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Role of Livestock in Food Security: An Ascertainment from Punjab Pakistan

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ABSTRACT
Livestock production plays a major role in the life of farmers in developing countries like Pakistan. As crops and livestock rearing in rural areas directly affects food security condition of the nations. This study has been devised to observe the impact of Livestock on food security. In this regard data was collected from Food Insecurity Report 2009 (SDPI, SDC and World Food Program 2009), Punjab Development Statistics (Government of Punjab 2009) and Agriculture Census Report 2010 (Government of Punjab 2010). Generalized Linear Model was used to find out the relationship between livestock and food security. Results show that there is positive relationship between the work animal per hectare, milk animal per person and food security, whereas meat animal per hectare and milk animal per person are negatively related with food security. The study finding has important policy implications for food security recommended that livestock rearing needs to be encouraged.

Key words: Livestock, food security, milk and meat animals, work animals, Punjab, Pakistan.

INTRODUCTION:

The World Food Summit of 1996 defined food security as "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (World Health Organization, 2014). Food insecurity is a grave issue of the developing nations all over the glove. Almost 870 million people (12.5% of the global population) are food insecure while

approximately 13.9% of the total Asians also fall in this category. Moreover, 17.6% of the South Asian population is living below food insecurity line (IFAD, WFP and FAO, 2012).

There are a number of threats to food security such as population growth, decreased rate of food production, conflicts and wars, poverty, political instability, market condition, rapid urbanization turning cultivable land into housing societies, natural disaster, climate change especially reduced water availability and brief rainy seasons, increase in prices of inputs, distorting agricultural development policies, shrinking investment both from the public as well as the private sector in agricultural research and development, and sometime natural hazards etc. Apart from the aforesaid reasons food security in the nations require better agricultural resources availability and their distribution. Although land, water, labour etc. are, no doubt, extremely important for food production and play pivotal role in food security of the people but livestock cannot be ignored in this regard. It provides the half of the output of agriculture sector in developed counties and one third of total output in developing counties (Martin, 2004). Livestock is the primary source of getting proteins and amino acids. Moreover, it plays a vital role in the human diet and contributes a significant part of the total calories intake.

Livestock 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. Moreover, it contributed about 11.9 percent to the Gross Domestic Product of the country and 55.4 percent to the agricultural value added during 2012-13 (Government of Pakistan 2013-14). As far as the gross value addition of the livestock sector at constant cost factor is concerned, it was increased by 2.9 percent with the rise from Rs. 735 to Rs. 756 billion in a year from 2011-12 to 2012-13 (Ibid).

Table-1: Milk and Meat Production in Pakistan (000 tones)

	2010-11	2011-12	2012-13
Milk (Gross Production)	46,440	47,951	49,512
cow	16,133	16,741	17,372
Buffalo	28,694	29,565	30,462
sheep	36	37	37
Goat	759	779	801
Camel	818	829	840
Milk (Human Consumption)	37,475	38,690	93,945
cow	12,906	13,393	13,897
Buffalo	22,955	23,652	24,370
sheep	36	37	37

Goat	759	779	801
Camel	818	829	840
Meat	3,095	3,232	3,379
Beaf	1,711	1,769	1,829
Mutton	616	629	643
poultry Meat	767	834	907

Source: Government of Pakistan (2013-14)

Livestock is not only a good source of livelihood in rural Pakistan but it also helps farmers to get institutional and non-institutional loans. Moreover, it is also source of power, fertilizers and help in irrigating land and earning income by working as an engine ahead of cart. Pakistan is the fifth largest milk producers (Shahana and Kazmi, 2009) but she still has to import milk from abroad to fulfill its various requirements.

Table-2: Estimated Figure based on inter census growth rate of Livestock Census 1996 & 2006

Livestock Population			Million Nos.
Species	**2009-10**	**2010-2011**	**2011-2012**
Cattle	34.3	35.6	36.9
Buffalo	30.8	31.7	32.7
Sheep	27.8	28.1	28.4
Goat	59.9	61.5	63.1
Camel	1.0	1.0	1.0
Horses	0.4	0.4	0.4
Asses	4.6	4.7	4.8
Mules	0.2	0.2	0.2

Source: Economic Survey of Pakistan (2011-12)

Punjab is one the most populous and agriculturally developed province of Pakistan. It not only shares largest population but produces abundant grains to feed the whole nation. Therefore, this study has been decided to observe the impact of livestock holdings on food security in this province. Appendix-3 shows the distribution of livestock population per acre in the districts of Punjab province of Pakistan. It is evident from the figure-1 that district Lodhran has highest number of livestock per acre while it is observed that Hafizabad is at the lowest rank. However,

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Sargodha, Khushab and Jehlum districts lie in the middle of all of the 34 districts of the province. The reason of being at lowest rank in livestock rearing of Hafizabad might be its significance of cash crop production like rice. Moreover, this area is well known for rice export, too. Table-2 showing the growth rate of livestock from 2009 to 2012.

The introduction part is followed by (a) Literature Review (b) methodology (c) results and discussion and (d) conclusions of the study.

LITERATURE REVIEW:

Most of the farmers use livestock as a supplement source of income and food, and use them for the crop cultivation at farm. As there is dearth of literature is available on livestock and food security nexus therefore some most relevant studies has been selected to observe the impact of livestock on rural livelihood, poverty and food security.

Richard and Adams (1996) studied rural household in Pakistan and household's total income into five sources i.e. agricultural, nonfarm, livestock, rental and transfer income. They concluded that livestock income from male animals has negative effect on income distribution and female animals have positive effect on income distribution.

Randolph, et al. (2007) reviewed the role of livestock in human nutrition and health for poverty reduction in developing countries. They also examined the linkages between livestock and human health. They found positive link between livestock and human nutrition & health. Moreover, they also concluded that increase in the livestock population leads to reduce poverty and improving human's health. Therefore, they suggested that Government must intervene to promote livestock contribution in alleviating poverty.

Alary, et al. (2011) analyzed the livestock's contribution to poverty alleviation in Mali. In this regard they used both measure-based approach and financial approach. The result showed that according to the asset-based approach livestock has strong role in poverty alleviation but according to dynamic approach livestock has weak role in reducing poverty.

Bashir, et al. (2012) studied the role of livestock to promote food security in rural household in the Punjab province of Pakistan. Primary data were collected from 12 districts of the Punjab province from 2009-2010 and binary regression was used. They concluded that livestock's has significant impact on achieving food security of households. Moreover, they observed that with the increase in the small & large livestock leads to increase in the food security level. They also concluded that female livestock help the household in terms of their nutrition and financial wellbeing.

Animal based food milk products, meat, eggs and fish are a major source of proteins and fats for human beings. Animal proteins are necessary and indispensable for human beings. Suggested quantities of protein for a fit human being are calculated at 36 grams per capita/day. But it is only 18 grams per capita per day, in Pakistan. The Government needs to take serious steps to address this issue, which will help to improve the health of the population at the national level and people's socio-economic status at the rural level (Economic Survey of Pakistan, 2006-07). Pakistan livestock sector produces annually, 41 million ton of milk, more than 3 million tons of meat and more than 10 billion eggs. Pakistan is earning a reasonable amount of foreign exchange with the export of livestock and livestock by-product, such as mutton, beef, skins, finished goods, raw wool carpet, leather hides, and footwear (Food,

Agriculture & Livestock Division, 2009). In the economy of Pakistan, livestock plays an important role and in the rural socio economic system of Pakistan. Unfortunately decline in Livestock growth rate has been observed in 1980-90 (6.2%), 1990-00 (6.3%) and in 2000-04 (3.2%) (FAO Report on Food Security in Pakistan 2000; 2003-04).

There are many threads (growing population and declining food productivity) which are influencing the food security of Pakistan. Long term decline rate in food productivity (from 4.18% in the 1970s to 1.7% in 2008) is showing the reduction of food security. Recent years import shows that Pakistan is importing 4 million tons of wheat every year to meet the domestic demand. Agriculture productivity growth is the big hurdle for food security in Pakistan (Mansoor, 2011).

MATERIAL AND METHOD:

Study Area:

Pakistan is comprised of four provinces and other regions including Punjab, Sindh, Baluchistan and Khyber Pakhtun Khaw, and Azad Jammu and Kashmir and Gilgit Balttatan Territories. However, Punjab is the biggest province, constitutes 29 % reported area, shares 55 % population and contributes 57 % of cultivated and 69 % of cropped area for agricultural production of the country (Government of Punjab 2013). The territorial segregation of this province contains 36 districts along with 6 different agro-climatic regions / cropping zones in it. It is also comprised of about 80 % of Indus Basin area (Starkloff and Zaman, 1999) which is the most fertile irrigated land in the country. Keeping in view these attribute of the Punjab it was decided to select this province as a target site to render this valuable study.

Data:

As far as type of data is concerned, secondary data /Cross-sectional data was used from various secondary data sources. Desired data was collected from Food Insecurity Report 2009 (SDPI, SDC and World Food Program 2009), Punjab Development Statistics (Government of Punjab 2009) and Agriculture Census Report 2010 (Government of Punjab 2010). As per title of this study the variables used in this study are Meat Animals per person (MePP), Milk Animals per Person (MAPP), Milk Animals per Hectare (MAPH), Work Animals per person (WAPP) and Work Animals per Hectare (WAPH) and % Food Insecure Population in the districts of the Punjab province.

As per knowledge of the authors no such study has been rendered to observe the relationships between these variables.

Analytical Modeling:

In the present study generalized linear regression model is used.

Generalized Linear Model:

(Nelder and Wedderburn 1972) proposed Generalized Linear Model (GLM) which is an extension of the linear regression model. It allows the data to follow a certain probability distribution such as the Poisson, Binomial, Multinomial and normal distribution. In case data follow normal distribution then it becomes special case of regression model. Additionally, Generalized Linear Model relaxes the assumption of equality or constancy of variances which is

the basic requirement for hypothesis tests in traditional linear models. In GLM response variable should belong to exponential family and link describes how the mean of response variable relates to linear combinations of predictors. In GLM the distribution of response variable belongs to exponential family of distribution which could be written as

$$f(y|\theta,\varphi) = \left[\frac{y\theta - b(\theta)}{a(\varphi)} + c(y,\varphi)\right]$$

Where θ is called canonical parameter and represents the location and φ is scale parameter representing dispersion. For different values of a, b and c the various members of family can be specified. The most commonly used are:

Gaussian Model:

$$f(y|\theta,\varphi) = \frac{1}{\sigma\sqrt{2\pi}} exp\left[-\frac{(y-\mu)^2}{2\sigma^2}\right]$$

$$= exp\left[\frac{y\mu - \mu^2/2}{\sigma^2} - \frac{1}{2}\left(\frac{y^2}{\sigma^2} + log(2\pi\sigma^2)\right)\right]$$

Here $\theta = \mu, \varphi = \sigma^2, a(\varphi) = \varphi, b(\theta) = \frac{\theta^2}{2}$ and $c(y,\varphi) = -\left(\frac{y^2}{\varphi} + log\left(log(2\pi\varphi)\right)\right)/2$

Poisson Model:

$$f(y|\theta,\varphi) = e^{-\mu}\mu^y/y!$$

$$= exp(y.log\mu - \mu - logy!)$$

$\theta = log(\mu), \varphi = 1, a(\varphi) = 1, b(\theta) = exp(\theta)$ and $c(y,\varphi) = -log(y!)$

Binomial Model:

$$f(y|\theta,\varphi) = \binom{n}{y}\mu^y(1-\mu)^{n-y}$$

$$= exp\left(y.log\mu + (n-y)log(1-\mu) + log\binom{n}{y}\right)$$

$$= exp\left(y.log\frac{\mu}{1-\mu} + n.log(1-\mu) + log\binom{n}{y}\right)$$

$\theta = log\left(\frac{\mu}{1-\mu}\right), b(\theta) = -n.log(1-\mu) = n.log\left(1+exp(\theta)\right)$ and

$c(y,\varphi) = log\binom{n}{y}$

Moreover, the Gamma and inverse gamma also belong to exponential family and may be used as link function in generalized linear model. The parameter φ in the normal and gamma density is free but in Poisson and binomial it is fixed to one.

Mean and variance of exponential family distribution can be defined as;

$$E(Y) = \mu = \frac{d}{d\theta}\left(b(\theta)\right)$$

$$Var(Y) = \frac{d^2}{d\theta^2}\left(b(\theta)\right)a(\varphi)$$

Mean is only a function of θ whereas the variance is product of function location and scale parameter. In case of Gaussian density function $\frac{d^2}{d\theta^2}\left(b(\theta)\right) = 1$ therefore the variance is independent from mean which is not true for other exponential distributions.

Link function:

In generalized linear model the effect of the predictors on the response through a linear predictor is modeled by using link functions i.e.

$\eta = \beta_0 + \beta_1 X_1 + \cdots + \beta_p X_p = X^T \beta$

The link function η describes how the mean response is linked to the covariates through the linear predictor i.e. $\eta = g(\mu)$. Simply speaking any monotone continuous and differentiable can be a link function in GLM. In Gaussian linear model link function is identity i.e. $\eta = \mu$. In case of Poisson GLM the mean must be positive therefore in that case $\eta = \mu$ will not be appropriate because η can be negative. The reasonable choice could be $\mu = e^{\eta}$ so that $\eta = \log \mu$ which will ensure $\mu > 0$, such *log* link will describe that additive effect of predictors leads to multiplication effect on μ. In case of binomial GLM, it is assumed that assumed that p is the probability of success and it also represents our μ and response is defined as proportion rather than count. Different link functions (logistic, probit and complementary log-log link) can be defined for binomial GLM the selection depends on the objective of the study. The link functions and variance functions for exponential family of distributions are shown in Table 1.

Table 1: Link functions and variance functions for exponential family of distributions.

Family	Link	Variance Function
Normal	$\eta = \mu$	1
Poisson	$\eta = \log \mu$	μ
Binomial	$\eta = \log\left(\frac{\mu}{1-\mu}\right)$	$\mu(1-\mu)$
Gamma	$\eta = \frac{1}{\mu}$	μ^2
Inverse- Gamma	$\eta = \frac{1}{\mu^2}$	μ^3

RESULTS AND DISCUSSION:

The distribution of food secure population (FSP) is displayed in Appendix-1 which is positively skewed. Since the distribution of food secure population is positively skewed and representing the discrete values therefore it could be assumed that it is distributed as Poisson. The generalized linear regression model could be appropriate choice for modeling the effect of independent variable upon food secure population (dependent variable). The summary statistics for fitted generalized linear model is shown in Table 2 and fitted model can be written as;

$$\eta = \log(\mu) = 12.69 - \frac{0.047}{MAPP} - \frac{0.257}{log(MePH)} - 0.029 * (MAPH)^2 - 0.989 * \log(WAPP) + 1.036 * \log(WAPH)$$

and the relation between dependent variable with independent variables may be written as follows;

$$y = e^{\ln(\mu)} = exp\left[12.69 - \frac{0.047}{MAPP} - \frac{0.257}{log(MePH)} - 0.029 * (MAPH)^2 - 0.989 * \log(WAPP) + 1.036 * \log(WAPH)\right]$$

The final model is;

$$y = \frac{exp(12.69) \times exp(1.036 \times \ln(WAPH))}{exp\left(\frac{0.047}{MAPP}\right) \times exp\left(\frac{0.257}{\ln(MePH)}\right) \times exp(0.029 * (MAPH)^2) \times exp(0.989 * \ln(WAPP))}$$

Now the interpretation of the coefficients in above equation and coefficients presented in Table 2 is very simple. The intercept of fitted GLM model is $exp(12.69) = 324486.8$ and $\ln(WAPH)$ has positive relationship with FSP; the one percent increase in $\ln(WAPH)$ results 2.817923 units increase in FSP. The independent variable $\frac{1}{MAPP}$ has positive effect on FSP; the one unit increase in $\frac{1}{MAPP}$ will result 0.9540874 units increase in food secure population. Since the values of MAPP are greater than 1 therefore the fraction $\frac{0.047}{MAPP}$ will be smaller as the values of MAPP increases; consequently it may be concluded that

Table 2: Summary statistics of generalized linear model by considering food secure population as dependent variable.

Coefficients	Estimate	Std. Error	z value	P-value
Intercept	12.69	0.00192	6612.1	0.00 ***
1/MAPP	- 0.047	0.00005	-925.9	0.00***
1/ln(MePH)	- 0.257	0.00039	-659.9	0.00***
MAPH^2	- e0.029	0.00007	-378.9	0.00 ***
ln(WAPP)	- 0.989	0.00046	-2171.3	0.00***
ln(WAPH)	1.036	0.00062	1668.2	0.00***

Null deviance on 33 degrees of freedom = 20404593

Residual deviance on 28 degrees of freedom =5091048

Variation explained = 1-(Residual deviance /Null deviance)= 0.750495

***Significant at 1% level of significance

MAPP has negative impact on FSP and same is also true for the independent variable MePH. The MAPH has positive effect on FSP; one percent increase in $(MAPH)^2$, may result 1.029425 percent increase in FSP. Similarly $\ln(WAPP)$has positive relationship with FSP; the one percent increase in $\ln(WAPP)$results 0.3719485 units increase in FSP. In the third column of Table 2 the values of standard error for the estimated coefficients are shown which are very small; indicating that the estimated coefficients are appropriate. The p-values for each regression coefficient are shown in the last column of Table2. Since the p-values for all regression coefficients are less than level of significance 0.01, therefore it can be concluded that all independent variables have significant effect on FSP. The performance of fitted model could be observed from the Figure 2, representing the actual values versus predicted values based on GLM. The overall performance of fitted GLM model could be observed from the explained variation by the independent variables. The 75.05% variation of dependent variable is explained by independent variable; it can be inferred based on variation explained that the model is reliable for further prediction and planning.

CONCLUSION

As livestock production is a very important component of the agricultural economy and perform very supportive role in reducing hunger and food insecurity, and the purpose of the current study was to estimate the impact of livestock on food security in Punjab, Pakistan. Our findings prove that with the increase in the work animals, Milk and meat animals, food security also increases. Moreover, work animals per hectare (WAPH), work animals per person (WAPP) and Milk animals per hectare (MAPH) have positive relationship with food secure population (FSP) which implies that one percent increase in work animal per hectare results 2.817 percent increase in FSP. While one percent increases in WAPP leads to 0.371 percent increase in FSP. Moreover, it is alos concluded that 1.029 percent increase in FSP is caused by one percent increase in MAPP. Furthermore, both, Meat animals per hectare (MEPH) and Milk animals per person (MAPP) have negative relationship with Food secure population. The reason might be behind that people use it domestically in making “Lassi” and other types of milk products at home in rural areas due to the fact that they don’t prefer to sell in the market. Livestock development interventions in lower-income countries is, typically, focus to generate income for livestock-keeping households. Nevertheless, livestock can also be used to deliver critical micronutrients needed to enhance the nutritional status of household members and secure their most fundamental livelihood assets as a pre-condition for alleviating poverty.
To achieve this requires a deeper appreciation for the complexities associated with the role that livestock play in the livelihood strategies of the poor and in household nutritional and health dynamics. There is the need for a systems perspective lens for research on livestock production and health in Pakistan. The study finding has important policy implications for food security.

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REFERENCES:

Alary, V. Christin, C. & Denis, G. (2011). **Livestock**'s Contribution to Poverty Alleviation: How to Measure It? World Development, Volume 39, Issue 9, September 2011, Pages 1638-164

Bashir, M. K. Schilizzi, S. & Pandit, R. (2012). Livestock and rural household food security: The Case of small farmers of the Punjab, Pakistan, Working Paper 1207, School of Agricultural and Resource Economics, University of Western Australia, Crawley, Australia

Government of Pakistan (2006-07). Economic Survey of Pakistan, Federal Bureau of Statistics, Statistics Division. Ministr of Economic Affairs and Statistics, Islamabad, Pakistan.

Government of Pakistan (2011-12). Economic Survey of Pakistan, Federal Bureau of Statistics, Statistics Division. Ministr of Economic Affairs and Statistics, Islamabad, Pakistan.

Government of Pakistan (2012-13). Economic Survey of Pakistan, Federal Bureau of Statistics, Statistics Division. Ministr of Economic Affairs and Statistics, Islamabad, Pakistan.

Government of Pakistan (2013-14). Economic Survey of Pakistan, Federal Bureau of Statistics, Statistics Division. Ministr of Economic Affairs and Statistics, Islamabad, Pakistan.

Government of Pakistan (2012). Pakistan Agriculture Census report 2010, Bureau of Statistics, Government of Punjab, Lahore.

Government of Pakistan (2012). Punjab Agriculture census Report 2010, Statistics Division, Agriculture Census Organization, Lahore.

Government of Pakistan (2012-13). Economic Survey of Pakistan, Federal Bureau of Statistics, Statistics Division. Ministry of Economic Affairs and Statistics, Islamabad, Pakistan.

Government of Punjab (2009). Multiple Indicator Cluster Survey Punjab 2007-2008, MICS-Volume-I Provincial Report, Government of Punjab, Planning and Development Department, Bureau of Statistics, Lahore.

IFAD, WFP & FAO, (2012). The State of Food Insecurity in the World.

IFAD (2013). The future of world food and nutrition security. Accessed on March 2013 http://www.ifad.org/hfs/index_full.htm

Mansoor, A. (2011). Land Reforms for Addressing Food Insecurity & Agricultural Stagnation: Options for Pakistan's Tenth Five-Year Plan 2010-2015, The Heinz Journal 8(1).

Randolph, TF. Schelling, E. Grace, D. Nicholson, C.F. Leroy, J.L. Cole, D.C. Demment, M.W. Omore, A. Zinsstag, J. & Ruel, M. (2007). Role of livestock in human nutrition and health for poverty reduction in developing countries, doi: 10.2527/jas.2007-0467 originally published online October 2, 2007.

Richard H. & Adams, Jr. (1996).Livestock Income, Male/Female Animals and Inequalities in Rural Pakistan, Discussion Paper No. 21

Sansoucy, R. Livestock-A driving force for food security and sustainable development http://www.fao.org/docrep/v8180t/v8180T07.htmAccessed on 15 July 2013.

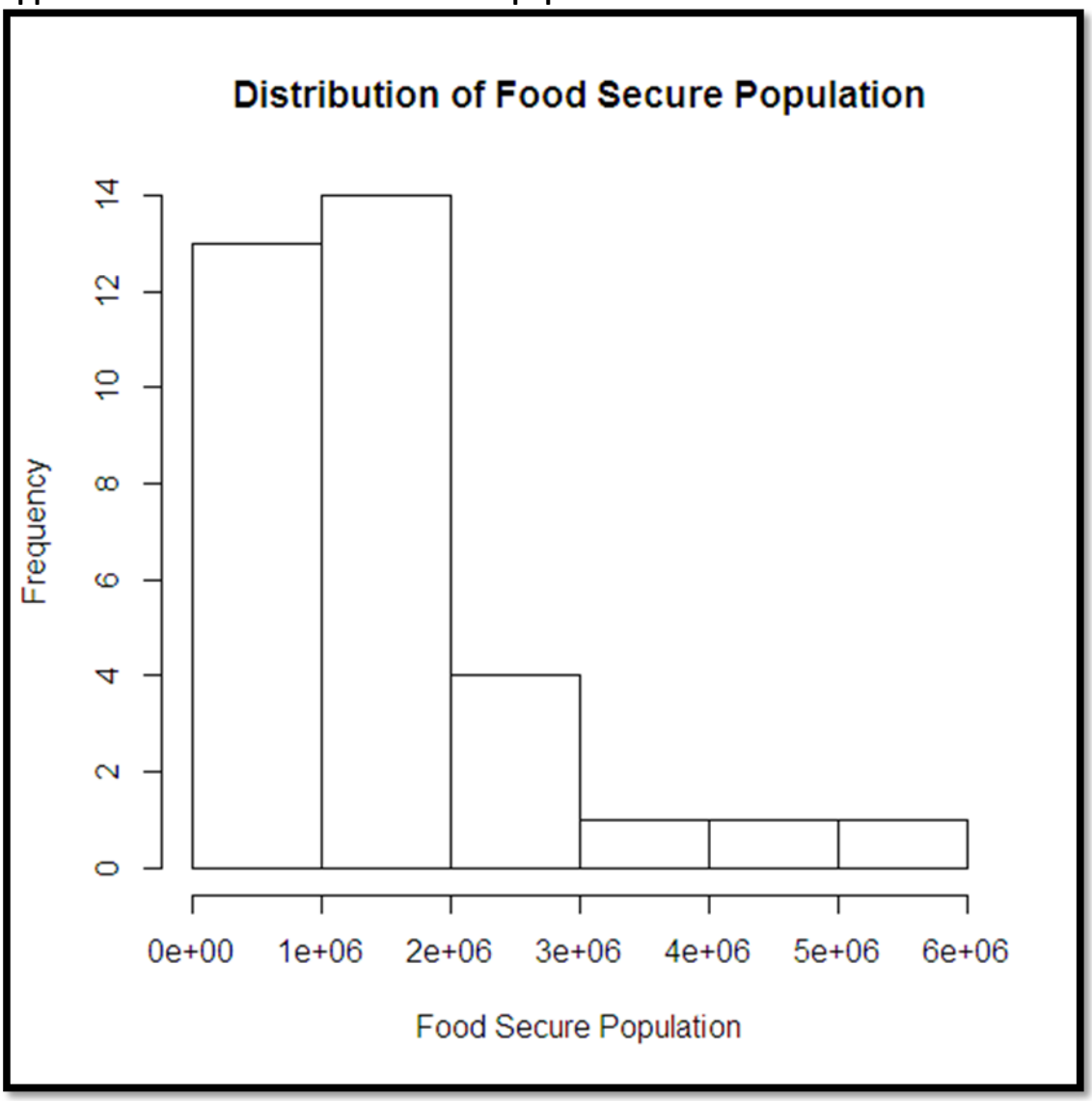
SDPI. SDC & WFP (2009). Food Insecurity in Pakistan. http://www.sdpi.org/publications/publication_details-284-36.html

Shahana and Kazmi, U. (2009). Future of Livestock in Pakistan. Pakistan Agricultural Research Council Islamabad. Animal Sciences Division.

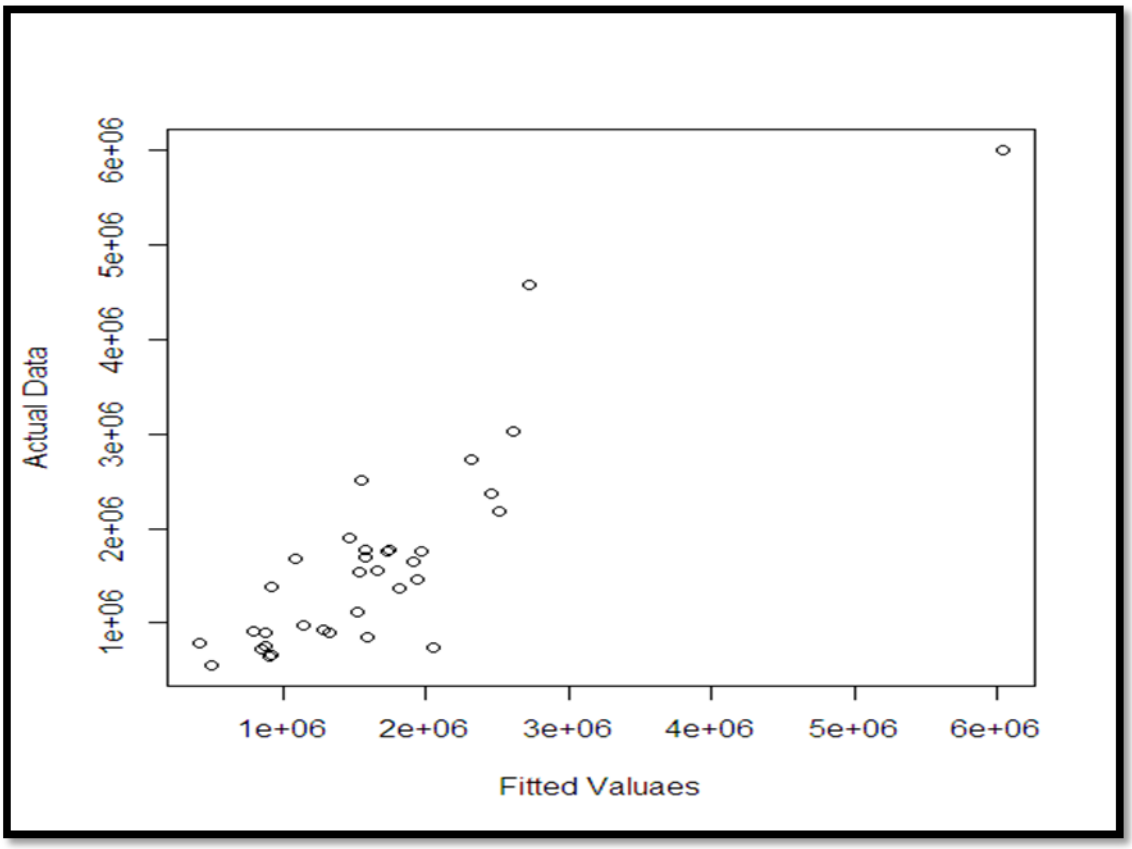
Starkloff, R. & Zaman, W. (1999). Farmer's Participation and Empowerment in Pakistan's Institutional Reform of Irrigation Sector" The farmers View of the Process, Deutsher Tropentag 1999 in Berlin, Session: Institutions and Organizations in Rural Development.

WHO (2014). Food Security
http://www.who.int/trade/glossary/story028/en/

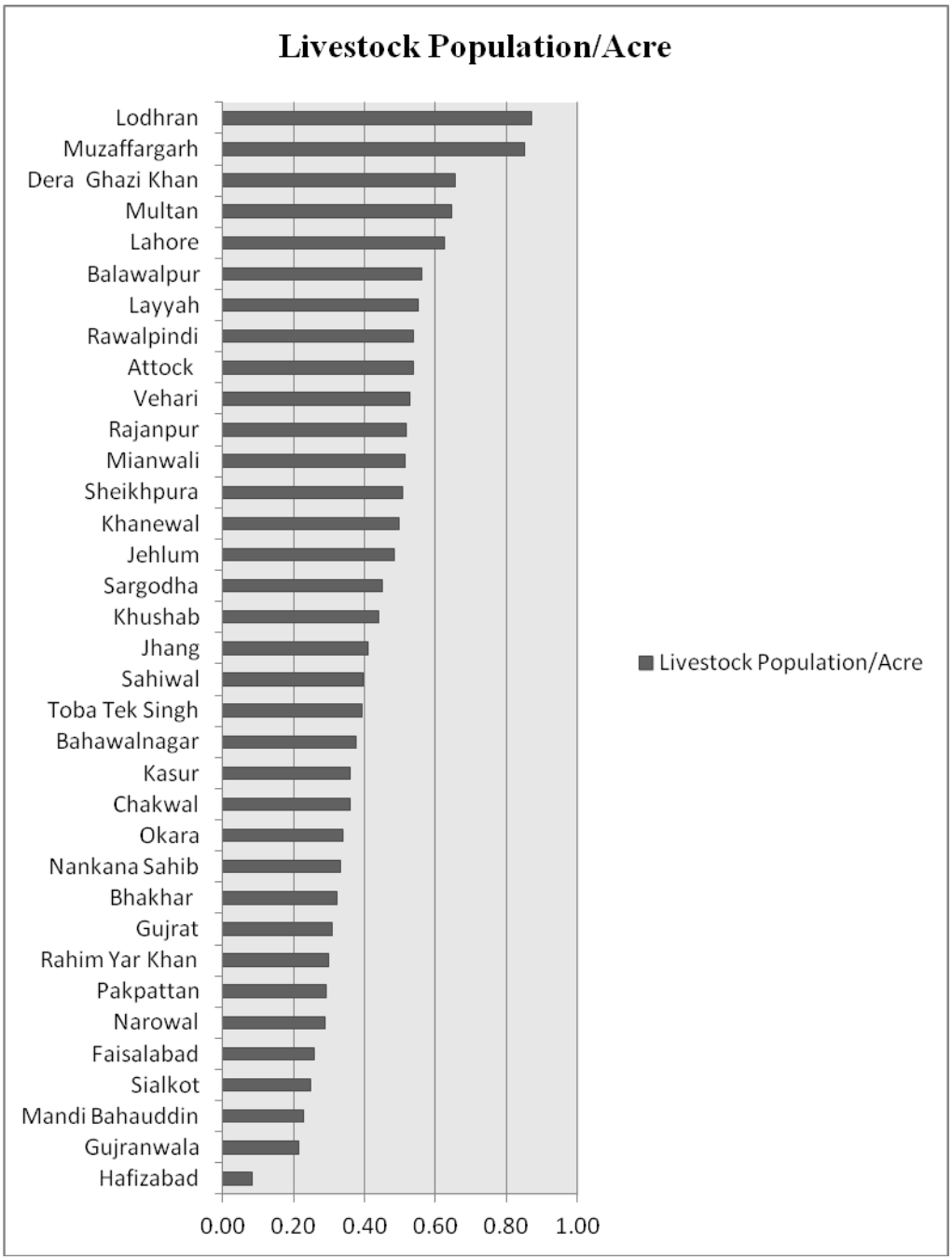
Appendix-1: Distribution of food secure population



Appendix-2: Fitted values by GLM versus actual data



Appendix-3: Livestock Population per Acre in the Districts of Punjab



Source: Diagram on the basis of data taken from Agriculture Census Report 2010.