatively low due to
low wage rate (Padamkumar, 2007). The animal based products from tropical countries are in great demand, both in the Asian as well as in the European markets. These products, especially those produced in India, fetch a good competitive price in international markets due to a low production cost after a reduction in the subsidies on livestock products (Allana, 2005; Padamkumar, 2007).
Figure 1.1: Framework for the Impact of Livestock Revolution on Small-Scale Producers in India

Livestock Revolution in India

- Consumption of Livestock Products
- Livestock Production
- Livestock Inventory
- Processing of Livestock Products
- Prices of Feed
- Producer Prices of Livestock Products
- Diversification in Livestock Production

Share of Livestock Kept by Small-Scale Producers
1.6.5 Research Hypotheses

Following hypotheses have been formulated to understand the impact of the Livestock Revolution on small scale producers in India. Figure 1.1 depicts the framework for the current study.

\( H_{01}: \) Consumption of livestock products does not impact the share of livestock kept by small-scale producers.

\( H_{a1}: \) Consumption of livestock products impacts the share of livestock kept by small-scale producers.

\( H_{02}: \) Livestock production does not impact the share of livestock kept by small-scale producers.

\( H_{a2}: \) Livestock production impacts the share of livestock kept by small-scale producers.

\( H_{03}: \) Livestock inventory does not impact the share of livestock kept by small-scale producers.

\( H_{a3}: \) Livestock inventory impacts the share of livestock kept by small-scale producers.

\( H_{04}: \) Processing of milk does not impact the share of livestock kept by small-scale producers.

\( H_{a4}: \) Processing of milk impacts the share of livestock kept by small-scale producers.

\( H_{05}: \) Feed prices do not impact the share of livestock kept by small-scale producers.

\( H_{a5}: \) Feed prices impact the share of livestock kept by small-scale producers.

\( H_{06}: \) Producer prices of livestock products do not impact the share of livestock kept by small-scale producers.

\( H_{a6}: \) Producer prices of livestock products impact the share of livestock kept by small-scale producers.

\( H_{07}: \) Diversification in livestock production does not impact the share of livestock kept by small-scale producers.

\( H_{a7}: \) Diversification in livestock production impacts the share of livestock kept by small-scale producers.