Climate change management, data sharing and government policies for sustainable agriculture to eradicate poverty

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This paper aims to propose the role of climate change management, data sharing, and government policies for sustainable agriculture in rural areas of Pakistan to eradicate poverty and the role of trade restrictions has also been discussed. The level of output and contribution to the Gross Domestic Product from the agriculture sector of Pakistan is decreasing over the period. Agricultural policies do not support the farmers, data and information sharing channels are outdated and farmers and landlords are relying on social networking. The government needs to revise policies consistent with the pace of change in climate, economic conditions and need to improve the methods and systems for data sharing to ensure sustainable agriculture growth in Pakistan. Magnificent trade restrictions on agriculture products have been imposed by developed economies and these are continuously increasing over the period. The Government of Pakistan needs to work on agricultural policies and work on the data or information sharing channels to ensure sustainable agriculture growth to eradicate poverty.

Keywords: Sustainable Agriculture Growth, Trade Restrictions, Eradication of Poverty, Government Policies, Data Sharing, Climate Change, Climate Change Management.

INTRODUCTION

Over the period of time, it is observed that the level of poverty is increasing in the rural areas of Pakistan, which were considered as a hub for agricultural production especially South Punjab and Sindh (Rana & Bhatti, 2018). The long-standing debate among the policymakers and researchers about the productivity and sustainable growth of agriculture in Pakistan to eradicate poverty concludes that poverty in rural areas can be eliminated by sustainable agriculture growth (Yasar, et al., 2017). Pakistan is considered an agriculture-based economy and contributes significantly to employment generation and towards the economic growth (25.6% of GDP contributed by the agriculture sector and 5.4% of total GDP is contributed by major crops) of Pakistan. The rate of inflation is consistently increasing over the last 20 years, the average annual growth rate was 3.52% during the 1995-96 to 2004-05 similarly, and targeted growth for 2017-18 was 3.5%. Comparatively, the rate of poverty in the rural areas of Pakistan was 33.65% during 2002-03 and in 2016-17 it has touched the 35.65% (UNDP, 2016). Population in the rural areas of Pakistan is in deprivation situation and poverty level is rampant and getting worse over the period especially with respect to human rights, education, sanitary facilities, healthcare, housing, clothing and incomes. Furthermore, natural resources are depleting over the period and population growth rate is increasing, considered as a major constraint for the eradication of poverty. Under developing countries like Pakistan are producing less as compare to other developing and developed economies due to lack of knowledge, access to information, technological advancement, limitation of resources, lack of government policies, and trade restrictions. Landlords and farms are facing challenges, how to maximum output with minimum resources, how to improve agricultural productivity from the available natural resources. How they can access to data or information related to climate change and how to remove the trade barriers or meet the domestic and international demands by eliminating the trade restrictions imposed by the developed economies on imports of agriculture products.

Economic development can be a source of reallocation of production resources or factors from the primary sector characterized by low productivity, decreasing contribution to economic growth, traditional technology to the modern industrial sector with higher profits and productivity (Adelman, Malanushenko, Ryabchikova, & Savanon, 2001). Due to low-productivity agriculture was seen as a traditional sector that only contributes to economic development by providing employment and food. In the early 1960s, a tremendous revision has been proposed based on the significance of the agriculture sector towards the economic growth at the initial stage of industrialization Agriculture demand-led-industrialization (ADLI) (Chowdhury & Islam, 2013). This strategy emphasized the central role of agriculture productivity and its link with economic growth by providing the base to the industrialization process.

During the early stage of industrialization, the central role of the agriculture sector was recognized based on two fundamental characteristics; the agriculture sector produces goods that directly or indirectly satisfy basic human necessities/ needs. Human and agriculture products with a combination of natural resources such as agro-ecological assets and land. Since there is no cost of natural resources and are available freely, moreover, early development theorists claim that the agriculture sector could grow independently despite other economic activities.

Recently literature documented an unprecedented fall in the poverty index in the Asian region due to the successful transformation that has been done in the agriculture sector of Pakistan in the last three decades (Chen & Ravallion, 2004). The agriculture sector of Pakistan contributes 25.6% to national growth and 42.02% of the total labor force is

associated with the agriculture sector. Approximate 9% of total exports are contributed by the agriculture sector of Pakistan reported by the Ministry of Finance, (2017) even a number of trade restrictions have been imposed on Pakistan and other developing nations by the developed economies. Moreover, the agriculture sector of Pakistan also providing raw material to agro-based industries, such as textile, leather, ghee and sugar. Approximately, 65.9% of the total population is living in rural areas of Pakistan and directly or indirectly is affected by the growth of the agriculture sector and dependent on agriculture for their livelihood (Ministry of Finance, 2016). Indicators published by the World Bank revealed that agriculture contributes to economic growth is declining over the period in the last six decades due to climate change and trade restrictions.

Contribution to % of GDP
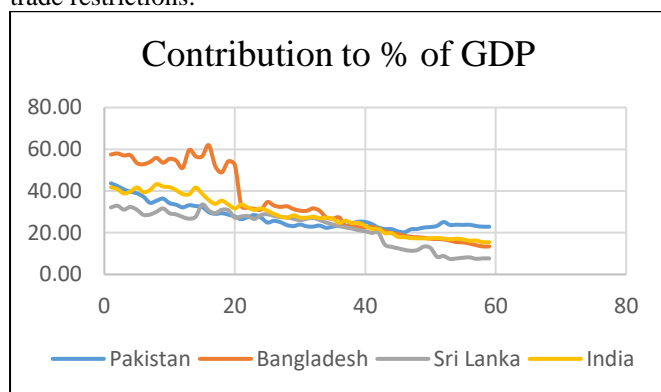
Figure 1: Contribution of agriculture sector percentage of GDP Source: World Bank Indicator, 2019 https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

Climate change and Data Sharing

Climate change is mainly concentrated by the greenhouse gases (fluorinated gases, carbon dioxide, methane, and nitrous oxide) which significantly affect rain patterns, temperature, land resource, and adversely affect quality and level of water and leads to droughts and floods. Climate change is now a global phenomenon; although, it significantly affects the developing nations because of their lesser ability to mitigate and greater vulnerabilities towards climate change.

Moreover, Food Security and Nutrition Strategic Review for Pakistan reported that 18.1 percent of the total population is undernourished. Global Hunger Map ranked Pakistan "moderately high" at the country level while, an initial survey of provincial-level ranked seven districts were reported as "severe chronic food insecurity" ten districts were reported as "moderate chronic food insecurity", and one as "Mild Chronic Food Insecurity" in Sindh. Wheat crop indicate as marginal increase of 0.4 percent growth from 25.6 million MT to 25.75 million MT in 2015-16 to 2016-17 similar pattern has been observed in rice production with growth of 0.7 percent from 6.8 million MT to 6.85 million MT (milled basis) in 2015-16 and 2016-17 respectively, while the population growth rate is much higher as compared to other regional economies.

According to United Nations, 37 percent world's population is lived in India and China and 22 percent lived in eight countries including United States, Brazil, Russian Federation, Japan, Nigeria, Indonesia, Bangladesh, and Pakistan (United Nations, 2013). Moreover, the world population is largely concentrated by eight countries which are accounted for over the half of population increased in the world includes United

States, Ethiopia, and Brazil, India, China, Nigeria, Indonesia, and Pakistan. In terms of receivers (international migrants) during 2010-2050 it was projected by the United Nations as given in Table 1:

Table 1: Country-level Migration

| Sr. No	Country	Net migrants (annually)
1	United States	1,000,000
2	Canada	205,000
3	United Kingdom	172,500
4	Australia	150,000
5	Italy	131,250
6	Russian Federation	127,500
7	France	106,250
8	Spain	102,500
9	Bangladesh	-331,000
10	China	-300,000
11	India	-284,000
12	Mexico	-210,000
13	Pakistan	-170,000
14	Indonesia	-140,000
15	Philippines	-92,500

Countries with positive emigration were projected as powerful generators for economic activities and agriculture growth within the medium-term future. Climate change will affect the poorest countries in terms of agriculture and food security. Developing nations evidencing crop yield losses and by 2030 it is expected to be a 12 percent increase in food prices.

Government Policies

However, there are no significant changes in policies related to the agriculture sector, and exports of agricultural products in Pakistan. Private investments in the agriculture sector of Pakistan are at the lowest level in the history of Pakistan while, governments investments are declining over the last three decades. The early 1960s poverty level in the rural areas of Pakistan was 42.28%. However, the poverty level in rural areas of Pakistan decreases significantly is the 1970s (Asian Development Bank, 2002). The public and the private sector combine efforts and investment in the agriculture sector during the 1970s to 1980s which boost the growth and push poverty level down significantly (Asian Development Bank, 2002). During the 1970s to 1980s foreign remittances also contribute towards the growth of the agriculture sector of Pakistan. However, in the late 1980s poverty level again starting rising in rural areas of Pakistan. In the early 1990s, the poverty level in rural areas of Pakistan was 25.2% which increased to 38.65% in early 2002. Most of the population living in rural areas of Pakistan is around the poverty line in the form of clusters. Approximately 63% of the poor population fall between the level of consumption and poverty line which is 75% of the poverty line (Ministry of Finance, 2003).

Since the late 1960s, Pakistan was earning a favorable balance of trade by producing a surplus of food items and was in the list of net exports of food products. However, this position was for a shorter period of time. During 1980s high population growth rate, imports of food items become indispensable, calamities like floods, water shortage triggered the poverty level upwards, however, the average growth rate of agriculture was 4.54% in the early 1990s but the poverty level keeps

increasing due to high level of population growth and climate change (Ministry of Finance, 2015).
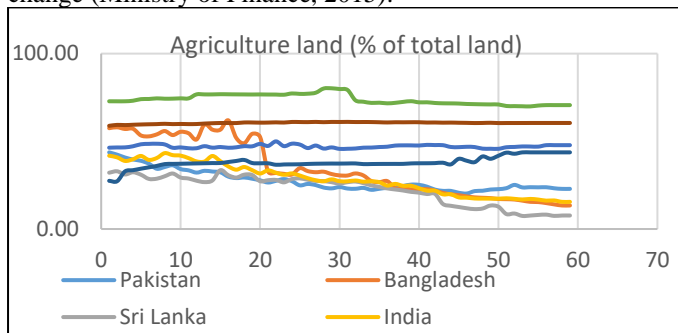
Figure 3: Agriculture land percentage of total land Source: Source: World Bank Indicator, 2019 https://data.worldbank.org/indicator/SL.AGR.EMPL.ZS

At the time of independence in 1947, the population of Pakistan was 33 million and in 2005 it raises to 153.95 million which makes Pakistan the seventh most populous country in the world. The average population growth rate in Pakistan was 3% from 1951 to the 1980s. Population growth rate decreases from 3% to 2.6% from 1985 to 2000 and since the early 2000 population growth rate is 2.2% which is much higher as compared to other developed (0.9%) and developing (1.7%) nations respectively (Ministry of Finance, 2015).

Trade restrictions

There has been growing recognition that the Sanitary and Phytosanitary (SPS) agreement can impede trade in agricultural and food products. Pakistan experiences problems in meeting the SPS requirements of developed countries and, it is claimed, this can seriously impede its ability to export agricultural and food products. Attempts have been made to reduce the trade distortive effects of SPS measures through, for example, the World Trade Organization (WTO) SPS Agreement, although it is claimed that current initiatives fail to address many of the key problems experienced by Pakistan and other developing countries.

Table 2 presents the measures and products affected by the region (s); most of the developed countries impose restrictions on developing and least developed countries. Latin America and Caribbean (Measures 29% and Products 35%), South Asia (Measures 23% and Products 17%), East Asia & Pacific (Measures 28% and Products 32%), Middle East & North Africa (Measures 4% and Products 2%), Europe & Central Asia (Measures 12% and Products 10%), and Sub-Saharan Africa (Measures 5% and Products 4%). Moreover, most of the developing and least developed countries affected due to these trade restrictions and measures taken by developed or developing countries.

Table 2: **Products affected by regions (Percentage)**

| Region	Measures	Products
Latin America & Caribbean	29%	35%
South Asia	23%	17%
East Asia & Pacific	28%	32%
Middle East & North Africa	4%	2%
Europe & Central Asia	12%	10%
Sub-Saharan Africa	5%	4%

Source: *ERA Database*

Figure 4 presents the distribution of products affected by the trade restrictions; products of the milling industry 8%, live animals 7%, rawhides 6%, meat 6%, residues and waste from the food industries 5%, coffee, tea, mate 5%, fruits and nuts 4%, food preparations 3%, sugar 3%, edible vegetables 10% and dairy products 8%.
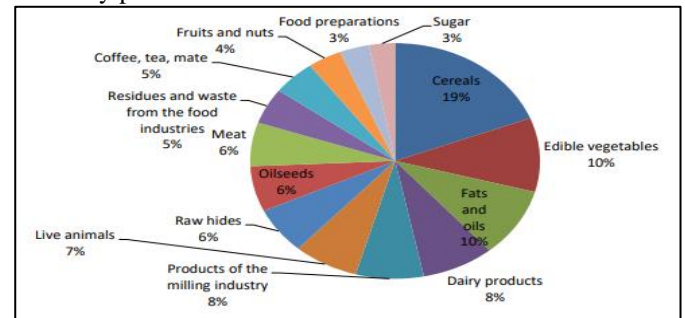
Figure 4: *Agricultural sectors affected by new export restrictions* *Source: ERA Database*

Figure 5 explains the possible reasons why countries impose restrictions; 40% reason was not specified by the countries, 3% other reasons include Export Taxes, Other Export Restrictions, Import Tariffs, 5% political reasons, 9% to guarantee domestic supply, 9% to stabilize/ control prices, 12% infant industry, 12% to increase public revenue, 12% food security purposes.
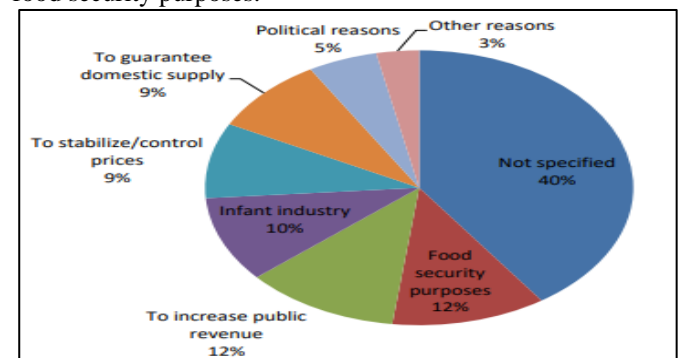
Figure 5: *Arguments to justify the introduction of export restrictions* *Source: ERA Database*

Sustainable Agriculture

So far no one set of farming practices considered as sustainable agriculture, literature documented certain factors that ensure and enhance the sustainability of agriculture based on *climate change management*. It includes the;

- **Crop rotation:** rotation of crops facilitates the farmers in interruption of pests' reproductive cycles and there is less need for pest control chemicals (Corselius, Wisniewski, & Ritchie, 2001). It also facilitates the farmers in the way one crop becomes the nutrients for the next crop.

- **Cover crops:** cover crops facilitate the farmers to improve the quality of soil, erosion of soil and minimize the weed growth. Moreover, few cover crops generate a significant amount of income.

- **Low and no-till farming:** these farming techniques include the minimum disturbance in the soil which ultimately increases water retention, topsoil, and nutrients.

- **Soil management**: soil management includes managing the balance of its biologic, physical properties and chemicals. Domestic agriculture focuses on physical properties while industrial agriculture focuses on chemical properties. Healthy soil contains four tons of organisms to manage the soil ecosystem (Brunetti, 13 February 1999). Organic matter

considered as food for the protozoa, nematodes, fungi and beneficial bacteria. If farmers are successful in the management of organic matter it significantly and positively affects plant growth (Horrigan, Lawrence, & Walker, 2002).

- **Diversity:** diversity in crops provides a buffer against economic and ecological problems. Monoculture is more appropriate for the fluctuations in market prices and pests. Diversity in crops also leads more to niches which is beneficial insects.
- **Nutrient management:** by monitoring the other nutrients and nitrogen farmers can prevent runoff into the required level of waters which ultimately saves money. Farmers need to apply only the amount of fertilizers that are required for the plants and soil.
- **Integrated pest management:** prefers biologic methods which suggest chemical pesticides are only last resort to keep destructive insects under control. Integrated pest management system focuses on intercropping, crop rotations and other methods to disrupt pest cycles or planation of cover crops which create resistance to pests.
- **Rotational grazing:** by moving animals to grazing areas farmers can prevent erosion of soil by managing enough vegetative cover which also saves in terms of fertilizer cost, animal feeding and contributes towards soil fertility. To ensure sustainable agriculture data sharing is considered an important component in recent studies and reports
- **Agronomic and crop management:** to improve and to get the high rate of crop data sharing should be required on the four major components which include, seeding rates and fertilizer, Narrow rows, Hybrid maturities, Starter fertilizers (Gene, 2015).
- **Resource-conserving technology:** resource-conserving technology ensures the regional and site level coordination with farmers of a different socio-economic group to ensure the level required level of crop yield and also ensure the water management (Guptaa & Seth, 2007).

- **Restoring degraded land**; by focusing and adoption of the following techniques restoration of degraded land can be possible, block ditches, create terraces, open-water reservoirs, pump water, mulch shade, the establishment of buffer zones (Lawrence, Slater, Tomas, Holland, & Deser, 2008).
- **Cropland Management:** to meet the demand of domestic and global population farmers need to ensure the cropland management to increase the crop yield without further degrading soil and water resources.

Government Policies

Macro-economic development goals are designed based on the government plans to achieve targets particularly in terms of national development. Government policies are truly related or based on how governments are planning to achieve that targeted goals. Four leading macro-economic goals have important significance in terms of achievement;

- A favorable and sound balance of payments;
- A stable and sound national currency and realistic foreign exchange rate;
- Recurrent expenditure and government capital budgets and
- Control over the acceptable level of insurance.

The above-mentioned leading goals focused by the governments too;

- To manage the poverty level and ultimately eradicate the level of poverty from within the country and focusing the more sustainable national income and growth with equal distribution of wealth.
- Ensure the degree of food security and maintain the level of nutrition in children and the nation, providing and creating equal opportunities for the nationals.
- Increasing the exports and the creation of substitution for imports
- Improvements in the achievement of quality of life and equal regional development across the country and
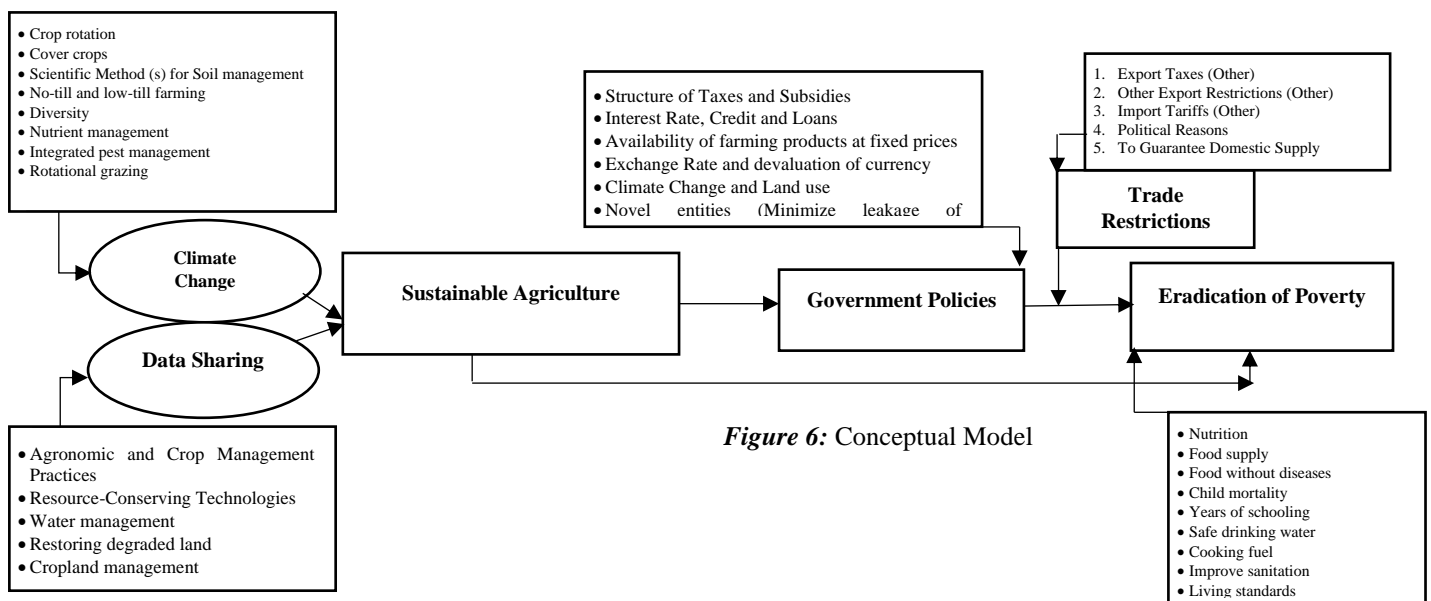- The management and sustainable use of natural resources at the national level.

Figure 6: Conceptual Model

DISCUSSIONS and CONCLUSIONS

Evidence from the literature consistently shows that agricultural growth is highly effective in reducing poverty. Gallup, (1997) reported that every 1% increase in per-capita agricultural output led to a 1.61% increase in the incomes of the poorest 20% of the population. Suhariyanto and Thirtle (2001), concluded from a major cross-country analysis that, on average, every 1% increase in agricultural yields reduced the number of people living on less than US$ 1 a day by 0.83%. Broad-based agricultural productivity growth raises incomes of poor farm households as well as households of landless laborers who primarily depend on agricultural wages. Increased agricultural productivity also brings strong indirect benefits for the poor. The most important pro-poor linkage is generated by the effects of agricultural productivity growth on food prices (Timmer, 2002). The poor typically spend a high share of their income on staple foods, and therefore they benefit from a productivity induced decline in the real prices. This was the positive effect and was beneficial for the landless laborers, poor farmers as a net purchaser. Similarly, a higher level of income of workers and farmers will also push the poverty level down by offering the labor-intensive products. Food security, nutrition, and macroeconomic stability are directly associated with the agriculture sector (Timmer, 2002). At the country level, irregular access to food inadequate productivity affects the nutrition supply and investment in human capital (Bliss & Stern, 1978; Strauss, 1986; Fogel, 1994).

Developed and developing economies impose trade restrictions on the exports of agriculture products due to a number of reasons. Sustainable agriculture (data sharing and climate change management) has a significant impact on the eradication of poverty in rural areas of Pakistan while government policies mediation the relationship significantly. During the data collection farmers with more than 20 years' experience explained the phenomena as;

> *"Countries are operating with the latest technology and high production rate in the agriculture sector while Pakistan farmers are using old or outdated techniques and technology to produce agriculture products. Government policies do not provide any support or awareness among the farmers to produce a suitable product as per the market demands. Markets in Pakistan are quite far, and farmers do not have direct access to markets"*

Similarly,

> *No proper education and information centers are operated by the governments to facilitate the farmers regarding ecological farming and data sharing for sustainable agriculture. Pesticide companies are companies providing the companies misleading information to just boost their sales which ultimately affects the production capacity of agricultural land.*

Sustainable agriculture is not possible until the government design the appropriate policies and for the agriculture sector and facilitates the farmers by the appropriate information required for the cultivation of products. Without sustainable agriculture development alleviation of poverty is not possible in rural and urban areas of Pakistan.

The most common phenomena are countries tries to reduce the level of poverty without focusing on and transforming the agriculture sector of Pakistan. The poverty reduction strategy needs to incorporate transformation in the agriculture sector of Pakistan to boost productivity which significantly contributes towards economic growth. Modern farming techniques, countermeasures for climate change, and spread of irrigation network needs to address and agriculture sector needs significant transformations. The land of Pakistan has great potential, the productivity and growth of the agriculture sector can increase which is directly associated with the reduction of the poverty level in Pakistan. Pakistan is an agriculture-based country and all government strategies or policies for eradication of poverty should primarily focus on the agriculture sector particularly on data sharing, climate change management, and trade restrictions. Other issues which needs to focus includes (i) data sharing (crop management practices, water management, restoration of degraded lands, and cropland management), (ii) climate change management (crop rotation, cover crops, scientific method (s) for soil management, no-till and low-till farming, diversity, nutrient management, integrated pest management, rotational grazing), (iii) government policies (Structure of taxes and subsidies, interest rate, credit and loans, availability of farming products at fixed prices, exchange rate and devaluation of currency, climate change management and land use, Novel entities (minimize leakage of Chemicals), (iv) trade restrictions (Export Taxes (Other), other export restrictions (Other), import tariffs (Other), political reasons, to guarantee domestic supply, to increase public revenue. and (vii) government policies need to work with international bodies for the reduction of restrictions on the trade of agriculture products. All the measures need to address while designing the policies for the agriculture sector of Pakistan which significantly affect the poverty level.

Future research studies should test this proposed conceptual model in Pakistan, and other developing countries, particularly in the South Asian region. Government policies are proposed as mediating while trade restrictions were proposed as moderating variables.

REFERENCES

Adelman, S. J., Malanushenko, V., Ryabchikova, T. A., & Savanov, I. (2001). On the rotation of the chemically peculiar magnetic star 56 Arietis. *Astronomy & Astrophysics*, *375*(3), 982-988.

Long, S. P., Ainsworth, E. A., Leakey, A. D., Nösberger, J., & Ort, D. R. (2006). Food for thought: lower-than-expected crop yield stimulation with rising CO_2 concentrations. *Science*, *312*(5782), 1918-1921.

Adelman, I. (1984). Beyond export-led growth. *World Development*, *12*(9), 937-949.

Barnes, D. F., & Binswanger, H. P. (1986). Impact of rural electrification and infrastructure on agricultural

changes, 1966-1980. *Economic and Political Weekly*, 26-34.

Byerlee, J. (1978). The friction of rocks. *In Rock friction and earthquake prediction* (615-626). Birkhäuser, Basel.

Byerlee, D., Diao, X., & Jackson, C. P. (2005). *Agriculture, rural development, and pro-poor growth: Country experiences in the post-reform era.* Agriculture & Rural Development Department, World Bank.

Carlson, A., Kinsey, J., & Nadav, C. (2002). Consumers' retail source of food: a cluster analysis. *Family Economics and Nutrition Review*, *14*(2), 11.

Cohen, J. E., Small, C., Mellinger, A., Gallup, J., & Sachs, J. (1997). Estimates of coastal populations. *Science*, *278*(5341), 1209-1213.

Adelman, S. J., Malanushenko, V., Ryabchikova, T. A., & Savanon, I. (2001). On the rotation of the chemically peculiar magnetic star 56 Arietis. *Astronomy & Astrophysics, 375*(3), 982-988.

Adelman, I. (1984). Beyond export-led growth. *World Development, 12*(9), 937-949.

Ashley, C., & Maxwell, S. (2001). Rethinking rural development. *Development Policy Review, 19*(4), 395-425.

Asian Development Bank . (2002). *Development Indicators .* Singapore : Asian Development Bank .

Bari, F. (2003). Growth and poverty paradox. *The Journal, 8*(4), 13-18.

Barnes, D. F., & Binswanger, H. P. (1986). Impact of rural electrification and infrastructure on agricultural changes, 1966-1980. *Economic and Political Weekly, 21*(1), 26-34.

Bhutto, A. W., & Bazmi, A. A. (2007). *Sustainable agriculture and eradication of rural poverty in Pakistan. In Natural Resources Forum.* Oxford, UK: Blackwell Publishing Ltd. Retrieved November 15, 2018

Bliss, C., & Stern, N. (1978). Productivity, wages, and nutrition: Part II: Some observations. *Journal of Development Economics, 5*(4), 363-398.

Byerlee, D., Diao, X., & Jackson, C. P. (2005). *Agriculture, rural development, and pro-poor growth: Country experiences in the post-reform era. Agriculture & Rural Development Department.* World Bank.

Chen, S., & Ravallion, M. (2004). Welfare impacts of China's accession to the World Trade Organization (WTO). *The World Bank Economic Review, 18*(1), 29-57.

Chowdhury, A. H., & Islam, R. (2013). Trade liberalization and de novo hypothesis in the context of Bangladesh: An empirical analysis. *International Journal of Business and Economic Development, 1*(1), 94-130.

Commonwealth Secretariat. (2001). *Gender mainstreaming in agriculture and rural development: A reference manual for governments and other stakeholders.* London: Commonwealth Secretariat.

Datt, G., & Ravallion, M. (1998). Farm productivity and rural poverty in India. *The Journal of Development Studies, 34*(4), 62-85.

Fogel, R. W. (1994). *Economic growth, population theory, and physiology: The bearing of long-term processes on the making of economic policy.* National Bureau of Economic Research.

Gallup, J. L. (1997). *Theories of migration.* Centre for Communication Program: Popline.

Haggblade, S., Hammer, J., & Hazell, P. (1991). Modeling agricultural growth multipliers. *American Journal of Agricultural Economics, 73*(2), 361-374.

Haggblade, S., Hazell, P., & Reardon, T. (2010). The rural non-farm economy: Prospects for growth and poverty reduction. *World Development, 38*(10), 1429-1441.

Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (2006). *Multivariate data analysis.*

Hazell, P., & Diao, X. (2005). The role of agriculture and small farms in economic development. *The Future of Small Farms*, 23-36.

Jayne, T. S., Mather, D., & Mghenyi, E. (2010). Principal challenges confronting smallholder agriculture in sub-Saharan Africa. *World Development, 38*(10), 1384-1398.

Johnston, B. F., & Mellor, J. W. (1961). The role of agriculture in economic development. *The American Economic Review, 51*(4), 566-593.

King, R. P., & Byerlee, D. (1978). Factor intensities and locational linkages of rural consumption patterns in Sierra Leone. *American Journal of Agricultural Economics, 60*(2), 197-206.

Mellor, J. M., & Milyo, J. (2001). Reexamining the evidence of an ecological association between income inequality and health. *Journal of Health Politics, Policy, and Law, 26*(3), 487-522.

Mellor, J. W. (1976). *The new economics of growth.* Cornell: Cornell University Press.

Ministry of Finance. (2003). *Economy Survey of Pakistan.* Islamabad: Government of Pakistan.

Ministry of Finance. (2015). *Economy Survey of Pakistan.* Islamabad: Government of Pakistan.

Ministry of Finance. (2016). *Economy Survey of Pakistan.* Islamabad: Government of Pakistan. Retrieved from http://www.finance.gov.pk/survey_1516.html

Ministry of Finance. (2017). *Economy survey of Pakistan.* Islamabad: Government of Pakistan. Retrieved from http://www.finance.gov.pk/survey_1617.html

Nunnally, J. C., & Bernstein, I. H. (1967). *Psychometric theory.* New York: McGraw-Hill.

Rosegrant, M. (2000). *Transforming the rural Asian economy: The unfinished revolution.* Asian Development Bank.

Schultz, T. W. (1964). Transforming Traditional Agriculture (Studies in Comparative Economics). *Economics, 37*(1), 47-61.

Srinivasan, A. (1985). Alternative measures of system effectiveness: Associations and implications. *MIS Quarterly*, 243-253.

Strauss, J. (1986). Does better nutrition raise farm productivity? *Journal of political economy, 94*(2), 297-320.

Suhariyanto, K., & Thirtle, C. (2001). Asian agricultural productivity and convergence. *Journal of Agricultural Economics, 52*(3), 96-110.

Thirtle, C., Lin, L., & Piesse, J. (2003). The impact of research-led agricultural productivity growth on poverty reduction in Africa, Asia, and Latin America. *World Development, 31*(12), 1959-1975.

Timmer, C. P. (2002). *Agriculture and economic development* (Vol. 2). Handbook of Agricultural Economics.

UNDP. (2016). *Pakistan poverty index.* Islamabad: Government of Pakistan.

Van de Ven, A. H., & Ferry, D. L. (1980). *Measuring and assessing organizations.* New York: John Wiley & Sons.

World Bank Group. (2014). *World development indicators of 2014.* NewYork: World Bank Publications.