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Original paper

Contribution of Livestock Sector in Food Security and Income of Rural Households in Punjab, Pakistan

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Abstract

Background and aim: Livestock production is a very important component of the agricultural economy and perform very supportive role in reducing hunger and food insecurity. Past empirical literature has focused on the effect of livestock sector on different aspects of food safety and food security. This study examines the contribution of livestock sector in the nutritional security and welfare of rural households in Punjab, Pakistan.

Materials and methods: Primary data were collected from 350 households using simple random sampling technique. Nutritional security in terms of micro and macro nutrients was calculated based weekly intake of food items. In the second stage, binary logistic regression was employed to analyze the role of livestock in the nutritional security.

Results: The results showed that about 35 percent of the sample households were food insecure. It was found that both education level and ownership of livestock significantly improve food security conditions. An increase of one percent in both education and livestock ownership increases the chances of a household to become food secure by 0.179 percent and 1.9 percent and respectively. Other important factors found to improve food security were monthly income and total earners in a household. Furthermore, increasing family size and family structure declines household food security.

Conclusion: Rural households` food security can be improved by focusing on livestock sector especially the small animals.

Keywords: *Livestock, Income, Food Security, Rural Households, Pakistan*

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Introduction

The socio-economic development and welfare of rural areas is dependent upon agriculture and livestock sector. It is a fact that world is now becoming food self-sufficient, but a significant portion of world population is still undernourished [1]. According to a recent report 24 percent of Pakistan's population faces food insecurity. Out of this 18 percent of people in Pakistan severely lack access to food [2].

Globally accepted definition of food safety is when all persons during a time period can have access to necessary, secure, nutritive food to sustain a vigorous and energetic way of living. Nearly 700 million individuals (9.2 percent of the world inhabitants) are suffering from nutritional insecurity and approximately 18.90 percent of the entire Asians are under this circle [2].

Pakistan's data from financial survey 2018 exhibited a decrease in poverty index from 50.40 percent to 24.30 percent during the year 2016-17. The poverty in villages and cities showing a decreasing trend with a headcount of 12.50 percent and 30.70 percent correspondingly in 2015 and 2016. This reduction in poverty is more prominent in cities than villages [3].

Livestock sector is considered to be the best source of earnings and cash income [4]. It is an important component of small farmers' livelihood to meet their needs of milk, food security and daily cash incomes in Pakistan. It is a good source of employment generation, poverty alleviation and socioeconomic uplift in the country [5].

In 2017-18, livestock sector has a major share of more than 58 percent to agriculture sector and 11.10 percent to total Gross Domestic Product. Almost 8.00 million households are being indulged in livestock rearing or generating 36 percent earnings from agriculture and livestock production processes and actions [3]. Total livestock population and its products such as meat and milk are given here.

Table 1-1. Population of Livestock

Species	2015-16	2016-17	2017-18(Million No.s)
Sheep	29.8	30.1	30.5
Goats	70.3	72.2	74.1
Cattle	42.8	44.4	46.1
Buffaloes	36.6	37.7	38.8
Camels	1.0	1.1	1.1

Source: Ministry of National Food Security & Research

Table 1-2. Livestock Products

Species	2015-16	2016-17	2017-18(000 Tonnes)
Milk (total production)	54.327	56.081	57.891
Sheep	39	39	40
Goats	867	891	915
Cow	19.412	20.143	20.903
Buffaloes	33.137	34.122	35.136
Camels	873	885	896

Source: Ministry of National Food Security & Research

Table 1-3. Total Meat Production

Species	2015-16	2016-17	2017-18 (000 Tonnes)
Meat(gross production)	3.873	4061	4262
Beef	2017	2085	2155
Mutton	686	701	717
Poultry meat	1170	1276	1391

Source: Ministry of National Food Security & Research

Livestock raising and dairy sector development shows a vital role and a source of earnings in the life of rural households after crop production in different countries of Asia and Africa [6]. In developing countries like Bangladesh, India and Pakistan this sector has a significant share in the GDP range from 15 percent to 25 percent respectively. This sector performs different functions and provides benefits e.g. sale of animals, sale of meat, animal protein supplement, source of income and food security [7].

Livestock sector has a significant place in Pakistan`s economy but this sector has been facing some issues. Some of these issues are lack of suitable expertise, management issues, availability of proper irrigation system, lack of infrastructure facilities, and low availability of credit [8]. Some other issues are deterioration of range land, animal health issues, marketing issues, lack of value addition and institutional issues. Besides these there are animal nutrition issues, insufficient extension services, and low productivity of animals, poor development and performance of livestock sector.

Food security is facing many problems such growing population, lower food availability, higher urbanization, increasing poverty, global warming, obsolete agricultural practices and management, shortage of rain and some natural disasters. Besides these, food security also requires better management practices, but livestock is considered to be the vital source for food and nutrition security. Livestock not only helps in income generation but also has a potential to reduce poverty, malnourishment and deprivation. In different ways almost 1300 million deprived people living in developing world are dependent on this sector for their income and food security [9].

There is a missing of research on livestock and food security nexus so this study will focus on the role of livestock in food and nutritional security and income generation. Other than aforementioned problem, this identify the socio-economic factors affecting food security keeping in view that livestock has major impact on food and nutritional security.

Literature Review

As mentioned above that livestock is mostly used as a source of food, income and for the cultivation of crops. A limited literature is available for livestock and food security therefore the most suitable literature to this study is given here.

Kazybayeva et al. (2006) [10] studied the livestock`s share in human food and income in Senegal. Both primary and secondary data were used from the reports of ESAMI while primary data were collected from 600 respondents. It was finalized that livestock had positive impact on income and food security. Further results revealed that more than 10 percent of food requirement was fulfilled due to livestock products. The share of livestock in income was ranged from 16 to 38 percent. The study gave suggestion to commercialize livestock sector for food security and earnings.

Bashir et al. (2010) [11] reviewed the contribution of livestock sector in food security in rural household of district Faisalabad, Pakistan. 300 households were interviewed using proportionate

sampling method. DIA method was used for food security calculation while logit model was used for socio-economic factors. They concluded that livestock has significant impact on achieving food security households. Food insecure rural households were 18 percent. It was also concluded that female livestock helped the household in terms of their nutrition and economic welfare.

Alary et al. (2011) [12] reported the contribution of livestock in income generation in Mali. A sample size 600 respondents were selected for interview through simple random sampling method. Two approaches were used, first was the measure-based approach while second was financial approach. According to the result of first approach major part of income was generated through livestock sector. But the second approach revealed that there existed a weak relationship between income and livestock ownership. Overall findings suggested that livestock must be encouraged.

Bashir et al. (2012) [1] stated the impact of livestock on food security of rural households in 12 districts of Punjab, Pakistan. Stratified sampling method was used to collect the primary data from 576 rural households. Binary logistic regression was used for the study. The results showed that more than 19 percent were food insecure in the study area. Furthermore, it was revealed that cows, buffaloes, sheep and goats had positive impact on food security condition. Finally, the research showed that with the rise in number of one animal either cows and buffaloes or sheep and goats improved the food security condition by 10 percent and 14 percent respectively. Total monthly income, level of education of households and earners in a family also had direct impact on food security. But food security declined due to increase in family size. It was suggested that by paying attention to livestock sector food safety can be ensured.

Kumar et al. (2012) [13] showed the role of livestock in food security and poverty reduction in Bihar. This study was conducted in nine districts. Secondary data were used with the help of Sanjay Gandhi Institute of Dairy Technology, Patna to assess the livestock scenario in Bihar. Survey revealed that the dairy contributed, on an average, about 22.39 percent to total household income in sample villages. It was also found that 58 percent of protein and 54 percent of calcium was provided by livestock and its products. In this regards the findings suggested to improve livestock sector in the study area.

Ali and Khan (2013) [14] analyzed the relationship between ownership of livestock and its role in food safety in the province of Punjab, Pakistan. Cross sectional data from 234 farmers were collected from three main districts i.e. Sheikhpura, Hafizabad and Gujranwala. The data were analyzed by using Poisson regression. Besides regression analysis propensity score matching method was also used to know the effect of livestock on food safety conditions of rural households. It was indicated that households having livestock were 19-40 percent more food secure as compared with non-owner of livestock. It was recommended that livestock sector must be improved because it can help to raise the status of food security.

Biradar et al. (2013) [15] inspected the role of livestock sector in income generation and food safety. This study was conducted in five taluks in western Maharashtra. Primary data were collected from 100 farmers through random sampling. The results found that livestock had share in income from 18.50 to 34 percent while it provided almost 35g protein, 1690 mg calcium and 52.3g fat to the everyday food of people. The study had given the suggestion that livestock sector must be boost up to improve food security.

Mahmood et al. (2014) [7] examined the share of livestock sector in the food security of rural households in Pakistan. For this study secondary data were used from different reports such as SDPI, SDC and World Food Program 2009 besides these Punjab Development Statistics, Food Insecurity Report 2009 and Agriculture Census Report 2010 were used. To analyze the association between livestock rearing and food security Generalized Linear Model (GLM) was used. The

findings revealed that there is direct impact of livestock ownership on food safety. The results also indicated that male animal had inverse impact on the food safety conditions. The research suggested that food security may be improved by boosting up the livestock sector.

Material and Methods

Data were collected from district Nankana Sahib, Punjab, Pakistan. The district Nankana Sahib was comprised on two tehsils i.e. Shahkot and Sangla Hill [16]. The population of these two tehsils were asymmetrical so it was decided to include them according to their population. For the purpose of sampling 10 villages from tehsil Sangla hill and 15 villages from tehsil Shahkot were selected on the basis of homogeneity. From each village 6 respondents were randomly selected. According to this selection procedure the sample was turned to be 150 rural households ($25 \times 6 = 150$). The map of study area is given below:

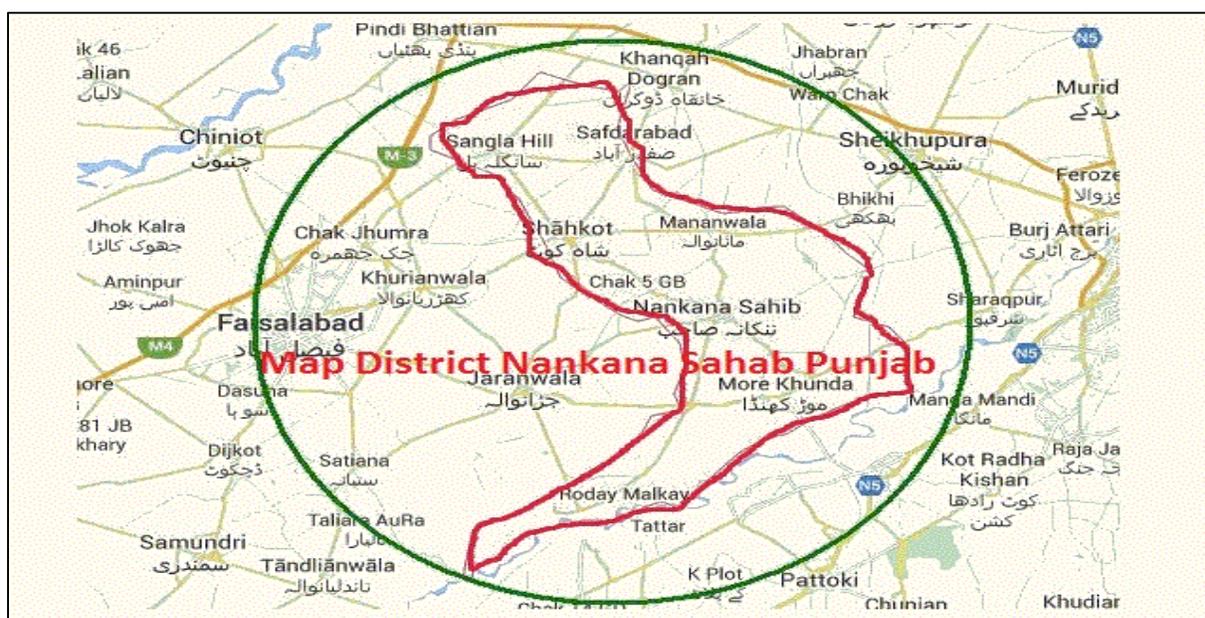


Fig. 1-1. Location of study area (Source: maps.google.com)

Before collection of data a pre-testing was done by using a structured questionnaire. After pre-testing, some adjustments had made and a comprehensive questionnaire was formulated. According to the designed questionnaire, several information was obtained on different aspects of food and nutritional security of rural households. The questionnaire was categorized into three parts: socio-economic information, common demographics and their weekly food consumption items` and different source of income information.

Empirical analysis of data was done at three stages. At first stage share of livestock in total income of rural households were calculated. For this purpose, data were collected on different source of income such as from crop sources, livestock income, occupational income and income from remittances or from other sources. Total income was sum up and percentage of livestock income was calculated.

At second stage food security were calculated. There were six different methods to calculate food security. One of the most important method adopted for the calculation of food security was dietary intake assessment (DIA) method. This method is very useful for calculation of food security. For the calculation of food security seven days recall method was used and this was based on their per

capita calories intake. This information were based on their food consumption for last seven days. According to Government guidelines [17] per capita calories level for urban households was set at 2350 Kcal/day/person while for rural households was 2450 Kcal/day/person.

$$FS_i = \sum Cal_i - L \geq 0$$

Where FS_i stands for food security status of i^{th} rural household and Cal_i is the calories intake of i^{th} households and L is the GOP's thresholds level for rural areas i.e.2450 Kcal/person/day. If the value of FS_i is equal to 1 then households were fully food secure while value equal to 0 showed the food insecure.

This Method Has Some Advantages

It measures calorie intakes and dietary quality at individual levels. It calculates food ingestion in direct ways but not the food accessibility. This method is most beneficial to apprehend current and extensive span dietary intake forms.

Some Limitations of This Method

As this method mostly depends on the memory of households so there are chances of measurement errors. On the basis of recall methods and estimations this become problematic to calculate the food security and costly method along with requirement of qualified scientists.

At third stage of analysis to know the contribution of livestock sector and other socio-economic indicators in food security, binary logistic regression was done. Before calculating this, some independent variables such as livestock ownership, income of rural households, family size, family structure and education level were identified. As a binary variable food security was the dependent variable having binary values; 1 for food secure while 0 for food insecure. According to (reference) the use of this regression analysis is beneficial because it helps to calculate directly to chance/probability of an event to occur for more than one independent variable. The food security status measured by equation 1 is subject to change with varying socio-economic factors, therefore, a linear function is assumed and can be written as:

$$FS_i = \sum_{i=1}^n \beta_i X_i$$

Where X_i shows the socio-economic determinants while β_i indicates the coefficients of model. The FS_i is a dependent and discrete variable so the above-mentioned equation can be written in the form of its probabilities.

The general form of logit model can be written.

$$\text{Log} \left(\frac{p_i}{1 - p_i} \right) Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7$$

Y = Dependent variable (Food Security)

β_0 = Intercept (Mean value when all independents are equal to zero)

β_{1-7} = Coefficients of independent variables.

X_i = No. of Independent variables

X_1 = Total number of buffaloes owned by rural households.

X_2 = Total number of cows owned by rural households.

X_3 = Ownership of livestock of rural households.

X_4 = Level of education from zero education to master and above of rural households.

X₅ = Total family members or family size of rural households.
 X₆ = Family structure of rural households either joint or nuclear family.
 X₇ = Total income of rural households.

Results and Discussion

Descriptive Analysis and Food Security of Rural Households

Food security of rural households of district Nankana Sahib is given in table 1. Results shows that almost 23 percent of rural households were food insecure similar results (19 percent) were presented by Nabarro and Wannous (2014) [18] using same threshold level in district Faisalabad. While more than 76 percent were food secure. By comparing both results, it may say that food insecurity were worsen in the study area. It can also be explained in terms of the variation in food security by location and time [19]. But the food insecurity of the sampled households was almost less than the overall undernourishment (24 percent) in Pakistan [2].

Table 1-4. Food Security Status

Food Security Status	Percentage	Frequency
Secure	76.67	115
Insecure	23.33	35
Total	100	150

Source: Field survey

It is found that average family size was 7 members per household with a range of 1 to 25 members in a family. The results show that among the sample households the lowest calorie intake was as low as 1100 Kcal/capita/day and maximum intake was almost 5419 Kcal/person/day with an average intake of about 2615 Kcal/person/day. The livestock owned by a family ranges from 0 to 25 for buffaloes and cows while 0 to 12 for sheep and goats with average livestock ownership of 5 cows and buffaloes while 4 sheep, goats per family. Total monthly income was about Rs. 20000 that varied slightly over Rs. 12756 to over Rs 64234 per family among the sample households.

Table 1-5. Descriptive Statistics

Variables	Minimum	Maximum	Mean	SD
Total monthly income	20000	135,000	64234	12756.1
Buffaloes	0	25	5	4.5
Cows	0	20	4	3.2
Sheep goats	0	12	3	1.2
Per capita calorie intake	1100	5419	2615	884
Family size	2	26	7	3.48
Total earners	1	5	2	1.5

The results of the binary logistic regression are presented in Table 3.

Table 1-6. Determinants of Household Food Security

Variables	Coefficients	Std. Err.	Odd Ratios
Total Monthly Income	0.00025**	0.000	1.00025
No. of Buffaloes	0.071***	0.0508	1.073
No. of Cows	0.051**	0.0359	1.052
Ownership	0.898***	0.0036	2.45
Education	0.679**	0.068	2.011
Status of respondent	1.256**	0.0245	3.490
Family structure	-0.9235**	0.251	0.39
Total family members	-0.110	.031	0.89
Constant	1.183	0.24	

Source: Field survey

Note: ** shows values are significant at < 5 % while *** indicates significant at < 1 %

In binary logistic regression, it is difficult to explain the coefficients of variables so, in this study the estimates of the probabilities are computed and explained in terms of the odds-ratios. The results of this research showed that out of nine variables, six variables were statistically significant including buffaloes and cows, monthly income, total family members of rural household, ownership of livestock, earning status of respondents, and level of education up to graduation and above. This model was 85% accurate in terms of predictive efficiency.

As discussed above that nine variables were used but some of them statistically insignificant so the results of the only those variables is given here that were statistically significant. Agriculture and livestock rearing were the most significant factors for livelihood and earning strategy of rural households in district Nankana Sahib. The results of binary logistic regression indicated that having animals like cows, buffaloes and sheep goat were directly impact rural household food security. As the number of cows, buffaloes, sheep goats increase people become more food secure because milking animals contribute more to income and food products. The coefficient of number of buffaloes is 0.071 and it was converted into its odd-ratio ($e^{0.071} = 1.073$) coefficient for the number of cows is 0.051 and converted into its odd-ratio ($e^{0.051} = 1.052$). This shows that when there is one percent increase in number of cows or buffalo the chance of becoming food secure increase by 1.071 and 1.052 times respectively. Similar results were described by Ali (2007) [20] and found that an increase in small and large livestock enhanced the chances of a household to be more food secure by 2.1 percent in the rural areas of province of Punjab, Pakistan. Kazybayeva et al. (2006) [10] proposed similar results that whenever there was increase in animal holding people become more food secure.

Empirical results of regression model showed that ownership of livestock in the food security had statistically significant. The coefficient of ownership of livestock was positive and had value 0.898 having odd-ratio ($e^{0.898} = 2.45$). It indicated that people that had livestock were more food secure. As people owned more livestock there are chances of people to be more secure. Similar findings by Asefah et al. (2005) [21] showed that when there is increase in one livestock animal the probability of becoming more secure increased by 1.05 times. The results of this study showed that when the ownership of livestock increases then there is probability to be food secure by 2.45 times. Bashir et al. (2010) [11] found that people having zero animal were less food secure as compare to livestock ownership by 37.03 percent.

As it was anticipated that the impact of total monthly household income on food security was positive, but this impact was little in coefficient. The estimated coefficient was 0.00025 having its odd-ratio ($e^{0.00025} = 1.00025$). The results showed that as there is one unit increase in income there is chance of becoming more food secure by 1.00025 times. Because the impact of total monthly income on food security was very small which could be anticipated for particular household group because some farmers grew their own food and related products. Similar results by Ali and Khan, (2013) [14] showed that when there was an increase in income were Rs 1000 then food security condition was improved by five percent in rural areas of Punjab, Pakistan. In a related study, Bashir et al. (2010) [11] also found a positive impact of income on food security that increase in income from Rs 1000-1500 the food security increased by fifteen percent. Similarly, using same method Sindhu et al. (2008) [22] for India, found that the chances of food security increases by 30% with an increase of 1000 Indian Rupees (\$20) in monthly incomes.

The impact of total family members was also analyzed by regression model. It was found that total family member had a negative sign -0.110 and odd-ratio 0.89, inferring that an increase in family size only by one member declines the probability of food security by 0.89 times. Similar results were proposed by a finding Herrero et al. (2013) [23] a research. They found that an increase of one household member decreases the chances of household food security by 31%. Similarly, Bashir et al. (2010) [11] indicated by using a categorical variable that households having up to nine members were less food secure as compared to 4 to 7 family members. In India; however, Sidhu et al. (2008) [22] showed in a study that an increase in one unit in family size decreased the food security of rural households by 49 percent.

Similarly, family structure (joint or nuclear family system) had negative coefficient -0.923 with odd-ratio 0.39. People that living in joint family system were less secure than living nuclear family. Education level also direct impact in the food and nutritional security of rural households. As people got more education there are chances of becoming more secure because they become conscious about their diet. The coefficient of education was positive 0.679. As the level of education increases the probability of food security increases by 2.011 times. Education level helps them to understand the latest production technologies and the use of available information through extension services regarding new crop varieties. Earlier, Tembo et al. (2014) [24] found that households whose heads have up to intermediate level of education have 133% more chance to become food secure. Similar effect of education was found by Bashir et al. (2010) [11] for graduation level that increased the odds of a household to become food secure by 21 times.

Share of Livestock in Food Security

Livestock sector had significant role in the fulfilment of nutritional requirement of human body. After calculating the total food and nutritional security the share of livestock in nutritional security were measured. Food intake of households was divided into different sources such as dairy products, poultry products, cereal related intake, fats and oils, sugar, sweets and beverages and similar other products. Total nutritional security was calculated then the share of livestock was analyzed. The share of livestock varied from 10% to 52%. Minimum share of livestock in the form of dairy products, poultry products, chicken, mutton, beef, eggs, milk, yogurt, cheese, butter and desi ghee was 10% while maximum share was 52%. On average the share of livestock was 23% in total nutritional security of rural households.

Share of Livestock in Income

Livestock has major impact on income of rural households. Some households were fully dependent on livestock, but some households were independent of livestock. Their income was come from different sources i.e. occupation, business or from remittances. Results of data showed that income

generated from source of livestock varies from 2 percent to 73.60 percent. Mean value of share of income from livestock was 25.76 percent while minimum share of income from livestock were 2.94 percent and maximum share of income from livestock were 73.60 percent having standard deviation 17.70.

Conclusion

The purpose of the current study was to analyze the contribution of livestock sector in the food security and income of rural households. From the theoretical and empirical analysis of food security, it can be generalized that food insecurity is a function of poor assets basis, socio-cultural related issues and poor access to market and infrastructure. 23 percent households were food insecure while almost 77 percent were food secure. The livestock ownership has a positive impact on food security and income levels on rural households in the study area. According to binary regression the livestock ownership can help to increase food security condition by 2.4 times. While income generated from livestock ranges from 2 percent to 73.60 percent. As the ownership of livestock plays an important role in ensuring household food security and income generation, so the livestock needs to be increased at rural level.

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Conflict of interests

The authors have no conflicts of interests to declare.

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