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RESEARCH ARTICLE

Modeling Land Utilization, Agricultural Transformation and Agrarian Labor in Pakistan

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Abstract

This study analyzes the interaction among land utilization, agricultural transformation and agrarian labor in Pakistan for the period 1991-2013. This study adopts VECM for the empirical analysis, which comprises ADF unit root test, Cointegration, error correction models, impulse response function and variance decomposition analysis. The study suggests that land utilization could be improved through the implementation of advance tools of agriculture, which obviously yields a high-level productivity. Contrary to this; the agricultural transformation holds negative effect on labor force engaged with this sector because the advancement in tools of production requires lesser manpower of labor.

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I. INTRODUCTION

Land is a finite and non-renewable resource of nature for any country; it cannot be extended to higher desirable level. Land is crucial for all developmental activities including natural resources, ecosystem services and agriculture (Nibanupudi and Shaw 2014). The growing population against limited given cultivable land imposes pressure on land resources and thus demands for more of higher cultivable land increases. This problem could be resolved if land is properly utilized. There is, however, a difference between the term “land use” and “land utilization”. The land use is referred to opportunity cost; implying the best available use of land, in the other words land use is related to optimum use of limited land; for example, agricultural land, irrigated land, forest land etc. while land utilization term can be used in terms of efficiency. According to Buck (1937) “Land utilization is the satisfaction, which the farm population derives from the type of agriculture developed, the provision of future production and the contribution to the national needs. A serious problem that world is facing at present, is the deterioration of both the natural environment and natural resources (Najfi, 2000)

Historically, agriculture has played key role in enhancing the growth in developing countries where major segment of population is dwelling in rural areas. Traditionally, basic function of the agriculture is provision of raw material and cheaper manpower to the industry (Todaro and Smith, 2003; and Liwes, 1954) but currently the role of this sector extend in new dimensions (Marsden et al 1993, Countryside Council, 1997; Ploeg and Frous, 1999). Growth of agriculture sector, particularly in labor abundant developing countries, mainly hinges on the land utilization. However, in recent decades the policies related to land use and land utilization have not been aimed at employment of resources that are socially and economically efficient. In fact the agrarian economies will work like an engine to enhance growth in the framework of export promotion incentives for agricultural items. Besides the significant importance of agriculture, it also faces severe major challenges, notably the deterioration of agricultural and natural

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resources especially overexploitation of renewable resources such as fisheries and forests, and degradation of basic resources like land and water (Najafi, 2003). Along with the land degradation, most of the cultivable land is still uncultivable, mainly, due to unavailability of water, proper harvesting and lack of other agriculture resources. The efficient utilization of uncultivated land is the need of the hour, which not only boosts up productivity of agriculture but also provides bases for economic development and opens new avenues for employment.

The notion of land-use planning has agronomic, social, economic and political dimensions and deals with the multipurpose use of land (Sharifi, 2003) and represents tradeoff between different functions of the land; due to the diverse nature of soil and thus it holds multiple objectives and endeavors complex process. Contrarily, the concept of land utilization is more specific than land-use, and is characterized by key attributes like biological, socio-economic and technical aspects of land-use which are relevant to the functioning of the land utilization type. For example crop selection, availability of farm power, implementation of labor and capital in farmland (Driessen and Konijn, 1992). Holding the large farms by small number of people is a major problem in Asia and Latin American countries therefore land reform incentives are desirable, which, will uplift the economic condition and income level of people. The agriculture output of developing countries is less by three times than the developed economies, which reflects the low level of labor productivity and less-sophisticated traditional methods of cultivation, hence, low level of living standards in rural areas.

Agricultural mechanization is one of the important factors that revive the land utilization by increasing production and agricultural incomes. However, several studies have revealed that mechanization of certain operations have caused replacement or displacement of labor, particularly in labor abundant countries; where labor intensive techniques are prevalent in farms. The expectation that labor released from agriculture could be absorbed in industry has not been realized in the East Asian countries (Pasha, 2007). Contrarily, China experienced big boost in agricultural production and went on to maintain high levels of overall GDP growth because of the linkages between agricultural growth and off-farm employment in village enterprises. The kind of agricultural transformation China had allowed is to achieve double digit growth for long time period. Learning from China's experience, government policies should aim not only at agricultural transformation and mechanization of farm operations but equally important is to entrench policies to absorb ousted labor in industry or other relatively high productive occupations. Besides the technological improvement, the high skill labor is also a major prerequisite for the optimal utilization of the available resources. Since the labor in developing countries is less potent mainly due to inadequate training and knowledge, therefore, proper knowledge of agricultural sciences is desperately needed. Land utilization as well as agricultural mechanization depends on many factors: including land properties like soil depth, soil texture, slope, and size of fields, water rights, seasonal water supply and distribution system. However, some of the characteristics are unchangeable for instance: salinity, depth to groundwater whereas the microfinance relief and some other social and economic conditions are changeable and can increase the land utilization by affecting agricultural mechanization. Agriculture is the backbone of an economy, provides raw material to the industrial sector. Agriculture is the main stream to uplift the rural life and to elevate poverty in fact the direct attack on rural poverty through accelerating agricultural development is necessary to raise the living standards (Todaro and Smith, 2003).

Since land utilization and agricultural transformation both increase productivity of agriculture sector, but has dual effect for the agrarians and labors; if the land utilization in terms of cultivable land increases, it means higher labor force will be required for farming and hence it increases the employment opportunities for labor, however on the other side, agricultural mechanization reduces the quantity of labor engaged in farming implying reduction in the employment opportunities for the agrarian labor.

Due to this dichotomous behavior of Land utilization and Agricultural Transformation towards agrarian labor, this paper primarily examines their impact on the agrarian labor in case of Pakistan. While at secondary level, this paper shows the impact of agricultural transformation on land utilization in the case of Pakistan.

II. Theoretical Framework:

Generally, scatter of villages and fragmented small-sized farmlands are the main impediment to agriculture development by threatening the mechanization process. It can be optimized through proper policy regarding the land use. This will work under farm mechanization, which is considered as sine-qua-non to reduce the human drudgery and enhance the agricultural productivity (Verma, 2008). It is a common perception in economics and other product

sciences that capital abundant industries require less labor, implying negative relationship between capital abundant and labor abundant industries (Rahman et al. 2011; Verma, 2008; McCauley, 2003). Agricultural mechanization reduces labor demand in fields, which, added to the existing unemployment in the economy especially in developing countries, however, mechanization on the other hand boosts up productivity (Aurangzeb et al. 2007). Indeed, mechanization opened up new avenues for human employment such as managerial and supervisory jobs on the one hand and driving, servicing, maintenance and repair of the machines on the other. (Verma, 2008). However, this will only engage a fraction of agrarian unemployed labor force and remaining unemployed labor force will divert to other sector including business sector (self employment), private sector and in extreme case² the labor force may migrate to the urban areas. It is worth mentioning that land utilization on one hand provides opportunities of employment in agriculture sector while on other hand agriculture transformation (mechanization) causes to lower the employment opportunity.

III. Review of Literature

Land utilization phenomena has been interacted with different variables by Willardson (2000), Li et al. (1998), Rosegram et al. (1999), Murray, C. H., (1993) and Doos and Shaw (1999). However this study analysis the case of Pakistan therefore few of selected studies are explained here.

Jahangir and Sampath (1991) examined the land use and its efficiency for the Pakistan and they found land utilization increase the efficiency of land, and farm size in terms of linear aggregation irrigated and unirrigated land lead to misspecification bias, therefore it is necessary to distinguish irrigated and unirrigated land while analyzing the data. Indeed irrigation is main component of land utilization.

Chaudhary (1986) showed the impact of mechanization on agriculture development. The technological improvement brings increase in output he proved this case of agricultural mechanization and suggests that mechanization of farm would obviously lead to higher agricultural productivity in Pakistan.

Hooke et al.(2012) analyze the land transformation by human, the human population has doubled in the past 40 years. The growing population has quickened the pace of land transformation and degradation. The current land of agriculture is unsustainable and there is need a proper policy to conserve the land resources against the high population.

Khan et al.(2011) studied the technological improvement and performance of agriculture in Pakistan for the period 1948 to 2008. Their findings shows that land reforms in past did not bring significant improvement in agriculture productivity. Contrary to this, technological improvement and mechanization bring significant improvement in agriculture productivity.

Kurosaki (2007) evaluated the Changes in land use and agricultural productivity for India, Pakistan, and Bangladesh. His study suggests that crop shift increase the productivity, which was not highlighted in past studies. In all the three countries the aggregate agricultural productivity pay an important role in economic growth of these economies.

IV. Land Utilization and Agricultural Transformation in Pakistan

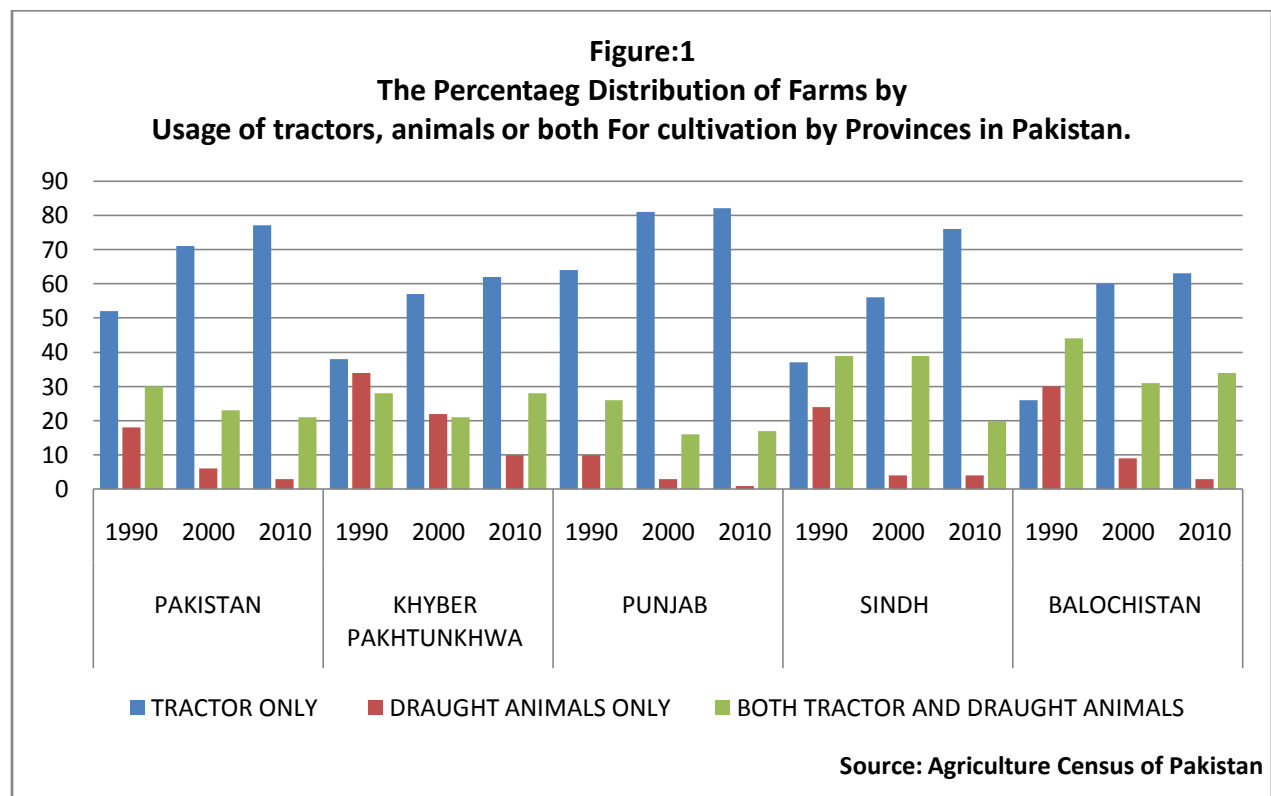
Land reformation is the part of poverty elevation program, first significant attempt at redistributive land reforms in Pakistan was undertaken by the military regime in 1959 (Gazdar, 2009) followed by democratic government in 1972 and 1977 respectively. Irrigation is a main channel for agricultural development, which is closely associated with per acre yield. A target of high growth per acre can be achieved with a sufficient availability of water especially to

² This will only happen when business sector is much weaker that could not absorb the remaining unemployed labor force.

boost up exportable items which certainly raises the income level of rural famers. The availability of water to *Kharif*³ crop in Pakistan⁴ has remained 20 percent less than normal supply, likewise 5 percent less for *Rabi* crop.

Since Pakistan faces inadequate farm power, as the number of tractors in operation is around 464,000, and per hectare horse power (hp) availability of 0.90 against the required power of 1.4 hp per hectare. However major hurdle in machination is the availability of capital to the rural farmer, the credit availability in soft terms and at low interest rate will obviously make easy access to the capital. Agricultural Credit Advisor Committee (ACAC) of Pakistan has allocated agriculture credit disbursement target of Rs.270 billion for 2010-11 (PEC, 2011) and it disbursed Rs. 168.7 billion, a 65 percent of the target.

Agriculture besides the traditional function in modern era provides food items which are exported. As agriculture has large share in exportable commodity; like cotton manufactures and rice remained the major component of exports as it is 53 and 8 percent in 2011 respectively. In Pakistan's case, though, share of public expenditures has not always been significant in agriculture sector compared to industry, still the farming techniques have changed over the years. To handle the trend in mechanization that took place in Pakistan, Figure 1 shows the percentage distribution of farms by use of tractors, animals and both. Over the years, use of tractors has increased replacing animals. In 2010 around 77% farmers used only tractors in Pakistan, while Punjab has the highest percentage of tractors usage (82%) and the use of animals is nearly non-existent. The farms using both tractors and animals have also decreased over the years.



³ There are two major crop season in Pakistan namely *Kharif* and *Rabi*, sowing season for which begins in April-June and October-December respectively.

⁴ Fiscal Year 2010-11

Economies of scale have always existed in agriculture as the larger the farm/land area lower the unit cost of production. Large farms holdings also increase the possibility of agricultural mechanization. Nonetheless, the extensive use of tractors, tube wells, threshers and other machinery related to different farm operations is not limited to large farm size. Small and medium sized farmers are also using mechanized farming which is mainly based on rented machinery. Figure 2 indicates the distribution of rented agricultural machinery. The highest percentage of renting in phenomena is experienced in case of tractors and threshers. The existence of market for agricultural machinery has also altered the land utilization in rural areas where the rented machinery is not only provided by the contractors but also by the large farmers that have enough resources to own high-tech machinery.

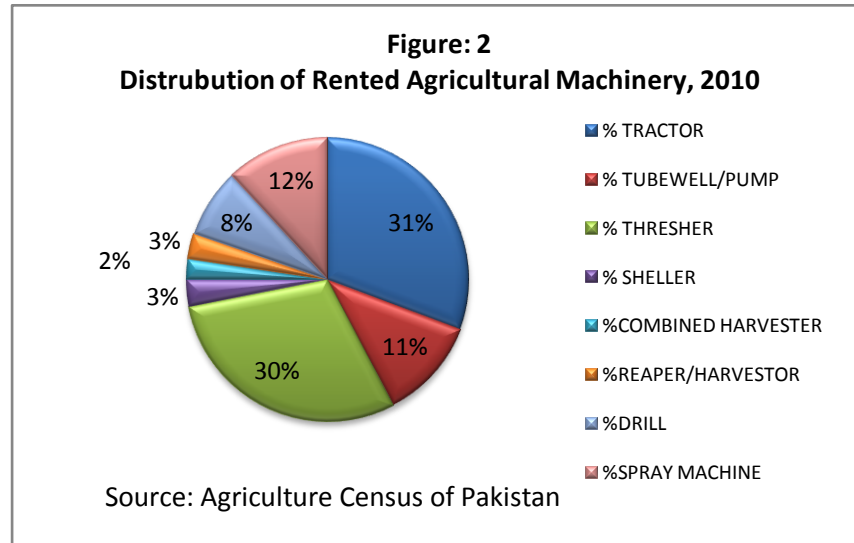
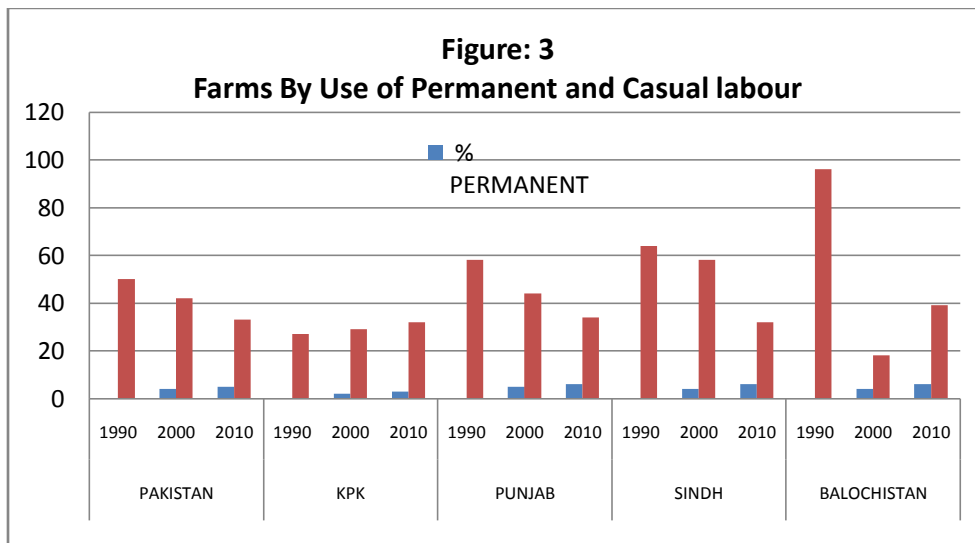


Figure 3 highlights an important feature of rural labor markets in Pakistan indicating that a large portion of rural laborers have to work in casual or seasonal environment. The absence of feature of permanent employment means that rural laborers are prone to only the seasonal yet also other factors affecting the land use and land utilization. Below figure also indicates that the percentage of permanent labor has slightly increased whereas casual labor has decreased across all the provinces of Pakistan.



The agricultural mechanization is associated with increased land productivity, decreased cost of production and increased labor productivity. In labor abundant economies, particularly where major portion of population is

dependent on agriculture, the displacement of labor into less productive sector like informal services industry must be avoided.

V. Analytical Background

Analytical framework will describe that how land utilization can affect agriculture production

$$Y = f(A(Ln, K)) \dots (1)$$

Where Y shows agricultural production employing two inputs, the labor (Ln) and Capital (K); A is the technology that remains constant and assumed to equal 1.

For maximum production there are two conditions in general derivatives

First order condition (FOC)

$$Y' = 0$$

Second order condition (SOC)

$$Y'' > 0$$

Since land is given resources and it cannot be extended therefor one can maximize the production function

$$\text{Max } Y(Ln, K)$$

$$\text{Subject to Land is constraint as } L = LUI(Ln + K)$$

Whereas L is land and LUI shows instruments of land utilization. This can solve through Lagrang Multiplier as

Where A shows technology is assumed to be fixed, and equal to 1, L is land and LUI shows instruments of land utilization.

Now solving through lagrangian multiplier

$$\ell = Y(Ln, K) - \lambda(L - LUI(Ln + K)) \dots (3)$$

Now taking partial derivative with respect to Ln, K and λ and setting equal to zero

$$\frac{\partial \ell}{\partial Ln} = -\lambda LUI$$

$$\frac{\partial \ell}{\partial K} = -\lambda LUI$$

$$\frac{\partial \ell}{\partial \lambda} = L - LUI(Ln + K)$$

VI. Research Methodology:

Indices

This study primarily concerns with dynamics interaction between land utilization, agricultural transformation and employed labor force in agriculture sector in Pakistan. Data for the variable, agrarian labor is available directly while for agricultural transformation and land utilization this study undertakes to use an index for agricultural transformation and land-utilization and later implement the time series tool for estimation. Following Irfan-Ullah (2013) methodology for agricultural transformation index (ATI) based on initial mechanism of Human Development Index (HDI) as:

$$ATI(vi) = \sum_{k=1}^n \frac{1}{n} \left(\frac{Xi - \min(Xi)}{\max(Xi) - \min(Xi)} \right)$$

Where ATI is agricultural transformation index, Xi the components of ATI including agricultural mechanization, credit disbursement to agriculture sector and education level of farmer etc. ATI is a unit-free index and its value lies between 0 and 1. Following model is used for empirical assessment:

While land utilization index (LUI) is constructed as;

$$LUI = \frac{TCA - TANC}{TA}$$

Where TCA indicates total cultivated area, TANC indicates total non-cultivated Area, TA is total area.

Model

$$LUI = f(ATI, L)Ut \dots\dots\dots(1)$$

Where

LUI = land utilization,

ATI = Agricultural Transformation index

L = labor force employed in agriculture sector

Ut = error term and

The expected sign of all relevant variables are positive showing positive association with dependent variable.

Unit root analysis and cointegration will be applied before VECM; this study has also been incorporating Johansen (1995) technique of maximum likelihood method for Cointegration, while ADF unit root test is used for the unit root analysis. The time series annual data is used for empirical estimation covering the period 1991-2013. The conventional OLS technique fails due to the spurious results while using long period time series data. Therefore, in order to avert this problem, we use other techniques like Cointegration and Error Correction models or Vector error correction models for multiple vectors. The same order of integration is the primary condition both in Engle and Granger and Johansen approach. Dickey-Fuller –DF (1978) or Augment Ducky-Fuller –ADF (1981) test are the main techniques exercised for unit root testing. ADF test is the extension of DF test, by including the augmentation to the equations of DF test. Thus the ADF unit root equation becomes as

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \sum_{i=1}^m \alpha \Delta Y_{t-1} + \epsilon_t$$

In the above equation δ is used for the testing hypothesis, which is testing through the tau (τ) statistics or Mackinnon (1999) critical value. If the value of δ exceeds the critical value of τ , one can reject the null hypothesis that Y is non-stationary and vice-versa. Cointegration test is applied for the long run relationship between the variables. There are two main techniques that are commonly used to test the cointegration: one is Johansen approach while the other is Engel and Granger approach. However, Johansen technique is preferred over Engel and Granger due the several desirable features, notably: the identification of number of cointegration vector. Unlike Engle and Granger technique, the Johansen approach provides sufficient information regarding the number of cointegrating vectors in the system. Therefore, this study uses Cointegration test suggested by Johansen (1995), which is based on Maximum Likelihood procedure of estimation and it has two statistics: one is maximal Eigen value while other is Trace statistics. Since cointegration is performed in Vector Autogressive (VAR) scheme, therefore, optimal lag length will be selected through Akaike, Schwartz and Bayesian Criteria. Cointegration covers only the long run phenomena, yet, there might be short run deviation from the long run equilibrium in the system which can be measured by error correction modeling. If the error correction model is used for the multivariate vector, it becomes *Vector Error Correction Model* (VECM). VECM estimation provides information on causal relationship among variables in the system. The VECM model for this study will become as;

$$\Delta LU_t = \beta_0 + \sum_{i=0}^n \beta_{1i} \Delta ATI_{t-i} + \sum_{i=0}^n \beta_{2i} \Delta L_{t-i} + \gamma_1 ECT_{t-1} \dots(2)$$

$$\Delta ATI_t = \beta_0 + \sum_{i=0}^n \beta_{1i} \Delta LUI_{t-i} + \sum_{i=0}^n \beta_{2i} \Delta L_{t-i} + \gamma_1 ECT_{t-1} \dots(3)$$

$$\Delta L_t = \beta_0 + \sum_{i=0}^n \beta_{1i} \Delta ATI_{t-i} + \sum_{i=0}^n \beta_{2i} \Delta LUI_{t-i} + \gamma_1 ECT_{t-1} \dots(4)$$

The VECM estimation is used for the causality analysis; the short run causality is estimated through imposing restrictions in Wald test on the parameters (β_{1i}) of each equation. Wald test offers Chi-Square statistics, which is used for the testing of hypothesis for the short run causality. The error correction term (ECT_{t-1}) of each vector is used for the long run causality; if its coefficient sign becomes negative and significant, it implies that it has long run causality.

The causality estimation doesn't provide information regarding the magnitude and direction of causations, so impulse response function and variance decomposition analyses are applied in order to find information about magnitude and direction of the causation. The data for the variables are obtained from Pakistan Economic Survey various issues.

VII. Empirical Findings

Table -1 ADF unit root

Variable	level	First Difference	Conclusions	Order of Integration
LUI	1.46714 (-3.00486)	-4.72870 (-3.02068)	Non-Stationary at level Stationary at 1 st difference	I(1)
ATI	-0.33144 (-3.01236)	-3.28288 (-3.01236)	Non-Stationary at level Stationary at 1 st difference	I(1)
L	2.12774 (-3.00486)	3.63780 (-3.01236)	Non-Stationary at level Stationary at 1 st difference	I(1)

* Parenthesis shows critical value at 5 percent level

The ADF test shows that all variables are non-stationary at level yet become stationary at first difference. This implies that all variables have order of integration -1 (I(1)) or the same order of integration. Since all variables have same order of integration, it can further be amenable for cointegration analyses. The next table shows Johansen cointegration estimations

Table -2 Cointegration estimation

Trend assumption: Linear deterministic trend

Series: ATI L LUI

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.647694	34.17632	29.79707	0.0147
At most 1	0.432564	12.26798	15.49471	0.1445
At most 2	0.017409	0.368809	3.841466	0.5437

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.647694	21.90834	21.13162	0.0388
At most 1	0.432564	11.89917	14.26460	0.1145
At most 2	0.017409	0.368809	3.841466	0.5437

* denotes rejection of the hypothesis at the 0.05 level
 **MacKinnon-Haug-Michelis (1999) p-values

Both the trace statistic and maximal Eigen value show the presence of one cointegrating vector; the existence of cointegration vectors implies that LUI, L and ATI have long run relationship. The existence of cointegration is also a primary requirement for VECM, which is fulfilled now; therefore, the study proceeds to VECM.

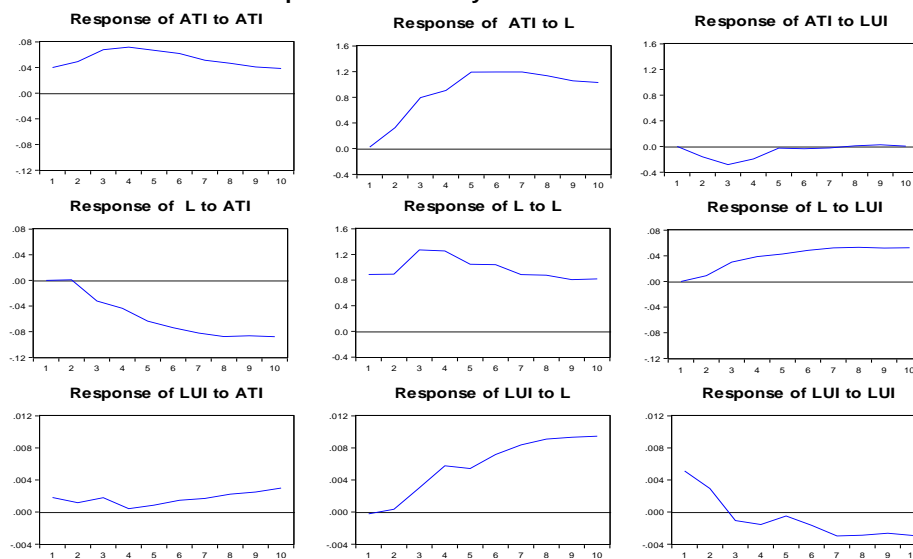
Table -3 VECM estimations

Variables	List of Independent Variable	ECT ₍₋₁₎	Chi -squ
ΔLUI	$0.00242 - 0.02207\Delta ATI_{(-1)} - 0.00013.\Delta L_{(-1)}$	-0.511895 (-2.36845)	12.8663 (0.100)
ΔATI	$0.02375 + -3.86284\Delta LUI_{t-1} + 0.01739\Delta L_{t-1}$	-5.938073 (-3.56557)	7.2543 (0.0237)
ΔL	$0.44963 + 1.022321\Delta LUI_{t-1} + 8.754465\Delta ATI_{(-1)}$	-9.17784 (-2.74932)	6.15905 (0.03817)

The VECM findings are here which show the short run and long run causation in the system. The first vector in which LUI is dependent variable and ATI and L are independent variables show that its error term is negative and significant, while its Chi-square estimates are also found significant implying both short run and long run causality from L and ATI to LUI. The second vector in which ATI is dependent variable, while LUI and L is independent variable also indicates that its error correction term (ECT_{t-1}) and its Chi-square are significant also indicates both long run and short causality and imply that LUI and L both causing ATI. The last vector comprises L as dependent variable while LUI and ATI are independent variables show that both significant ECT and Chi-square estimation indicating that LUI and ATI both are causing L in short run and long run. VECM estimations only provide the causal relationship among the variables; it does not provide information regarding magnitude and direction. Thus impulse response function IRF and variance decomposition analysis VDA is applied. The subsequent graph shows the outcomes of impulse response function.

Impulse Response Function

Response to Cholesky One S.D. Innovations



The impulse response function is applied to determine the causal relationship of the variables; the land utilization (LU) has positive response to both of the labor (L) and agricultural transformation (ATI). Whereas, labor (L) has negative response to agricultural transformation, yet land utilization (LU) has positive association with L.

Table -4 Variance Decomposition Analysis

Variance Decomposition of ATI:				
Period	S.E.	ATI	L	LUI
1	0.039909	100.0000	0.000000	0.000000
2	0.063951	97.98251	0.024270	1.993222
3	0.103082	80.91567	9.702373	9.381959
4	0.138462	71.74763	15.27124	12.98113
5	0.171742	61.78892	23.58325	14.62783
6	0.202716	53.62608	30.14220	16.23172
7	0.230612	46.38164	35.93134	17.68702
8	0.256589	40.75760	40.64824	18.59416
9	0.278700	36.69476	44.06553	19.23970
10	0.299382	33.45528	46.79860	19.74612

Variance Decomposition of L:				
Period	S.E.	ATI	L	LUI
1	0.888167	0.068969	99.93103	0.000000
2	1.310763	6.279023	92.21647	1.504506
3	2.011482	18.25520	79.12224	2.622556
4	2.545333	24.10651	73.67837	2.215121
5	2.999497	33.14523	65.25294	1.601831
6	3.392030	38.30019	60.43613	1.263673
7	3.703407	42.52111	56.41496	1.063939
8	3.971143	45.14322	53.93066	0.926121
9	4.187869	46.94696	52.21615	0.836889
10	4.389541	48.23272	51.00534	0.761939

Variance Decomposition of LUI:				
Period	S.E.	ATI	L	LUI
1	0.005435	11.05860	0.166285	88.77512
2	0.006292	11.71148	0.418843	87.86967
3	0.007286	14.74624	17.56508	67.68868
4	0.009432	8.998377	47.86449	43.13713
5	0.010929	7.331713	60.34631	32.32198
6	0.013260	6.210218	70.29349	23.49629
7	0.016051	5.347561	75.16796	19.48448
8	0.018809	5.295371	78.15949	16.54514
9	0.021303	5.502766	80.06331	14.43392
10	0.023684	6.038743	80.75652	13.20474

The final part of this table shows the variance decomposition for LUI, and its findings show that Labor is the major factor responsible for variation in LUI, while agricultural transformation is the second major factor. The variance decomposition of L shows that ATI is the most affecting factors to L.

To summarize the empirical finding of this study, it has been observed that agricultural transformation is the basic element for the land utilization, but on the other hand, agricultural transformation harms agrarian labor due to substitution effect as high level mechanization needs less labor in the field and thus has negative implication.

VIII. Conclusions

Agriculture is the main component of economic growth in the labor abundant developing countries. Traditionally, agriculture performed the role of provider of raw material and cheaper labor to the industrial sector. However, in the current scenario, its role has been changed into new dimensions: the repaid population and exports of agricultural product increase the demand for the agricultural productivity. Since land is a fixed component of productivity and cannot be expanded to desirable level; therefore, its optimum utilization is the Hobson's choice to increase the productivity. Agricultural transformation is the major element for the land utilization and higher productivity; it can be achieved if more modernized mechanisms and tools of harvesting are applied. The large portion of rural labors are engaged with agriculture; the agriculture transformation, on one hand, increases the productivity of agriculture while on the other hand it substitutes labor with machines, hence, reduces the labor engaged with agriculture. This study primarily examines the relationship among land utilization (LU), agricultural transformation (ATI), and agrarian labor in Pakistan for the period 1991 to 2013.

Pakistan is an agrarian economy and 42 percent of its labor is engaged with agriculture sector, the

The paper adopts vector error correction modeling approach for the empirical estimations. This study innovates the land utilization index (LUI), and also uses the agricultural transformation index (ATI) (Irfan-Ullah, 2013) and agrarian labor variables in the system. VECM involves ADF unit root, cointegration and error correction models, impulse response function and variance decomposition analysis. The empirical findings show that all variables have same order of integration. The cointegration results indicate the existence of one cointegrating vector in the system, which depicts that all variables LUI, ATI and L have significant long run relationship. The vector error correction model is applied to know the interactive effect between the variables. The VECM findings show that all variables in the system are causing each other. This proved that labor and agricultural transformation are causing Land utilization. Similarly, land utilization and agricultural transformation are causing agrarian labor. The impulse response function shows the direction of this causation that both the agricultural transformation and agrarian labor has positive cause on land utilization; while labor is negatively caused by the agricultural transformation and positively caused by land utilization. Variance decomposition also indicates that labor is major factor for LUI. Congruently, agricultural transformation is most affecting factor for labor. To summarize the empirical findings of this paper, it indicates that labor and agricultural transformation increase the land utilization while agricultural transformation reduces the labor engaged to the agriculture sector due the substitution affect.

Therefore, this study recommends that agricultural transformation is primary element for optimum land utilization; therefore, government should take serious steps for the agricultural transformation including loan disbursement for agricultural mechanization and provide subsidies on the agricultural equipment. Since mechanization of agriculture has substitution effect for agrarian labor, therefore, government should also take steps to provide substitute opportunities of employment to absorb the agrarian labors in other sector through different projects.

References

- Aurangzeb, M. Nigar, S., and Khan, M., (2007) Labour Requirements Model For The Wheat Crop Under Mechanized and traditional Farming Systems In The NWFP: A Case Study Of Peshawar District, *Sarhad Journal of Agriculture* . 23,(1), pp.177-186.
- Buck (1937), Land utilization in China: A Study of 16786 Farmers in 168 Localities and 38256 Farm Families in Twenty Two Provinces in China, 1929-1933. Vol.1, Shanghai: University of Nanking.
- Chaudhry, M.G (1986), Mechanization and Agricultural Development, *Pakistan Development Review* , Vol-25 (4).
- Countryside Council, 1997, (raad voor het, Landiljk Gebied (1997) Points for Future; Advice on the policy Agenda for the rural area in twenty-first century, publication 97/2a.
- Dickey, D.A and Fuller, W.A. (1979) Distribution of Estimator for Autoregressive Time Series With a Unit Root. *Journal of the American Statistical Association*, Vol. 74, pp. 427-431.
- Dickey, D.A and Fuller, W.A. (1981) Likelihood Ratio Statistics For Autoregressive Time Series With a Unit Root. *Econometric Review*, Vol. 15, pp. 369-386.

- Doos, B.R., and Shaw, R., (1999) Can we predict the future food production? A sensitivity analysis: Global Environmental Change, vol. 9.
- Driessen, P.M., and Konijn, N.T. (1992) Land-Use Systems Analysis, ISRIC Library Wageningen University, Netherlands.
- Engle F.R. and Granger W.C 1987 “Cointegration and Error Correction: Representation, Estimation and Testing”, *Econometrica*, vol 55, pp. 251-27.
- Hooke, L.R. Martin-Duqune, J.F, and Pedraza (2012), Land Transformation by Human:A review, *Geological Society America (GSA) Today*, Vol.22 (12).
- Gazdar, H. (2009), *The Fourth Round, And Why They Fight On: An Essay on the History of Land and Reform in Pakistan*, PANOS South Asia Conference paper.
- Gigg, D. (1987) The Industrial Revolution and Land Transformation, Land Transformation in Agriculture, Vol.1.
- Khan, M.M. , Zhang, J. Hashmi, M.S (2011) Land Distribution, Technological Changes and Productivity Inpakistan’s Agriculture: Some Explanations and Policy Options, *International Journal Of Economics And Management Sciences*, Vol-1 (1).
- Irfan-Ullah (2013) Agriculture Transformation and rural Development in Pakistan: A Time Series Analysis, *Spanish Journal of Rural Development*, Vol.4(3).
- Johansen, S.(1995), Likelihood-based Inference in Cointegration Vector Autoregressive Models, Oxford University Press.
- Lewis, W. A (1954), “ Economic Development With Unlimited Supplies Of Labour,” Manchester School; Development Of The Labour Surplus Economy ; Theory And Policy , Homewood , III; Irviwn
- Li, G., S. Rozelle and L. Brandt. ((1998) “Tenure, Land Rights, and Farmer Investment Incentives in China.” *Agricultural Economics*, Vol.19
- Marsden, T., Murdoch, J., Lowe, P., Munton, R. and Flynn, A. (1993), *Constructing the Countryside*, UCL, press London.
- Mackinnon, J. G., Alfred A. H., and Michelis, L. (1999). Numerical Distribution Functions: Likelihood Ratio Tests For Cointegration. *Journal of Applied Econometrics*, 14, pp. 563-577.
- McCauley J.F., (2003) Plowing Ahead: The Effects Of Agricultural Mechanization On Land Tenure In Burkina Faso, *Journal of Public and International Affairs*, Volume 14.
- Murray, C. H., (1993) Foreword in “Guidelines for Land-use Planning”, papers of interdepartmental group on Land-use Planning, FAO, Rome, Italy.
- Najafi, B. (2003), *An Overview of Current Land Utilization Systems and Their Contribution toAgricultural Productivity*, Resource Paper APO Seminar on Impact of Land Utilization Systems on Agricultural Productivity, Iran.
- Nibanupudi, H.K, and Shaw, R. (2015), *Mountain Hazards and Disaster Risk Reduction*, Springer Publisher, Japan.
- Najaf, A. (2000) *Land Consolidation As A Movement Toward Agricultural Productivity Promotion: Experience Of The Islamic Republic Of Iran*, Resources paper, APO Seminar on Impact of Land Utilization Systems on Agricultural Productivity, Iran.
- Pakistan Economic Survey (PEC). (2011)., Government of Pakistan Economic Advisor Wing, Finance Division, Islamabad.
- Ploeg, V.D and Frous, J. (1999) On Power And Weakness Capacity And Impotence; Rigidity And Flexibility In Food Chain, *International Planning Studies*, Vol-4(3).
- Rahman, M. S., Monayem M. S., Moniruzzaman And Hossain S., (2011) Impact Of Farm Mechanization On Labour Use For Wheat Cultivation, In Northern Bangladeshthe, *Journal Of Animal & Plant Sciences*, 21(3), pp: 589-594.
- Rosegramt, M. W., C. Ringler and V. Roberta, (1999) Water and Land Resources and Global Food Supply”, proceedings of 23rd International Conference of Agricultural Economists, Ashgate, U.S.A.
- Sharifi, M. A. (2003) *Planning Support Systems to Enhance Sustainable Land Utilization*, Resources paper, APO Seminar on Impact of Land Utilization Systems on Agricultural Productivity, Iran.
- Todaro M.P. and Smith S.C. (2003), Economic Development, Eighth Edition, Pearson Education Ltd, Essex, UK.

Jahangir, W. A. and Sampath, R.K. (1991), Farm Size and Land Use Efficiency in Pakistan Agriculture, *Pakistan Development Review*, Vol-30 (3).

Verma, S.R., (2008) Impact of Agricultural Mechanization on Production, Productivity, Cropping Intensity Income Generation and Employment of Labour, Punjab Agricultural University, Ludhiana. pp 133-153.

Willardson, L.S (2000)An Analysis Of The Issues And Problems In Improving Land Utilization Systems For Sustainable Agricultural Production, Resource paper, APO Seminar on Impact of Land Utilization Systems on Agricultural Productivity, Iran.