The Journal of Animal & Plant Sciences, 29(5): 2019, Page: 1402-1412
ISSN: 1018-7081

AGRICULTURAL LAND USE AND FOOD SECURITY IN PAKISTAN: A STRUCTURAL EQUATION MODELING APPROACH

B. Pervaiz[1*], N. Li[2] and M. Q. Manzoor[2]

[1]Department of Economics, Lahore Leads University – Pakistan and Visiting faculty member, Department of Economics, COMSATS University, Islamabad (Lahore Campus) – Pakistan
[2]Institute of Agricultural Economics and Development, Chinese Academy of Agricultural Sciences, Beijing – China
[*]Corresponding Author's email: bushra19@live.com

ABSTRACT

Pakistan is an agrarian country and has diverse resources of agricultural land. The current study has been conducted in the province of Punjab with an aim to explore the association among agricultural farm area, agricultural farm infrastructure, agricultural farming community, agricultural output, and the issues of food security in the context of bringing improvement in the living standard of farmers and the rural poor. For this purpose, a field survey was conducted across Punjab and data from 300 households was collected under multi-stage clustered sampling technique on a detailed questionnaire. Structural Equation Modeling (SEM) technique was employed to incorporate the significance of special situations for improved understanding. The results showed that secure land administration and tenancy improved the farm production. Meanwhile, farm area, modern production technology and safeguards against natural disasters were important for increasing farmers' income. The poor nutritional level of rural community was found to be associated with its agricultural profitability which suggested compromised standard of living. Food security in Pakistan appeared to be directly affected by agricultural output and indirectly by appropriate farm area which in turn was directly linked with standard of living. The government may like to improve land governance and implement such policies which increase farmers' profitability for their better nutrition and standard of living.

Key words: Food security; Land use; SEM; Standard of living; Farm area; Pakistan

INTRODUCTION

The agricultural production primarily depends upon prevailing climatic conditions and endowment of natural resources. Pakistan is amongst countries which are highly vulnerable to climate change. The challenges of climate change have posed serious issues for agriculture and food security in Pakistan especially in view of its dense population and prevalent poverty (Abdullah *et al*., 2016). During last few years, the frequency and intensity of extreme weather events has increased and erratic changes in the patterns of monsoon rainfall has resulted in intense spells of draught and frequent floods in Pakistan (NCCP, 2012). The extreme climatic conditions, long high temperature and heat stress have adversely affected wheat and rice production in Pakistan (Arshad *et al*., 2017)

Not only climatic conditions but the prevailing market situation and implementation of suitable public policies in production sector also influence the agricultural production. The major constraints in agricultural production in Pakistan are meagre agricultural infrastructure, lack of modern production technologies, non-availability of easy farm credit and distorted agricultural input and output markets (GoP, 2009; Amjad, 2010). Besides food availability, the factors related to food access and food utilization are also important for understanding the concept and nature of food security situation. These aspects of food security are linked with household's risks of not having access to required food. These risks may be associated with not only household crop production but employment and income etc. Thus, insecure household cannot ensure adequate dietary needs of all the household members.

According to National Nutritional Survey of Pakistan held in 2011, at least 58% of households were food insecure and each household incurred 50.8% of monthly income on food only. Similarly, 15% of children under five suffered from acute malnutrition and 22% of the same age were underweight (GoP, 2011). Pakistan has been ranked 78th out of 113 countries in Global Food Security Index 2016. Its score for affordability, availability and quality & safety of food is much below half of the observed countries (EIU, 2016). Similarly, the hunger level in Pakistan has been described as 'serious' in Global Hunger Index 2016 with very high score of 33.4. According to the same index, 22% of Pakistan's population is undernourished, 10.5% children under five suffer from wasting, 45% children under five are stunted whereas mortality rate under five is 8.1% (IFPRI, 2016). It has been observed by the Sustainable Development Policy Research Institute of Pakistan that the food security situation in Pakistan has deteriorated since 2003 and food security is inadequate in 61% districts of Pakistan whereas 48.6% Pakistanis do not have access to

sufficient food for living a healthy and active life (SDPI, 2009).

Current research has been conducted to explore the association among agricultural farm area, agricultural farm infrastructure, agricultural farming community, agricultural output and the issues of food insecurity in the context of bringing improvement in the living standard of farmers and the rural poor. For this purpose, an advance statistical technique of Structural Equation Modeling (SEM) has been employed to incorporate the significance of special situations for improved understanding. The instant study has focused Punjab province which is the most populous and can be called as the granary of the country because 57% of total cultivated area and 69% of total cropped area of Pakistan is located in this province (GoP, 2015).

Agricultural land use and its administration: Agricultural land area is almost 35% of Pakistan's total land area. However, only an area of 21.3 million hectares (27.6% of total land area) is under cultivated agriculture. Out of this cultivated agricultural area, nearly 80% is irrigated which is one of the highest proportion of irrigated cropped area in the world. Conversely, about 65% of Pakistan's total land consists of desert, mountains and urban settlements (GoP, 2010). The forest area including scrubs, riverine vegetation, mangroves and plantation is just 5.4% of total land area in Pakistan and nearly half of it is situated only in KPK province. The rangeland area is 26% of total land area and most of it is situated in Baluchistan province. Agricultural land includes irrigated, rain fed and hill torrent irrigated land which is almost 20% where 10% is marked as open spaces or fallow land. Pakistan also has nearly 10% of desert land and 2.2% of snow glacier. Water logged and water bodies constitute almost 1% of total land area (GoP, 2004).

The above patterns of land use in Pakistan have evolved over a period of centuries but have been heavily influenced by physical factors e.g. different land forms, soil categories, climate and water availability, and various human factors e.g. population size, level of economic growth, economic demand and cultural practices or customs. The review of agricultural development reveals that very little efforts have been made to carve the land use patterns in Pakistan by legislation or government control to achieve certain land use planning. Moreover, crop specific zoning or specialized cropping patterns could not be successfully implemented under a public policy in Pakistan.

In Pakistan, most of the agricultural farms are small farms which are many in numbers but possess very little total area e.g. on one side, at least 15% of total number of agricultural farms covers just 01% of total agricultural land whereas, on the other side, 1.12% of total number of agricultural farms possess nearly 22% of total agricultural land in the country. If the total agricultural land is categorized into small farms (having land less than 5.0 acres), medium farms (having land area from 5.0 to 12.5 acres) and larger farms (having land area more than 12.5 acres), then these farms possess 16%, 28% and 52% of total agricultural land respectively. Similarly, 86% households in Pakistan have 43% agricultural land where big land lords which constitute just 5.5% of total households possess more than 37% of agricultural land area (GoP, 2010).

The land administration system in Pakistan is based on traditional land registers and maps. The Board of Revenue is responsible at the provincial level to deal with all the matters related to land administration; collection of land revenue; and preparation, updating and maintenance of various land records. This antiquated system of land record and administration results in a lot of hurdles for the land owners especially farmers. The land administration system is highly complicated for the general public. Due to its complex nature, it results in frequent and protracted land related disputes (USAID, 2010). This creates doubts about tenure security in land owners' minds due to which they cannot use their property for any mortgage or loan from banks and resort to informal form of agricultural credit (Cotula *et al*., 2006). Moreover, land transactions are relatively expensive and disputes about the correctness of land rights are caused, among others, by an inefficient and dispersed land record system.

The lack of credible information and insufficient cooperation of land administration officials during land disputes generate considerable delays in resolving pending cases in courts. The legal procedures in land cases are complex and the duration of a land case may go beyond the litigant's lifetime. Being convinced of the importance of land administration system for Pakistan and remarkable inefficiencies of traditional system of land record, the Government of Pakistan is moving towards development of digitized map of land and computerization of land related transactions.

Land use and food security nexus: Pakistan is an agrarian economy but it has an alarming level of food insecurity. The role of high yield varieties of crops and fruits, mechanized agricultural farming methods, and improved input/output markets have ever been considered important to meet any country's food security needs. But, on the other hand, the role of land use has least been acknowledged in context of food security especially in the developing countries. The relationship between farm size and agricultural productivity is important but controversial. For example, Wang *et al*. (2015) concluded that positive relationship existed between farm size and productivity whereas the inverse situation was observed in India. Heltberg (1998) found inverse farm size and productivity relationship from the analysis of data from

Pakistan. Moreover, the farmers who were relatively well-off and enjoyed political capital were found to easily reclaim waste land for increased agricultural production (Komarek *et al*., 2017). Land use is directly related to its various aspects i.e. land administration, land governance, land tenure, land value and land development.

Land is a fundamental asset in the rural economy like Pakistan. Its importance is doubled in context with small farmers who mostly undergo subsistence farming. The food security of such farmers is directly linked with their right and access to land. The government cannot implement successfully any of its policies towards food security if land administration and land governance institutions are weak in any country. Due to insecure land tenancy situation, farmers cannot benefit from agricultural finance and, subsequently, their land development decisions are delayed. Poor land administration causes the poor land use as farmers have less access to land. Due to lack of secure land tenancy, the farmers fail to make long-term investment for better agricultural production (Malik *et al*., 2016).

Food insecurity may be caused due to mismanagement of agricultural land resources. This aspect of land resources has least been explored in the context of food insecurity. It is hypothized in the instant research that the choices for agricultural production are linked with land use, security to land tenure and assurance of property rights. Due to lack of long-term investment, fear of land grabbing and defused ownership rights, the farmers fail to produce more which has a strong impact on the food security of the country. Land use decisions are linked with the availability and service delivery of the land administration and governance institutions of a country and finally government fails to implement its agricultural policies which results in increased food insecurity.

MATERIALS AND METHODS

Research methodology: The purpose of instant research was to investigate all those factors which affected agriculture land use and food security. For this purpose, a comprehensive and structured questionnaire was developed that was consisted of separate modules for household economic level; agricultural farm productivity; farm machinery and livestock information; land use and investment; land tenure and ownership security; and food security situation. A sample size of 300 rural households was used and data across Punjab province was collected during November, 2016 by employing multi-stage cluster sampling technique. Due to distinct difference of agricultural conditions within Punjab, total sample size was proportionately divided into four agro-ecological zones: irrigated, arid, Thal and marginal lands. Then, 18 respective districts and 28 sub-districts were proportionately selected within the agro-ecological zones whereas the villages were selected by using simple random sampling technique. All the data entry and data documentation was made by using EpiData version 3.1 and subsequently the same was analyzed by using IBM SPSS Statistics (Amos) version 23.

Description of the model: Structural Equation Modeling (SEM) technique was used in the instant study. SEM is an extension of General Linear Model (GLM) which is used to handle complex situations involving analysis of a set of regression equations simultaneously. It provides an alternative and improved method to undergo multiple regression, path analysis, factor analysis and analysis of covariance. SEM is a series of statistical methods which provides a way to analyze one or more observed variables, latent variables and any combination of these two types of variables. The reason for selection of SEM was to benefit from its analytical and graphical descriptive power much needed in the current study due to *priori* information on the presence of complex interactions, nonlinearities, correlated variables, measurement errors and one or more latent variables with multiple indicators.

The situation of food insecurity is complex. It goes beyond the simplistic idea of a country's inability to feed its population and involves various natural, social and economic factors. In the instant study, the food insecurity in Pakistan was perceived in the context of interrelationship between household dependency, land use, water resources, climate change, food availability and food accessibility. The arable land has been analyzed in the literature as a natural factor contributing towards agricultural production and food security but the managerial aspects of agricultural land use especially in the perspective of land administration, land governance, land value and land tendency status has least been studied.

In Pakistan, the stark disparity between number of farms and total farm area, weak land title, poor tenancy status and social importance of agricultural land is much to do with the optimal production capacity of agricultural land. Due to weak land title, farmers are not in a position to sub-let their agricultural land and their investment decisions are delayed. It is inferred that the administrative and managerial dimensions of agricultural land use is directly linked with type and quantity of agricultural production which in turn affect the food security situation of the country (Lichtenberg and Ding, 2006). Similarly, the availability and access to food is linked with overall living standards of the farming community (Grote, 2014). The following theoretical model was constructed in which agricultural farm area was taken as to be associated with crops output value. The crop output value was taken as to be associated with food security and, finally, the food security was taken as to be associated with standard of living of farming community.

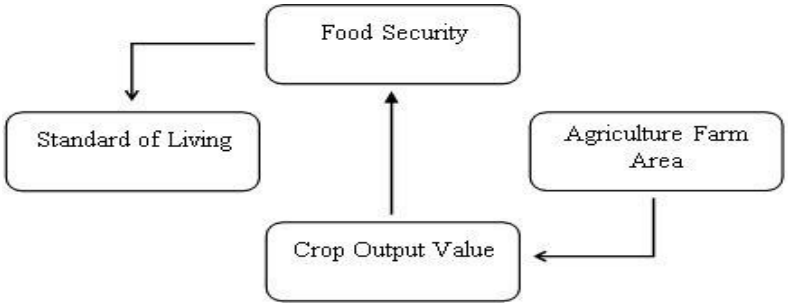

Figure 1. Theoretical Model of Agricultural Land use for food security

The following table 1 presents a list of various variables and their notations used in the current study.

Table 1. List of variables used in the study

Variable notation	Description	Variable notation	Description
VA04	Area of house	VE392	Inherited agricultural land
VA051	Material of house	VE393	Purchased agricultural land
VA06	House repair	VE40	Registered agreement of farm land
VA07	Standard of living	VE411	Written agreement of tenancy
VA081	Open air kitchen	VE421	Written document of land title
VA082	Bricked kitchen	VE43	Agricultural land sold
VA083	Toilet	VE49	Agricultural land disputes, if any
VA084	Bathroom	VE51	Mediation mechanism for disputes
VA085	Electricity	VE52	Land ownership secure or not
VA086	TV	VF543	Safe distribution of land to heirs
VA087	Bicycle	VF55	Daily milk consumption
VA088	Motorcycle	VF56	Daily eggs consumption
VA089	Car	VF57	Perception of HH for food security
VA08X	Mobile phone	VF58	Duration of food insecure period
VA09	Quality of drinking water	VF591	Crop failure due to climate
VA101	Hand pump	VF592	Crop failure due to pests/disease
VA102	Electric motor	VF593	Less production from land
VA103	Water supply	VF594	Illness of the breadwinner
VA12	Water storage tank	VF595	Money shortage
VA131	Gas for cooking food	VF601	Used self-grown crops
VA132	Wood for cooking food	VF602	Consumes less meat
VA133	Animal dung for cooking food	VF603	Reduced amount of food
VA134	Oil for cooking food	VF605	Worked extra labor
VA148	Household monthly expenditure	VF606	Wife contributed as labor
VB15	Agricultural farm area	VF607	Resorted to child labor
VB161	Owned farm area	VF608	Government subsidy
VB162	Rented in farm area	VF61	Sugar consumption
VB163	Rented out farm area	VF62	Frequency of fry food
VB171	Irrigated agricultural land	VF63	Children milk intake
VB172	Rain fed agricultural land	cropotptval	Crop output value
VB25	Natural disaster	Grainfeed	Grains as feed
VB2924	Wheat quantity sold	Grainfood	Grains as food
VB2934	Rice quantity sold	Grainseed	Grains as seed
VB2941	Vegetable consumed	Landrent	Agricultural land rent
VB2944	Vegetable sold	Meat	Monthly consumption of meat
VC30	Ownership of tractor	Fodderotpt	Fodder productivity
VD33	Investment of agricultural land	Vegeotpt	Vegetable productivity
VE391	Joint family ownership of farm land	Grainotpt	Grain productivity
		Cottonotpt	Cotton productivity

RESULTS AND DISCUSSION

Validity of measurement model: There is no point in proceeding further into the SEM until the measurement model is satisfactorily validated (Paswan, 2009). The validation of measurement model provides how well this model fits to the data. There exists a lot of literature to select appropriate criteria to assess the validity of measurement model in SEM solutions. Bollen and Long (1993) have provided much details on the selection of best approach for evaluating the model fit. A good fit model between the model and the data does not mean that the model is correct rather it explains that the measurement model is plausible (Schermelleh-Engel, *et al*., 2003). Following the recommendations of Kline (2010), the Chi-Square CMIN/DF was used in the instant research to evaluate the validity of the measurement model. The Chi-Square CMIN/DF also called as normal Chi-Square to *df* ratio is the Chi-Square fit index (minimum discrepancy) divided by degrees of freedom and indicates differences between observed and expected covariance matrices. The Chi-Square CMIN/DF is normally less dependent on sample size, thus, the only difficulty with this test is that it may fail to reject an inappropriate model with small sample size and reject an appropriate model with large sample size. Because, a sample size of 300 rural households was used in the instant study, thus, it was safe to use Chi-square test of model fit.

The chi-square test value of model fit closer to zero represents better fit and indicates smaller difference between observed and expected covariance matrices but its value below 1.0 is considered poor model fit. Paswan (2009) described that value up to 2.0 as good fit but up to 3.0 is acceptable fit. The index value as high as 5.0 also represent adequate fit (Lomax and Schumacker, 2012). The below Table 2 indicates that he CMIN/DF value was 4.241 for default model which indicated that the measurement model was adequate fit to the data.

The measurement model used in the instant study had four observed variables: a) agricultural farm area (VB15), b) crops output value (Cropotptval), c) food security (VF57), d) and standard of living (VA07). These variables were taken as to affect each other directly and indirectly.

The endogenous variable of agricultural farm area (VB15) construct in the following Figure 2 represented the relationship of agricultural farm area with crop output value and food security. It was observed that the variable agricultural farm area (VB15) was affected by a total of 20 observed variables which were measured directly, however, it was not affected by any indirectly measured variables.

Assessment of measurement model: The Table 3 presents the standardized regression weights of AMOS output. As a rule of thumb, the loadings of 0.5 or higher and, ideally, 0.7 or higher are desirable in the SEM (Garson, 2015). The variables with positive sign indicate positive relationship with level of living whereas the ones with negative sign mean negative relationship. As per research hypothesis, the poor land administration resulted in land disputes and land investment decisions were delayed which adversely affected agricultural output and food security. The issues related to land administration were captured by the variable VE40 (Registered agreement) and variable VE49 (Land dispute during last five years). The estimated value of variable VE40 carried positive sign whereas that of the variable VE49 carried negative sign which substantiated the research hypothesis. It is evident that the explicit and transparent land titles had positive effects on agricultural output and food security. Similarly, frequent and protracted litigation and disputes adversely affected the agricultural output and food security. The variable VB162 (Land rented in) and variable VB163 (Land rented out) were negatively associated with agricultural output. It might be due to weak tenancy regulation and administration in Pakistan.

Table 2. Chi-Square test of model fit.

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	318	24070.310	5676	.000	4.241
Saturated model	5994	.000	0		
Independence model	216	26091.731	5778	.000	4.516

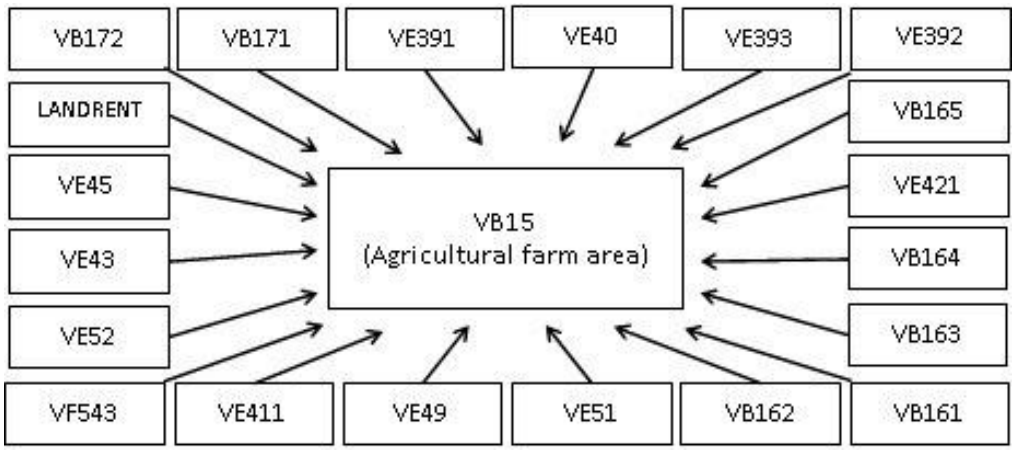

Figure 2. Agricultural farm area construct with its directly observed variables

Table 3. Standardized regression weights in AMOS output between the observed variables of agricultural farm area construct.

Sr. No.	Agricultural farm area	Direct Affect	Observed variables	Estimated Value	Sr. No.	Agricultural farm area	Direct Affect	Observed variables	Estimated Value
1.	VB15	<---	VB172	0.683	11.	VB15	<---	VB161	-0.057
2.	VB15	<---	VB171	0.719	12.	VB15	<---	VB162	-0.011
3.	VB15	<---	VE391	0.063	13.	VB15	<---	VE51	0.010
4.	VB15	<---	VE40	0.007	14.	VB15	<---	VE49	-0.010
5.	VB15	<---	VE393	0.020	15.	VB15	<---	VE411	0.001
6.	VB15	<---	VE392	0.046	16.	VB15	<---	VF543	0.006
7.	VB15	<---	VB165	0.005	17.	VB15	<---	VE52	0.005
8.	VB15	<---	VE421	-0.003	18.	VB15	<---	VE43	0.004
9.	VB15	<---	VB164	-0.001	19.	VB15	<---	VE45	0.003
10.	VB15	<---	VB163	-0.021	20.	VB15	<---	landrent	0.001

The estimated values of variable VB171 (Irrigated land) and variable VB172 (Rain fed land) showed the relationship of agricultural irrigation mode with agricultural output. It was evident that the estimated values of variable VB171 and VB172 were 0.719 and 0.683, and which were highly significant and carried positive signs. This underlined the importance of irrigation in the agricultural production system. It can be concluded from the estimated values that the agricultural land that was irrigated by canal or tube-well had more importance in the agricultural production system as compared with agricultural land that was exclusively rain-fed. The estimated value of variable VE391 (Joint family ownership) was 0.063. The positive sign of variable VE391 indicated that agricultural land jointly owned by whole family was more profitable as compared with individual owned land which might be due to the fact that most of the farm were small farm and did not make commercially profitable agricultural production unit. Furthermore, if land was pooled for the whole family then increased total land area made it more profitable. With an objective to find out the factors which affect the crop output in the context of food security, the crop output value (Cropotptval) construct is presented along with its variables in the Figure 3. It is evident that the crop output value was affected by directly measured a total of 29 observed variables and indirectly measured 20 observed variables. Crop output value directly affected food security but indirectly affected standard of living. As per research hypothesis, the people with higher crop output value experienced improved standard of living. Pakistan is much behind its neighboring countries in respect of agricultural crop output value which leads to low income level of farmers and low standard of living.

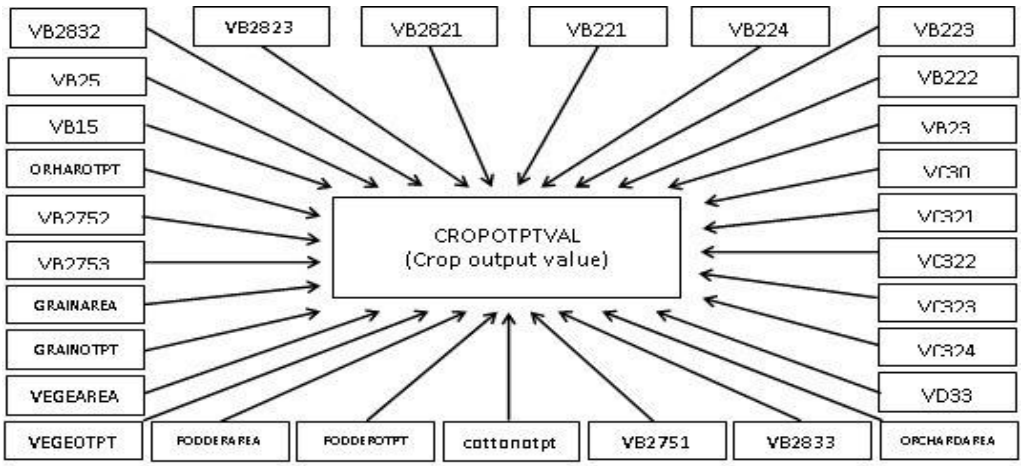

Figure 3. Crop output value construct with its directly observed variables

The Table 4 shows the standardized loadings or standardized regression weights of the crop output value construct. The results indicated that the incidence of natural disaster e.g. floods, landslides, avalanches, earthquakes and insect attacks posed immediate risk to food security in the farming community. Due to these natural disasters not only did farmers bear crop losses but also, some times, loose their houses especially during floods. The variable Cropotptval (crop output value) and variable VB25 (Natural disasters) were found negatively associated. The estimate of variable VB25 was -0.051 which was relatively large enough to substantiate the significance of incidence of natural disasters in the agricultural sector and its impact on food security and standard of living. The variable VD33 (Investment on agricultural land) had estimated value of 0.018 which proved that agricultural investment was positively associated with agricultural crop output. The use and ownership of tractor is usually used as proxy for farm mechanization in Pakistan. The variable VC30 represented ownership of tractor. The estimated value of 0.004 for this variable was surprisingly low which indicated not only low level of mechanization but also high prevalence of traditional agricultural farming practices. This is in line with modern agricultural practices where the crop output is usually found to be highly linked with farm mechanization.

The variables of 'fodderotpt' (Fodder productivity), 'vegeotpt' (Vegetable productivity) 'grainotpt' (Grain productivity) and 'cottonotpt' (Cotton productivity) had estimated values of 0.218, 0.255, 0.638 and 0.037 respectively. All these variables had positive relationship with crop output whereas the value of 0.638 for cereal grain productivity was highly significant in context of food security. Another important variable in the analysis was farm area. Agricultural farm area played an important role in crop output. In Pakistan most of farmers had small sized farms. According to hypothesis used in the instant study, the larger farm area results in more crop output and the same was supported by the estimated value of 0.292 for variable VB15 (Farm area).

The investigations of the factors which affect the food security are presented in the following Figure 4. It can be observed that the variable of food security (VF57) was directly affected by a total of 29 observed variables and 28 indirectly observed variables.

The Table 5 shows the standardized loadings or standardized regression weights of the food security construct. The results supported the research hypothesis that the improved crop product was associated with better food security situation. It can be observed that the variable VF592 (crop failure due to pest attack or plant disease) had negative relationship with food security. If farmers borne losses due to pest attack or plant disease then they became more food insecure due to decreased availability of agricultural production. The decreased crop production resulted in hike in food prices and added to food insecurity by decreasing less access to food items.

The model outputs showed some surprising facts as well. The estimated value of variable VF57 (food security) with respect to VF605 (extra work labor) was -0.136 which showed negative relationship between them and was relatively high as compared with other outputs. It meant that the people who were relatively food secure did not need to do extra work and the people who were less food secure used to opt for extra work as their mitigation strategy to deal with food insecurity. Similarly, the people who were relatively food insecure had to involve their children to meet labor requirements for better agricultural production which resulted in increased levels of existence of child labor in families which were less food secure. The estimated value for variable VF607 (Child labor) was -0.062 which had negative relationship with VF57(Food security).

The level of food consumption is an important aspect of food security situation of any country. In the current model, the variables of 'meat'(Consumption of meat), VF55 (Consumption of milk) and VF56 (Consumption of eggs)

Table 4. Standardized regression weights in AMOS output between the observed variables of the crop output value construct.

Sr. No.	Crop output value	Direct Affect	Observed variables	Estimated Value	Sr. No.	Crop output value	Direct Affect	Observed variables	Estimated Value
1.	Cropotptval	<---	VB2832	0.001	16.	Cropotptval	<---	orchardarea	0.112
2.	Cropotptval	<---	VB2823	0.011	17.	Cropotptval	<---	VB2833	0.327
3.	Cropotptval	<---	VB2821	0.151	18.	Cropotptval	<---	VB2751	0.027
4.	Cropotptval	<---	VB221	-0.050	19.	Cropotptval	<---	cottonotpt	0.037
5.	Cropotptval	<---	VB224	-0.068	20.	Cropotptval	<---	fodderotpt	0.218
6.	Cropotptval	<---	VB223	-0.006	21.	Cropotptval	<---	fodderarea	-0.066
7.	Cropotptval	<---	VB222	-0.018	22.	Cropotptval	<---	vegeotpt	0.255
8.	Cropotptval	<---	VB23	-0.024	23.	Cropotptval	<---	vegearea	-0.122
9.	Cropotptval	<---	VC30	0.004	24.	Cropotptval	<---	grainotpt	0.638
10.	Cropotptval	<---	VC321	0.042	25.	Cropotptval	<---	grainarea	-0.129
11.	Cropotptval	<---	VC322	0.008	26.	Cropotptval	<---	VB2753	0.010
12.	Cropotptval	<---	VC323	-0.008	27.	Cropotptval	<---	VB2752	-0.026
13.	Cropotptval	<---	VC324	0.001	28.	Cropotptval	<---	orchardotpt	-0.117
14.	Cropotptval	<---	VD33	0.018	29.	Cropotptval	<---	VB15	0.292
15.	Cropotptval	<---	VB25	-0.051					

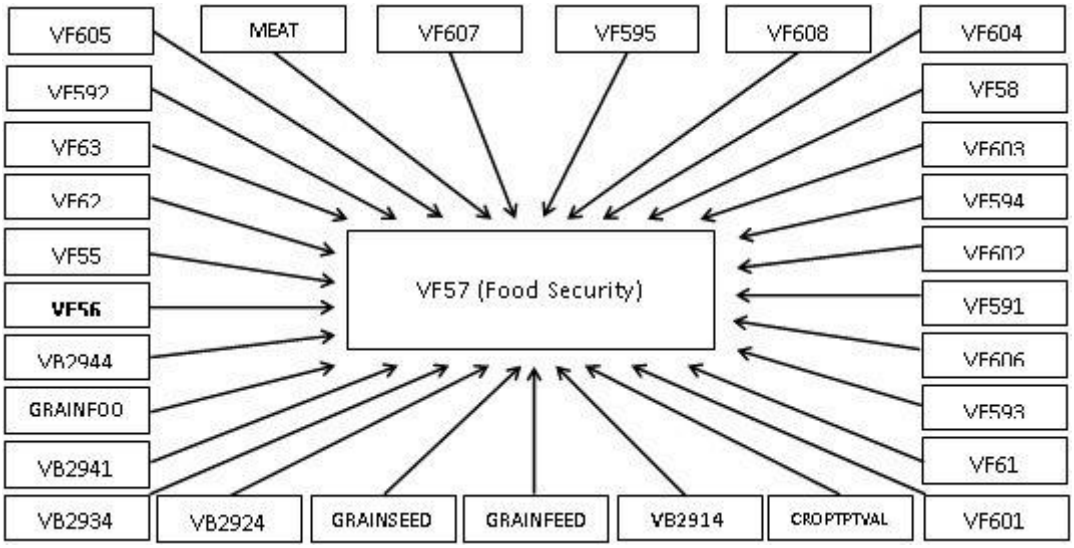

Figure 4. Food security construct with its directly observed variables

had estimated values of 0.021, 0.008, 0.012 respectively. These values were positive and were not relatively large enough to conclude that food security situation in Pakistan was very bad. The meat, milk and eggs were among basic human nutrition but people did not consume adequate level of such food. The low level of nutrition was already highlighted by various surveys conducted in Pakistan e.g. National Food Security Survey of Pakistan, 2011.

The relationship between standard of living and food security is explained with the help of following Figure 5. The standard of living (VA07) was the most important variable and associated with so many factors like income, food, education, health, transport, environment etc. It can be seen that the standard of living (VA07) was directly affected by a total of 28 observed variables directly and 29 observed variables indirectly. All the variables in model are of rectangular shape indicating that they were observed and measured variables.

Table 5. Standardized regression weights in AMOS output between the directly observed variables of the food security construct.

Sr. No.	Food Security	Direct Affect	Observed variables	Estimated Value	Sr. No.	Food Security	Direct Affect	Observed variables	Estimated Value
1.	VF57	<---	VF592	-0.012	16.	VF57	<---	cropotptval	-0.016
2.	VF57	<---	VF605	-0.136	17.	VF57	<---	VB2914	-0.017
3.	VF57	<---	VF607	-0.062	18.	VF57	<---	grainfeed	-0.003
4.	VF57	<---	VF595	-0.124	19.	VF57	<---	grainseed	0.037
5.	VF57	<---	VF608	0.003	20.	VF57	<---	VB2924	0.006
6.	VF57	<---	VF604	-0.107	21.	VF57	<---	VB2934	0.021
7.	VF57	<---	VF58	0.879	22.	VF57	<---	VB2941	-0.007
8.	VF57	<---	VF603	-0.052	23.	VF57	<---	grainfood	0.045
9.	VF57	<---	VF594	-0.053	24.	VF57	<---	VB2944	-0.007
10.	VF57	<---	VF602	-0.010	25.	VF57	<---	VF56	0.012
11.	VF57	<---	VF591	-0.041	26.	VF57	<---	VF55	0.008
12.	VF57	<---	VF606	-0.058	27.	VF57	<---	VF62	-0.041
13.	VF57	<---	VF593	-0.182	28.	VF57	<---	VF63	-0.039
14.	VF57	<---	VF61	-0.041	29.	VF57	<---	meat	0.021
15.	VF57	<---	VF601	-0.005	-	-	-	-	-

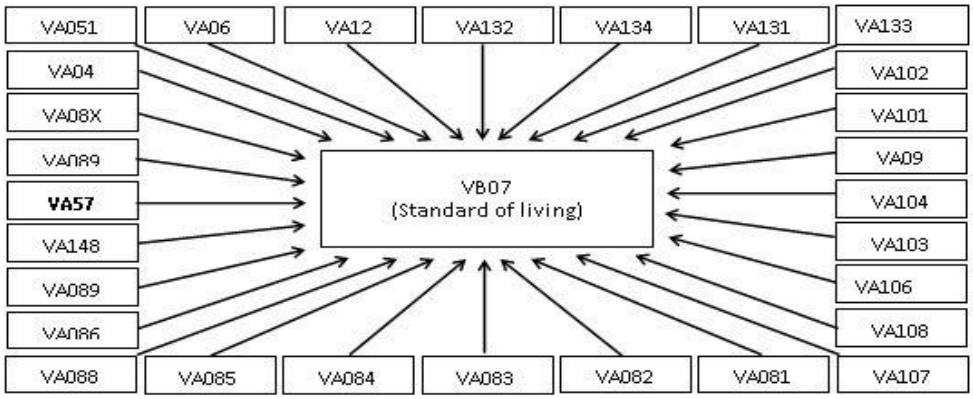

Figure 5. Standard of living construct with its directly observed variables.

The following Table 6 shows the standardized loadings or standardized regression weights in AMOS output between the different variables of the standard of living construct. The first observed variable in table was VA04 (Area of house). The estimated value for area of house was -0.121 which had negative relationship with standard of living. It was inferred that merely the area of the house was irrelevant or had least association with standard of living because most of the houses with large area might have bigger open yards as compared with houses with small area those were usually bricked and had more covered area. Usually, the houses with large area were those where livestock was reared within the house. In the instant survey, some questions about the assets farmers had in their houses were also asked like kitchen, bathroom, electricity, TV, bicycle, motorcycle etc. The people possessing these assets in their house had better standard of living.

The variable VA082 (Kitchen in house) had estimated value of 0.175 which presented positive relationship with level of living showing that the houses where kitchen was available had better standard of living as compared with those houses where cooking was done on open space. Similarly, in the instant analysis, the variables VA083, VA085, VA086, VA087, VA088 and VA08X represented toilet, electricity, TV, bicycle, motorcycle and mobile phone respectively. All these variables had positive relationship with standard of living.

The most important variable in this part of analysis was food security represented by variable VF57. The variable VF57 was endogenous variable and had an estimated value of 0.303 which supported the hypothesis that food security was associated with standard of living. In the survey, some questions related to fuel used for cooking in the house like natural gas, wood, animal drug, kerosene oil, etc were also asked. The variables of VA131, VA132, VA133 and VA134 represented natural

gas, wood, animal drug and kerosene oil respectively. The estimated value of variable VA131 was 0.165 and showed that people who had natural gas supply also had improved standard of living as compared with those who used wood or animal dung for cooking purpose.

Table 6. Standardized regression weights in AMOS output between the observed variables of the standards of living construct.

Sr. No.	Standard of living	Direct Affect	Observed variables	Estimated Value	Sr. No.	Standard of living	Direct Affect	Observed variables	Estimated Value
1.	VA07	<---	VA04	-0.121	15.	VA07	<---	VA148	-0.089
2.	VA07	<---	VA051	-0.134	16.	VA07	<---	VF57	0.303
3.	VA07	<---	VA06	0.148	17.	VA07	<---	VA107	0.113
4.	VA07	<---	VA12	-0.007	18.	VA07	<---	VA108	-0.046
5.	VA07	<---	VA132	0.103	19.	VA07	<---	VA081	0.146
6.	VA07	<---	VA134	0.089	20.	VA07	<---	VA082	0.175
7.	VA07	<---	VA131	0.165	21.	VA07	<---	VA083	0.097
8.	VA07	<---	VA133	0.066	22.	VA07	<---	VA084	0.035
9.	VA07	<---	VA102	-0.097	23.	VA07	<---	VA085	0.040
10.	VA07	<---	VA101	-0.001	24.	VA07	<---	VA088	0.066
11.	VA07	<---	VA09	-0.093	25.	VA07	<---	VA087	0.185
12.	VA07	<---	VA104	0.044	26.	VA07	<---	VA086	0.109
13.	VA07	<---	VA103	-0.015	27.	VA07	<---	VA089	-0.033
14.	VA07	<---	VA106	-0.015	28.	VA07	<---	VA08X	0.089

Conclusion: From the above discussion it can be concluded that the appropriate agricultural land use was very critical in the agricultural production. The farm size and land administration had significant relationship with agricultural crop output value and, subsequently, with food security. The land disputes and weak tenancy status of agricultural land adversely affected the food security situation. The natural disasters made the farmers vulnerable to food insecurity. It can be concluded that cereal grain productivity had strong positive relationship with food security. It was observed that farmers opted for extra work for mitigating food insecurity and resorted to engage their minor children as helping hands which resulted in issues of child labor in rural areas. Crop output was highly sensitive to insect attack and it was one of the major causes of crop failures. Nutritional deficiencies were indicated by the consumption level of rural poor. It was observed that there was severe need to improve the consumption level of meat, milk and eggs in the rural community. The household assets were found to be associated with standard of living and food security. Similarly, improved level of food security or specifically nutrition led towards better health and increased income i.e. improved standard of living. However, the area of house was irrelevant indicator because most of the houses with large area might have bigger open yards as compared with houses with small area which were usually bricked and had more covered area.

It is recommended that government may like to implement the secure land governance and tenancy system in the agricultural land. Rural community should be provided safeguards from natural disasters and crop failures due to pest attacks. With the help of pooling of agricultural land for appropriate farm size and improved farming methods, the agricultural output value can be increased. The less profitability of agricultural ventures for the farming community resulted in low standard of living and food nutrition. Government should launch such policies so that the income levels of the rural poor may be increased.

REFERENCES

Abdullah, M. H., A. Saboor, I. A. Baig and M. Arshad (2016). Climate change, risk and food security: an analysis of wheat crop in Pakistan. In. Climate Change Challenge (3C) and Social-Economic-Ecological Interface-Building. Springer, Cham, pp. 41-63.

Amjad, R. (2010). *Key challenges facing Pakistan agriculture: How best can policy makers respond: A Note*. Pakistan Institute of Development Economics (PIDE), Government of Pakistan, Islamabad.

Arshad, M., T. S. Amjath-Babu, T. J. Krupnik, S. Aravindakshan, A. Abbas, H. Kächele and K. Müller (2017). Climate variability and yield risk in South Asia's rice–wheat systems: emerging evidence from Pakistan. *Paddy and water environment*, Vol 15 No 2, pp. 249-261.

Bashir, M. K., and S. Schilizzi (2013). Determinants of rural household food security: a comparative analysis of African and Asian studies. J. The

Science of Food and Agriculture, 93(6):1251-1258.

Bollen, Kenneth A. and J. S. Long (1993). *Testing Structural Equation Models*. Newbury Park, CA, Sage Publications.

Cotula, L., C. Toulmin and J. Quan (2006). *Better land access for the rural poor: Lessons from experience and challenges ahead.* Int. Inst. for Env. and Dev. (IIED), FAO.

EIU (2016). *Global Food Security Index 2016: An Annual Measure of the State of Global Food Security.* A report from The Economist Intelligence Unit (EIU).

Heltberg, R. (1998). Rural market imperfections and the farm size— productivity relationship: Evidence from Pakistan. *World Development*, 26 No. 10, pp. 1807–1826. http://doi.org/10.1016/S0305-750X(98)00084-9

Garson, G.D. (2015). *Structural equation modeling*. North Carolina State University. Statistical Publishing Associates, USA. Available fromhttp://www.statisticalassociates.com/sem_p .pdf [Accessed 22 November 2018].

GoP (2004). *Land use atlas of Pakistan*, National Land Use Plan Project (NLUP), Ministry of Environment, Government of Pakistan, Islamabad. Available from http://202.83.164.29/moclc/userfiles1/file/Land_ Use_Atlas_of_Pakistan.pdf [Accessed 8 February 2019].

GoP (2009). *Task force on food security – Final report*, Ministry of Planning, Development and Reform, Government of Pakistan, Islamabad.

GoP (2010). *Agriculture Census of Pakistan 2010*, Pakistan Bureau of Statistics, Government of Pakistan, Islamabad. Available from http://www.pbs.gov.pk/content/agriculture-statistics-pakistan-2010-11 [Accessed 20 March 2019].

GoP (2011). *National Nutritional Survey of Pakistan 2011*, Nutrition Wing, Cabinet Division, Government of Pakistan

GoP (2015). *Agricultural Sectoral Plan – 2015,* Agriculture Department, Government of Punjab, Lahore. Available from https://agripunjab.punjab.gov.pk/system/files/Ag. Sectora l%20 plan %20 2015. pdf [Accessed 11 March 2019].

Grote, U. (2014). Can we improve global food security? A socio-economic and political perspective. *Food Security*, 6 No. 2, pp.187-200. DOI:10.1007/s12571-013-0321-5

IFPRI (2016). *2016 Global Hunger Index – Getting to zero hunger*, International Food Policy Research Institute (IFPRI).

Kline, R. B. (2010). *Principles and practice of structural equation modeling* (3rd ed.). New York, New York: Guilford Press.

Komarek, A. M., M. Spoor, S. Feng and X. Shi (2017). Income implications of political capital and agricultural land use in western China. *China Agricultural Economic Review*, *9* No. 1, pp. 93-110. https://doi.org/10.1108/CAER-03-2015-0030

Lichtenberg, E., and C. Ding (2006). Land use efficiency, food security, and farmland preservation in China. *Land Lines*, 18, pp. 2-7.

Lomax, R. G., and R. E. Schumacker (2012). *A beginner's guide to structural equation modeling*. New York, NY: Routledge Academic.

Malik, S. J., S. Ali, K. Riaz, E. Whitney, M. Malek and A. Waqas (2016). *Agriculture and the Rural Economy in Pakistan: Issues, Outlooks, and Policy Priorities*, University of Pennsylvania Press, Philadelphia.

NCCP (2012). *National Climate Change Policy 2012*, Ministry of Climate Change, Government of Pakistan, Islamabad. Available from http://nidm.edu.pk/Documents/Policies/National _Climate_Change_Policy_2012.pdf [Accessed 23 January 2019].

Paswan, A. (2009). *Confirmatory Factor Analysis and Structural Equations Modeling - An Introduction,* Department of Marketing and Logistics, COB, University of North Texas, USA.

Schermelleh-Engel, K., H. Moosbrugger and H. Müller (2003). *Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures*, Methods of Psychological Research Online, 8 No. 2, pp. 23-74

SDPI (2009). *Food insecurity in Pakistan*. Sustainable Policy Research Institute, Islamabad – Pakistan. Available from https://goo.gl/RkNGTG [Accessed 27 April 2018]

USAID (2010). *Property rights & resource governance, Country profile – Pakistan*, United States Agency for International Development (USAID). Available from https://www.land-links.org/wp-content/uploads/2016/09/USAID_Land_Tenure_ Pakistan_Profile_0.pdf [Accessed 9 January 2019].

Wang, J., K. Z. Chen, S. D. Gupta and Z. Huang (2015). Is small still beautiful? A comparative study of rice farm size and productivity in China and India. *China Agricultural Economic Review*, *7* No. 3, pp. 484-509. https://doi.org/ 10.1108/ CAER-01-2015-0005.