NEXUS OF SPENDING ON PUBLIC GOODS AND AGRICULTURE GROWTH IN PAKISTAN

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A thesis submitted to Pakistan Institute of Development Economics Islamabad, Pakistan in partial fulfillment of the requirements for the degree of Masters of Philosophy in Economics.

DEPARTMENT OF ECONOMICS

PAKISTAN INSTITUTE OF DEVELOPMENT ECONOMICS

ISLAMABAD

2015

ACKNOWLEDGEMENTS

First of all thank to Almighty Allah for giving me guidance, inspiration and ability to fulfill this study. Then I am grateful to my supervisor Dr. Anwar Hussain, Assistant Professor, Pakistan Institute of Development Economics (PIDE), Islamabad for his proper time and guidance to address all my queries. I am also thankful to Mr. Akbarullah and Mr. Ramzan, Staff Economists, PIDE for their cooperation in my research. Furthermore, I acknowledge the help of my friends and offer my regards to all those who supported me in any respect during the completion of this task.

Abid Ali

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This study aims to find out the nexus of spending on public goods and agriculture value addition in Pakistan. To this end, time series secondary data has been used from 1972-2013, taken from World Development Indicator (WDI) and Statistical Supplement to Economic Survey (SSES). To check stationarity of the data Augmented Dickey Fuller (ADF) test is used. Further to assess the relationship, Auto Regressive Distributed Lag (ARDL) model and Error Correction Model (ECM) has been used. Estimation shows a positive and statistically significant effect of public goods' spending on agriculture value addition in the long-run. Furthermore a positive effect of other major inputs on agriculture productivity is witnessed both in long and short-run. Study recommends government intervention for agricultural growth through spending on health, education and transport and communication. More investment on human capital in the form of training and technical education should be made.

CHAPTER 1

INTRODUCTION

1.1 Background and Statement of the Problem

Different economic systems may provide different solutions to economic problems. The Fiscal lists laid stress and recognized the role of the government in the economy. Accordingly, spending on public goods [1], mainly education, health, transport and communication and subsidies is considered the responsibility of the government. Among the fiscal policy instruments, public expenditure is the most important policy instrument available to government for promoting economic growth and equitable distribution of wealth. Public spending contributes to the growth of an economy (Hsieh and Lai: 1994). Public expenditures play multi-dimensional role in the economy. Construction of roads not only facilitated the masses but also have implications for other sectors of the economy like agriculture and industry (Benin et al., 2009; Fan et al., 2009).

There is a growing body of knowledge that supports and links public expenditures to agriculture value added. Agriculture growth not only depends upon agriculture expenditure but also on non-farm expenditures like spending on various public goods i.e. health, education and infrastructure (Fan et al. 2009). Spending on public goods plays a positive role in agriculture GDP per capita growth rate (Armas et al., 2012). Sustained and effective growth of agriculture sector needs extensive investment which cannot be provided by the private sector alone. Furthermore, importance of agricultural sector in the growth of developing economies cannot be ignored due to its major share in those economies. Thus, assessing public spending and its effect on agriculture value added is crucial.

[1] Public goods refers to non rivals and non excludable goods, e.g. police and fire protection, highways, national defense, lighthouses, television and radio broadcasts, clean air, and so on (Varian, 1999).

Agricultural growth is linked with spending on various heads in the economy. Mushtaq and Nadeem (2010) suggested that government should allocate more funds to agriculture research and extension sectors to ensure sustainable development in agriculture sector. Spending on agricultural research and development programs helps to introduce new technologies and high yielding varieties which ultimately affect the agricultural value added per worker. Similarly spending on extension services creates awareness about high yielding varieties of seeds and adoption of new technologies. Research and development expenditure has the largest effect on agriculture growth and productivity (Mogues et al 2012). Allocating public resources towards Research and Development has positive effect on agriculture growth (Edward Misch and Dodson 2010). Public spending on agriculture research and extension services uplift agriculture productivity (Fan et al 2004). Furthermore expenditure on agriculture research and extension services leads to more use of fertilizer (Elias 1985).

Expenditures on education helps develop and strengthens the skills of farmers in using modern technologies and finally increase the productivity of laborers. There is a positive and statistically significant effect of household heads' education and adoption of high yielding varieties of seeds (Lin 1990). Spending on infrastructure like roads and markets improve access of farmers to the urban markets that leads to raise the value of their production and getting more benefits.

Spending on public goods correlates with agriculture value addition. The average spending on public goods2 during 1995-2007 for Pakistan, Syria, Iran, and Kuwait were 1.33, 7.86, 12.48, and 15.32 as a percent of GDP respectively while average of agriculture growth for the same period were 4.03, 6.78, 4.10 and 6.57 as a percent of GDP respectively (Malaiyandi, 2010).

Agriculture is an important sector of Pakistan's economy by contributing 21 percent to GDP, 45 percent to the employment sector. Almost 60 percent of the rural population

[2] These include agriculture, health, education, transport and communication and social protection.

depends upon this sector for their livelihood (Economic Survey of Pakistan, 2014). Moreover, recent issue of food security demands for more investment in this sector.

1.2 Motivation of the Study

Agriculture sector is the most important sector of Pakistan's economy both as the main contributor to GDP and main employer for the rural population. Almost sixty two percent population of Pakistan lives in rural areas where the main source of their livelihood is agriculture sector. Agriculture sector, if developed properly can help eradicate rural poverty in the country. Importance of this sector gives motivation to find out what factors and policies on government's behalf will help promote this sector. So the present study focuses on how the spending on public goods is going to affect agriculture value added per worker.

1.3 Significance of the Study

There are considerable studies conducted on the nexus between public spending and growth [Elias, 1985; Fan, Omilola and Lambert, 2009; Malaiyandi, 2010; Mushtaq and Nadeem, 2010; Mogues et al 2012]. These studies analyzed the impact of spending on public goods on agriculture growth in different regions of the world. Some of these studies examined the impact of overall public agriculture expenditure on agriculture growth whereas some took different heads of public spending like agriculture subsidies, agriculture R&D, agriculture extension services, rural infrastructure, education, health on agriculture growth, total factor productivity growth and on private investment in agriculture sector.

Studies regarding Pakistan have also been conducted on public spending and growth related issues. Most of the studies have focused on partial effects of the components of public spending such as effects of expenditures on education, effects of health on agricultural growth in Pakistan [Khan, 1997; Ali and Iqbal, 2003; Ali et al., 2008] . By closely looking, it comes out that there is a research gap regarding, effects of overall public spending (Government spending on health, education, infrastructure and provision input for agriculture) on agricultural value addition per worker in the context of Pakistan.

This study is an endeavor to bridge the aforementioned gap and it covers public spending i.e. expenditures on health, education, infrastructure (road length) to see its influences on agricultural value addition per worker in Pakistan. This study answers the question "Does spending on public goods matter for agriculture value addition in Pakistan?". Hence, to the best of knowledge, this would be the first study of its nature to find out the impact of spending on public goods on agriculture value addition in Pakistan using time series data.

1.4 Objective of the Study

This study aims to estimate the impact of spending on public goods along with other influencing factors on agricultural value addition per worker in Pakistan.

1.5 Hypothesis of the Study

This study is based on the hypothesis that spending on public goods has positive impact on agricultural growth

1.6 Organization of the Study

Introduction of the study covering background and statement of the problem, research question, objectives, and hypothesis have been given in chapter one. The second chapter discusses the relevant literature. Overview of government expenditure and agriculture growth is given in chapter three. The data used and methodology developed for the study is given in chapter four. The fifth chapter presents results and discussions. The last chapter covers conclusion and recommendations based on the findings of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 Review of Previous Studies

Armas et al (2012) found out the response of agriculture growth to public spending using time series data from 1976-2006 for Indonesia. Authors used Ordinary Least Squares and Generalized Method of Moment techniques for analysis. Furthermore the study analyzed the trends of agriculture public spending in Indonesia for the period of 2000-08. After holding constant the non-agriculture GDP per capita growth and private inputs the overall results indicated that public expenditure on agriculture is positively effecting agriculture GDP per capita growth. Furthermore the study finds out that subsidizing fertilizer have negatively affected agriculture GDP per capita. Paper recommended the reallocation of resources by government from subsidizing fertilizer to the provision of other public goods which have positive impact on the sector like extension services, research and development and irrigation system. Paper concluded that this reallocation of resources can positively affect the productivity and growth of the sector.

Mogues et al (2012) undertook another comprehensive study to examine the impact of public investment using the data of developing countries. They argued that agriculture investments have significant and multiple effects on health, through access to its own produced low prices food and higher level of income. They observed that research and development investment has the profound effect on the productivity and growth of the sector. They concluded that investment in public goods has two dimensional effects on private investment. It can raise the reward of private investment but at the same time it may have crowding out effect.

Olabisi, et al. (2012) investigated the composition of public spending and its relation with the economic growth of Nigeria. Study used the vector autoregressive (VAR) model to

analyze the data for time period 1960 to 2008. They argued that Government intervention reduce the negative impact of market failure in an economy. They found that public expenditure on agriculture and transportation significantly increases economic growth, while public expenditure on education negatively affects the economic growth. The negative effect of education is due to high unemployment rate, corruption and rapid falling of education standards, which needs to be investigated further. Public expenditure on water was found adversely related to growth because inequality in the distribution of water and corruption, in most areas public water supply was not available. They suggested that public expenditure on health, agriculture and transportation should be encourage in order to promote more economic growth and there is a dire need to further explore this issue.

Mogues (2011) looked into the backward and forward linkages of agricultural productivity in Ethiopia. As far as the backward linkage is concerned, the direct effect of the government agricultural spending on agricultural productivity was investigated. No evidence of this sort of effect was found for Ethiopia. The forward linkage was studied in the context of the effect of agricultural productivity on rural income. A robust and strong evidence of an increase in rural income due to higher agricultural productivity was found.

Reimers and Klasen (2011) examined that how education affect agriculture yield using the panel data of 95 developing and middle income countries from 1961 to 2002. They argued that mostly micro level studies found that the rural education increase agriculture productivity, but the recent cross-country analysis found that schooling has negative and even in few cases insignificant effect on agricultural productivity due to poor proxies used to measure education. By using the random effect and fixed effect education is found to be positively and significantly affects the agricultural productivity. They found using the FGLS model that an additional year increase in the education for the whole population will raise agricultural productivity by 3.2%. By further distinguishing the education in different levels it reveals that tertiary education was found to be insignificant whereas up to secondary education is positively affecting agriculture output. They separately estimated the impact of

education on across countries with differ income levels, and found that education effect is much smaller for low or poor countries. They concluded that education has bigger effect on agricultural output in the presence of rapid technological change, as it really helps farmers to adjust with new innovations and technology which will significantly increase the agriculture growth.

Armas, et al. (2010) examined that how public expenditures are going to influence growth of agriculture sector in Indonesia using time period 1976- 2006. They argued that the purpose for public sector in agriculture is to boost private sector activity, efficient allocation the resources and minimize the price distortion while stimulating inclusive growth. Study found that agriculture GDP per capita growth is being positively affected by agriculture expenditures. By splitting the spending on public goods into developing spending on agriculture, irrigation, fertilizers' subsidies they found that public spending on agriculture and irrigation positively affects the agriculture growth while fertilizer subsidies had negative impact on the agriculture growth. They suggested that as the agriculture sector modernize in Indonesia, it is much better if the public spending on subsidizing seeds and fertilizer seeds are reallocated to improving public spending on agriculture services and irrigation will enhance agriculture growth in the country.

Edmeades, et al. (2010) studied the effects of sub-national public expenditures on agriculture growth in Bolivia. They used the Bolivian time series budget data from 1996 to 2007 and construct different public expenditure categories at sub national level and also disaggregated it at different level to see its impact on a particular area or level. They followed the endogenous growth model of Devarajan et al. (1996) and used fixed effect model both with time-invariant and with time. They found that reallocating the public resources from other rural areas expenditure and other non-rural expenditure towards R&D has positive effects on agriculture growth. They also found that public spending composition matters a lot and irrigation would have positive growth effects over the medium run and these results are robust over all empirical specification.

Baba et al. (2010) tried to study the nature of the relationship between public and private sector investment in agriculture during 1969-2002 in an Indian state. They found that public investment in agriculture drive up the private sector investment in agriculture and thus concluded that there was a crowding in phenomenon instead of crowding out. Studies like Dhawan and Yadav (1995), Dhawan (1996), Saeed, et al. (2006), and Ahmad and Qayyum (2008) supported the results arrived at in this particular study.

Benin et al (2009) studied the impact of expenditures on public goods and services like agriculture, health, education and rural roads sectors on agriculture productivity of Ghana by using district and regional level public expenditures data and its agriculture productivity returns. Study applied three stages least squares (3SLS) method using data from 2001 to 2006 for the four agro-ecological zones of Ghana. Study revealed that spending on agriculture, roads and health have positive returns while formal education has negative impact. Study recommended more efforts to provide agriculture-relevant knowledge and skills.

Sun et al (2009) studied the impact of public R&D expenditure on US agriculture productivity growth by using dual cost function for the state-by-year panel data set. Papers studied data from 1980 to 2004 for the 48 contiguous states of US. Study examined the role of extension services transportation network and human capital in the process of technology dissemination. Author concluded that higher level of local public goods, R&D spillins, extension services and transportation network decreases cost. Paper further concluded that agriculture productivity from all series of R&D spillins is positive.

Fan, et al. (2009) examined the public expenses on agriculture in Africa. According to them agricultural growth also depends upon non-agriculture spending such as rural infrastructure, health and education. They used the data of forty three developing countries from four regions (Latin America, North Africa, sub-Saharan Africa and Asia), from 1980 to 2007. They found and argued that African countries need to increase their public spending on agriculture. Although some countries have increased but their overall expenditures in

agriculture are lower than those of Asian countries where agriculture sector has been transformed through the green revolution strategies. They suggested that increasing agriculture spending is just a small part of a picture and agriculture growth neither happens by simply investing in agriculture sector alone. There is need to set right priorities to investment in rural infrastructure, agriculture research and education which has more and long lasting effect on agriculture growth and productivity. They finally concluded that African countries confronting with a forthcoming challenge of recent surge in food prices requires more expenses on rural development and agriculture so as to escape from this danger and can ensure stable supply of foods to millions of people.

Govereh et al (2009) conducted a study to analyse the composition of public investment in agriculture sector of Zambia for the period 2000-08. Study found that low productivity of the sector is not due to scarcity of resources but due to misallocation of public spending to the subsectors. High returns' projects are given low priorities than low returns' projects. Study revealed ineffectiveness of subsidies and emphasized on more investment in agriculture infrastructure and extension services. Study recommended more involvement of government for the effectiveness of agriculture spending and for not only increasing the yield but also for equitable distribution and allocation of resources.

Mogues et al (2008) conducted a study and said that public spending on agriculture is very low in Nigeria. They said only less than 2% allocated to agriculture sector for the time period 2001-05 which is comparatively very lower than allocation to other sectors like water, education and health sector.

Fan, et al. (2008) did an analysis in India about the return to public spending on different types of agricultural subsidies and to public investment in agriculture. They reached on some interesting findings. There were vast variations in returns across different types of agricultural subsidies. The return to fertilizer subsidy was as minimal as 1.79 while the return to agricultural credit was as much high as 18.77. However, the average pay offs to public

investment in different agriculture related projects were high, though, not much different from the returns to agricultural subsidies at that time.

Mullen (2007) analyzed the impact of R&D expenditure on productivity growth in Australian agriculture. The study found strong positive impact of R&D expenditure on production growth and found no evidence of diminishing returns from the rate also found by Mullen and Cox (1995). Study further found increasing marginal impact of research which points toward underinvestment in agriculture research. Therefore study strongly recommended maintaining current rate of public investment in agriculture research.

Chand (2006) arrived at a little different conclusion while studying the relationship among public and private investment in agriculture and agricultural terms of trade. The author found a positive and significant effect of the agriculture terms of trade on the formation of private capital in agriculture while an insignificant and even negative effect of government agricultural spending on the private fixed capital formation.

Fan et al (2004) estimated outcomes of public expenditure on agriculture productivity and poverty alleviation in rural Uganda. Furthermore study shown that public expenditure on agriculture research and extension uplift agriculture productivity and reduce rural poverty. Government expenditure in health has not a significant effect on agriculture productivity and decrease in rural poverty.

Fan, et al. (2004) conducted an interesting study for the more rich coastal, the not much poor central, and the more poor western regions of China. The western region of China was not only having high incidence of income poverty but also suffered from low agricultural productivity. The study found that the pay offs in terms of increased income to public spending on agriculture were the highest in the poorer western region as compared to the rich coastal region. Interestingly, these pay offs in terms of increased income to public spending on more direct poverty alleviation programs in western China were not as much high as to public spending on agriculture.

Knight, et al. (2003) examined that how education is affecting farmers' attitude towards risk. Study used household data of rural Ethiopia. They argued that education plays a vital role and household head's education is found to reduce risk aversion. They found that the schooling or education encourages the farmers to adopt new innovation while risk aversion reduces its probability, meaning that educated farmers are less risk averse than the one with no education. In some extent educated farmers took the lead in inventing and then followed by uneducated farmers. Thus study concluded and recommended more investment in human capital which will lead to more risk taking by farmers and will acquire higher returns. In the meantime, this reduction in risk aversion has private benefit for farmers but also has positive externality effect.

Huffman (2000) examined the impact of education which is recognized as human capital on agriculture growth and its potential for future. In this regard, institutions plays very important role and week institutions lower the expected private returns and also undermine future economic growth. In rural areas investment in schooling of children will enhance their income level in long run, and also improves their living standards. He found that schooling cannot be viewed as unconditionally productive in agriculture sector, as its impact is conditioned upon the options of off-farm work and migration. They argued that as the technology is improving and rapid advancement in the communication is taking place at a lower cost in current era, so farm people will need strong basic schooling in order to adopt and use these new technologies, which will reap the maximum gain and to mitigate the upcoming challenges. They concluded that the rate of return on primary schooling in the low income countries is very high and in other countries, strong primarily schooling is needed to provide the foundation for formal and informal learning.

Easterly and Rebelo (1993) investigated the effect of government agricultural spending upon private investment across different countries of the world during 1970-1988. They found a negative and significant effect of government agricultural spending on private investment. However, the results were not consistent under different estimation procedures

and even became insignificant when the public spending variable was instrumented by other variables to avoid the problem of endogeneity. Moreover, the study used aggregate private investment instead of private investment in agriculture. The crowding out phenomenon might be disappeared if the authors would use a disaggregated data for investment.

Diakosavvas (1990) studied the impact of government current and capital investment in agriculture on agricultural output across different developing countries during 1974-1984. He found positive effects of both types of public investment on agricultural output, however, current expenditure were more productive in countries of Africa and Latin America while capital expenditure were more productive in countries of Asia and the Near East. Moreover, the author found negative impact of inconsistent and volatile government agricultural spending on the growth rate of agricultural output.

Lin (1990) analyzed the impact of education on technology and innovation adoption in agriculture. Study analyzed the role of education on household decision about the use of F1 hybrid rice in China. Study is based on a behavioral model developed from a sample of five hundred households of five counties from Hunan province. Usage of new technology is treated as a portfolio selection problem in that model. Empirical results of the study indicate that education of household's head have significantly positive effect on adoption of F1 hybrid seeds. Study recommended public investment in rural education to assist the adoption of new technology in agriculture.

Elias (1985) assessed that how government expenditure on agriculture is affecting agriculture growth in nine Latin American countries for the time period 1950-1980 using production function approach. Study showed that the average increase in agriculture output is not only due to the increase in inputs. Cross country analyses of agriculture growth showed that the differences in the output increase were some other factors than the difference in inputs growth. Study told that the 40% of output growth showed the impact of government expenditure on agriculture as this growth is not explained by the growth in traditional inputs.

In this study an aggregate concept of public expenses on agriculture is used. Government expenses on agriculture include expenditures on education, administration, extension and research. Study concluded that the aggregate concept of government expenditure on agriculture is more significant than the individual component in the estimates of production function. Positive nexus of per hectare government expenses on agriculture farming sector and sector's growth is noted in this study. Furthermore study revealed that more government investment in irrigation, research and extension leads to higher growth of the sector. Government expenditure on agriculture leads to the stability of agriculture. Positive relations were found between research and extension expenditure and the use of fertilizer and land reforms expenditure and use of irrigation. Small negative relation was found between education and health and the use of labor.

2.2 Studies about Pakistan:

Yasmeen, Abbasain and Hussain (2011) conducted a study to examine the impact of farmer education on agriculture product in the district Mailsi, Pakistan using the primary data 330 households from rural areas. By using the OLS, they found that education of farmer is positively related to agriculture product but the magnitude of educated farmers in large farm holders is smaller than for small-farmer due to fact that the large farmers are less dependent on credit. They also found that labor cost is much higher for large farms-holding than for the small farms, because they hire labor rather than family members participating itself which is the case in small farms. They concluded that inputs like fertilizers, seeds, pesticides positively and significantly affect the agriculture product but educated farmer is more likely to use fertilizer than the illiterate farmer.

Ali and Iqbal (2005) conducted this study to focus on sources of growth in total factor productivity of Pakistan agriculture sector from 1960-1996. The study observed that main causes behind growth in TFP are technological improvement, public expenditure in irrigation system, agriculture research, extension services and infrastructure. Therefore in late 1970s and in early 1980s growth in TFP sustained mainly due to given factors. The study

recommended that public investment for the strengthening of agriculture markets. Further public funds to agriculture research should increase up to five to six times of present level.

Khan (1997) conducted another study on agriculture growth and public policy in Pakistan. Author explained the agriculture crisis and policy option for sustainable growth of the sector. Study said that unsustainable growth of agriculture in Pakistan is mainly due to the public policy. Governments have been very active in some areas of agriculture and very much inactive in some areas which were the wrong diagnosis by policy makers and furthermore there is an inadequate will and administrative capacity on behalf of governments to implement those policies. Some policies were not used due to the political issues even when those were considered desirable. Author blamed public policy for the large part of the low growth of Pakistan's agriculture. Study concluded that governments should play an active role instead of withdrawing from economy but to avoid market failure and minimize their own failures.

Ali et al (2008) conducted this study to find out total factor productivity (TFP) for the agriculture using the data on Pakistan for the time period 1971-06. Study divided the whole period into four sub-periods i.e. seventies, eighties, nineties and last six years, and estimated average annual TFP growth rate by using Tornqvest-Theil (T-T) index for each sub-period. They found that average annual TFP growth rate was highest in last six years i.e. 2.86% and lowest in 70s i.e. 0.96%. Average TFP growth rate for the decades of 80s was registered as 2.24 and for 90s it was 2.46. TFP growth contributed to agriculture productivity growth about 33, 53, 81 and 83 percent for all the sub-periods respectively. Study recommended large public expenditure allocation for research development, extension services, markets and overall infrastructure for the increase in growth rate of TFP rather than increase in the use of inputs.

Faruqee and Carey (1995) examined the role of government in agriculture sector in Pakistan and concluded the major reforms needed to enhance the agricultural growth. They

argued that Government's role is grouped into two broad areas: price and trade policy, and public institutions service and expenditure. They assessed the effect of price and trade policy on functioning of input markets, through the direct effect on agriculture and indirect effect of exchange rate. They found that subsidies on inputs have created distortions in input markets. They argued that role of public institution is increasing in each part of agriculture but it yields too little benefits to this sector, and its important failure is in the area of research and extension. They concluded that through under-pricing of water and electricity hidden expenditure also taken place. They finally concluded that Government's role in agriculture has little beneficial effect on farmer, and there is need of major policy reforms to mitigate the challenges faced by this sector and increase its growth potential.

Azhar (1991) investigated how agriculture yield is being affected by human capital in Pakistan. By examining cross section data of the year 1976-77 author tried to find out how technical efficiency and education is going to affect the sector. By using the production function approach, analysis is conducted for both new crops variety and for old counterparts. They argued that education effects yield in two ways: the allocative effect which deals with better allocation decision, adoption of new technology, while worker effect related to technical efficiency aspect of production. They found that education is highly effective on technical efficiency in case of new crops and supported study's hypothesis. An educated farmer is adjusted quickly to the technical change. They concluded that the elementary education is insufficient to assure a positive effect on agriculture yield, and at least primary and above level of education will enhance the productivity.

Zuberi (1989) estimated the production function for agriculture sector of Pakistan for time period 1956-86 using OLS based on the Cobb-Douglas model. He argued that the agriculture development of Pakistan is primarily based on the low cost technology with higher pay off. Over the period of time both consumption of fertilizer and credit disbursement immensely increased, and out of this credit 70% is used in the purchase of seeds and fertilizers which contributed the agriculture growth. He found that despite the increase in the

use of seed-fertilizer technology in Pakistan, it is still lower than the other LDCs in the region. Author recommended additional inputs for improvement in productivity as existing technology is at its peak level investment in human capital (i-e: education) which is necessary to increase the productivity.

2.3 Summary of the Previous Studies:

The aforementioned studies analyzed how spending on different public goods effect agriculture growth in different parts of the world. Some of them studied the impact of overall public expenditure in agriculture and their impact on agriculture growth whereas some studied the impact of different heads of public spending like agriculture subsidies, agriculture R&D, agriculture extension services, rural infrastructure, education and health on agriculture growth, total factor productivity growth and on private Investment in agriculture sector.

2.4 Contribution of the Present Study

The aforementioned studies are silent about the impact of spending on public goods on agriculture value added per worker in Pakistan. So the present study will bridge this gap.

CHAPTER 3

Agriculture Sector and Public Spending in Pakistan

3.1 Importance

Agriculture sector of Pakistan comprises of main crops such as rice, wheat, maize and cash crops, while trivial crops include pulses, vegetable, fishery, livestock and forestry. In Pakistan mainly two crops seasons prevail firstly the Kharif crops, sowing of which starts in spring and harvested in autumn whereas it consists upon cotton, sugarcane, rice, maize and pulses i.e mung, mash, bajra etc. Secondly the Rabi crops, their sowing starts in winter and harvested in the end of spring and in the beginning of summer. While Rabi crops consist of wheat, gram, rapeseed, barley, mustard and tobacco (Sethi 2002).

Agriculture has been one of the key sectors of the economy since the independence of Pakistan. Still agriculture is dominant sector of the economy as its share to GDP is still 21 % and its contribution to labor force is 45%. The importance of agriculture sector can be further revealed from following table 3.1 showing the decade wise analysis of its share to GDP and towards employed labor force respectively.

Table 3.1: Contribution of Agriculture to GDP and Employment.

Decade	Percentage Share of Agriculture to GDP	Percentage Share of Agriculture to Employed Labor Force
1970s	33.69	53.26
1980s	28.55	51.93
1990s	26.04	47.67
2000s	23.24	44.38
2010s	21.56	44.24

Source: Statistical Appendix to Economic Survey of Pakistan

Agriculture sector supply raw material to agro-based industry and its income creates demand for industrial products (Economic Survey of Pakistan, 2014-15). Along with supply inputs to industrial sector, it also creates market for industrial products (Ahmad et al, 2008).

Whereas agriculture supply food to consumer and fibers to home industries, it furthermore contributes larger part to foreign exchange earnings (Alam and Naqvi, 2003)

Likewise, expanding agricultural development or profitability is a standout amongst the most vital determinants of economic development. The rise in profitability of this sector raises the overall interest for merchandise and developing of other sectors in the economy as well. Development of this sector additionally gives sustenance security to the economy, permitting it to focus on the development of different divisions. Not just that agricultural development also gives support to international trades which balances out the exchange rate of the country.

About the previous 67 years a huge increment underway of the significant yields has been accomplished. Wheat production ascended from 3.3 million tons in 1950/51 to 25.97 million tons in 2013-14. Similarly during this period rice production increases from 0.86 million tonnes to 6.97 million tonnes. There was additionally a record increment in grain generation. The production of cotton came to 12.76 million bundles amid 2013-14. Sugarcane production came to 67.46 million tons amid 2013-14. The decade wise trend of the agriculture value added per working can be seen in the following table 3.2.

Table 3.2: Agriculture Value Added Per Worker

Decade	Agriculture value added per worker 2005 $
1970s	655.97
1980s	743.68
1990s	1006.11
2000s	1132.52
2010s	1085.68

Source: Statistical Appendix to Economic Survey of Pakistan
World Development Indicators (World Bank)

3.2 Overview of Agriculture Performance

In 1970's, the growth rate in agriculture value added was of 2.65 percent which was far less to compare with that of 1960's which was 4.56 percent (See table 3.3). Its contribution to GDP was also declined to 33.69 percent (see table 3.1). The growth rate of 2.65 percent in agriculture value addded was because of several reasons. First, due to green revolution the public expenditure focus was spending on inputs while spending on other important factors such as agriculture research, education and training was neglected at that time. Second, the inputs like fertilizer, pesticide and seeds were productive at their initial stage but soon due to improper check their marginal returns were diminished (Ahmed & Amjad, 1984). Third, the agriculture growth was adversely affected by the structural and institutional reforms of the government. Finally, due to adverse weather conditions the crops output declined during the first quarter of the seventies. Ali et al. (2008) reported that heavy rains with floods in seventies led to the loss in crops output. The contribution of total factor productivity and inputs were 33 percent and 66 percent respectively. The number of draught animals, tractors and tube wells were increased more than double during the decade of eighties. The decade of eighties had shown improvements than seventies where in eighties the value added of agriculture sector grew at 4.43 percent (See Table 3.3). However, at this time the share of agriculture declined in GDP i.e. 28.55 percent (See Table 3.1). Further in eighties government opted policy of rising support prices of major crops which led to the growth of agriculture by 4.4 percent and 3.5 percent in first and second quarter of eighties respectively (GOP, 1990). The per hectare yield of production index for cotton increased from 312 kg per hectare in year 1977-78 to 615 kg per hectare in year 1990-91. Technical change in complementary inputs i.e. water availability and fertilizer innovation highly added to the productivity. The variation in cotton seeds also raised cotton productivity. High investment in 1970's become fruitful in 1980's led the growth rate of agriculture value added to 4.43 percent in the decade. In years of 1980-1984 and 1985-1999 the agriculture value added growth rate was of 2.91 percent and 5.94 percent, and share of the GDP was of 30.04 percent

and 27.06 percent respectively. It is evident that this growth has added greatly to GDP in last half five years of the decade. In this decade of eighties, live stock was grew at 5 percent average annual rate. This live stock rate was inspiring because in seventies there was no growth in livestock. Factors like better weather condition, main inputs availability and their effective utilization and in addition policy changes for stability in prices of crop highly supported the growth of total factor productivity (Ali e al. 2008). In 1990's, the growth rate of agriculture value added was recorded 4.23 percent (see Table 3.3) and agriculture TFP increased from 2.24 percent in 1980's to 2.46 percent in 1990's. The inputs contribution falls to 19 percent from 47 percent while TFP contribution increased from 35 percent to 81 percent. The growth rate of the agriculture value added was 3.48 percent and 4.23 percent in years of 1990-1994 and 1995-1999 respectively.

Table 3.3: Agriculture Value Added (% Growth rate)

Decade	Agriculture value added % growth
1960s	4.57
1970s	2.66
1980s	4.43
1990s	4.23
2000s	3.21
2010s	2.16

Source: World Development Indicators (World Bank)

It may be right to say that in 1990's the higher prices were due to the elimination of fertilizer subsidy by the government. The higher prices ultimately affected the fertilizer consumption efficiency which resultantly contributed to the increase in TFP. Also the livestock partly contributed to the growth in highest where the live stock was of value 11.2 percent in 1995-96 which is the high growth rate. For sustain economic growth the incentives in favor of farmers cannot be ignored. Farmers' incentives are important factors which contribute to maintain productivity (Ali et al. 2008). However, the decline in output growth of agriculture was because of the attack of CLCV on cotton which is major crops of the sector, and floods and droughts (GOP. 1997). In 2000's, the agriculture sector had grew at 3.21

percent and its share decreased to 23.24 percent (see Table 3.1 & 3.3). In first half decade of 2000 TFP increased by 16 percent from TFP of previous decade. Moreover, in 2000s TFP contribution was 83 percent to agriculture productivity which is too much higher than the previous decade's performance. The input role has decreased to agriculture by 17 percent. In addition, wheat production has increased to 21.3 million in year of 2005-06 from 19 million in year 2000-01. Likewise, in the same period production of other crops such as cotton, rice and maize increased to 2.2, 5.5 and 3.1 million tons from 1.8, 4.8 and 1.6, respectively. During the same period of first six years in 2000s, the cultivated area from 2.2 million hectare grew to 2.3 million hectare. The fertilizer utilization and pesticide has also shown moderate growth in the time with inactive food consumption (Ali et al. 2008). The agriculture value added had surpassed its growth of 4 percent and had a striking growth rate of 6.48 percent in the year of 2004-05. This rising growth in agriculture was mainly because of outstanding rise in wheat and cotton crops that supported from timey rainfall and their rising procurement prices. The rice production leads to expand by 2.7 percent the agriculture growth in year 2004-05. The above discussion has shown high-quality performance of the agriculture TFP and resultantly its payment to the agriculture output growth. The average growth of agriculture value added and its share to GDP of the years 2000-05 was 2.84 percent and 23.75 percent, respectively. In last five years of 2000s, due to natural calamities the performance of major crops remain slow and resultantly leads to lower value added growth of rate 3.05 percent. The major crops were highly affected by natural calamities and even most of the years have witnessed negative growth in key crops. The record floods happened in July 2010 highly destroyed the crops of rice and cotton which led to a lower growth of rate 1.2 percent (Economic Survey of Pakistan, 2010-11).

3.3 Problems in Agriculture Sector of Pakistan

Agriculture sector of Pakistan faces many problems. These problems should be taken into consideration and addressed on priority basis to help ensure the high and stable growth rate in this sector. First problem is the lack of farm mechanization in this sector (Alam and

Naqvi, 2003). In the modern age of twenty first century the machinery available in our farming sector is far below the required level. No mechanism is being implemented to stop soil erosion and to improve or maintain the soil energy. Even with the much fertile layer thickness Pakistan has lower average yield than countries with having thinner layer of fertile soil (Ali, 2010). Second is wastage of water as 50 to 60% of the water is wasted due to the old method of irrigation in the whole country (Ali, 2010). Efficiency in the usage of water is the primary factor for the revival of agriculture sector of Pakistan. Fifty percent of water is wasted at the watercourse level and thirty three percent of the water is wasted at the canal level due to lack of attention given to the fading and weakening canal system (Ahmed et al, 2007). The poor performance of agriculture sector resulted from the water shortages in this sector due to the deteriorating and inefficient irrigation system (Economic Survey of Pakistan 2009-10; Alam and Naqvi, 2003). Third problem is the fragmentation of farms. Due to the increase in population and thus fragmentation of land the small farmers are unable to get agriculture credit. These small farmers are unable to purchase and use high yielding varieties of seeds, fertilizers and pesticides due to the non availability of credit (Economic Survey of Pakistan, 2009-10 and 2010-11; Ali, 2010; Planning Commission of Pakistan, 2011). On the other hand farm mechanization can't be applied to small pieces of land. Similarly tenancy in Pakistan is also one of the reasons for the low productivity of agriculture sector due to the discouraging work environment and non favorable terms and conditions for them (Ali, 2010; Saeed, 2007). Fourth big problem is salinity and water logging which is increasing with everyday and no proper arrangement has been done yet to control it. Furthermore per acre water availability is also falling due to the lowering storage capacity of existing dams. As a result increasing number of tube wells are being installed by farmers. Fifth problem is the training and education of agriculture labor force. Due to low level of education and less professional knowledge of the sector this labor force is unable to apply modern technology and use high yielding varieties of seeds. Furthermore due to unawareness farmers are too much risk averse and extra cautious to use new technology on their farms. Same was the reason for the low growth rate in 1970's (Saeed, 2007; Ali, 2010). Sixth problem is the farm

to markets access for the farmers to find favorable prices for both their inputs and outputs and hence get more income to apply high yielding varieties of seeds. The final problem of agriculture sector of Pakistan is the low labor productivity in this sector. This low labor productivity is due to the lack of credit availability to poor farmers, wasteful and deteriorating irrigation system, old farming techniques and high prices of inputs (Planning Commission of Pakistan, 2011).

Proper government policies are needed to deal with the problems of agriculture sector. Many such policies are being devised and implemented by the government for the growth of agriculture sector. Policies like provision of high yielding varieties of seeds, expenditures on research and extension services, subsidies on different inputs and extension of roads etc. (Islam, 1996; Ahmad et al, 2008; Economic Survey of Pakistan, 2010-2011). Similarly government also spent on mechanization of firms, irrigation system and spending on canals and dams in the past. Growth in agriculture sector is vital for every economy. Both inputs and raising the productivity can help achieve this high growth rate in the sector (Rosegrant and Evenson, 1993; Collins and Bosworth, 1997). The primary element of growth in agriculture sector consist upon land, labor, water, fertilizer, pesticides, etc which are the main inputs engaged of agriculture sector of Pakistan The second component is the increase in productivity. The second element of agriculture growth is the growth of factor productivity which is the difference of the growth of outputs and growth in inputs (Rosegrant and Evenson, 1992). Growth of the total factor productivity is crucial for the growth of the whole economy (Ali et al, 2008).

In the above discussions we found that in 70s even with the green revolution we got low agriculture growth rate due to the negligence of government sector to spend on public goods like research and extension services, education and training. More emphasize was being given to other inputs like fertilizers, pesticides and seeds which eventually gave diminishing returns. Secondly it is evident from the huge amount of literature and past

experiences of nations that education and health plays an important role in growth of an economy. Nations with more human capital can catch high and faster growth. Agriculture sector is not an exception to that. In the case of Pakistan 45 % of the labor force is employed in agriculture sector. Due to which importance of education and health of this labor force can't be ignored. Similarly we found that transport and communication plays a vital role in speeding up the growth of an economy and agriculture sector particularly. In agriculture sector mostly we are dealing with perishable goods which needs speedy and cheap market access. Farmers will get favorable prices of inputs and for their yield and thus incentive to produce more.

In the case of above public goods markets usually fail to allocate efficiently. Due to this market failure it is then considered as the responsibility of the government to allocate resources for the provision of these services to help the economy grow faster and agriculture sector particularly. Due to the importance of these spending by the government for the agriculture growth this study focuses on their contribution towards agriculture value added. The relation between spending on these goods and agriculture value added is clearly evident from the following table.

Table: 3.4. Government Expenditure and Agriculture Value Added

Years	AGVAD	RL	PEH	PEED
1971-75	650.39	75.70	0.02	1.80
1976-80	661.87	86.57	0.09	2.17
1981-85	716.26	104.20	0.21	2.09
1986-90	798.65	143.39	0.42	2.64
1991-95	972.95	189.46	0.44	2.59
1996-00	1095.09	235.33	0.78	2.62
2001-05	1149.75	253.62	0.73	2.08
2006-10	1107.60	259.50	0.86	2.56
2010-13	1093.20	261.50	0.98	2.28

SOURCE: World Development Indicator (WDI)
Statistical Supplement to Economic Survey (SSES)

Above table shows five years averages of data on Agriculture Value Added per worker, Road Length, Public Spending on Health as a percentage of GDP and Public Spending on Education as a percentage of GDP in 2nd, 3rd and 4th column respectively. Road Length is taken as a proxy of spending on transport and communication. Increasing and positive trend can be witnessed between Agriculture value added per worker (AGVAD) and all other variables.

To further investigate the above relationship between agriculture value added per worker and spending on these public goods proper theoretical based techniques are required which are discussed and applied in coming chapters.

CHAPTER 4

DATA AND METHODOLOGY

This chapter deals with the theoretical background of this study, definitions, data sources and also explain the econometric model used for the analysis.

4.1 Theoretical Framework

The provision of the public goods and its effects on welfare or economic well-being of the society has always been under consideration and this question is vastly examined across the globe and lot of debate is going on this important issue (Fenn et al., 2002 & 2004). The paramount concern of provision of the public goods is the conceptual framework of market failure. Public spending carries its weight in this regard and is highly acknowledged to achieve well-being of the people through or in poverty reduction. It looks quite intuitive and logical that the government would spend where its effect may be highly significant and major part of the society reaps benefits of it. The decision to spend on public goods is debatable whether it is endogenous or exogenous (Ansari et al., 1997; Zhang and Fan 2004).

As far as this study concerns, the effects of public spending on agriculture value added per worker is under consideration. In this regard, to conceptualize decision making in agriculture production, immensely, existing literature draws our attention toward farm household models, use of agricultural technologies and the determinants of the agriculture investment (Singh et al., 1986; de Janvry et al., 1991; Feder et al., 1985 & Ervin and Ervin, 1985). Commonly, a cogent notion suggests that public as well as private capital is a complimentary factor in the production process. Ashipala and Haimbodi (2003) extracted that private spending is more effective rather than that of public spending. Therefore, public spending may cause hindering growth. Further, it comes out that public expenditure may not be productive. Devarjan et al. (1996) found that there could be low synergy between public spending and growth.

Twofold effects of the public spending on the agriculture value added per worker can be estimated: 1) direct effects where public spending influences factor productivity and 2) indirect effects, where government expenditures influence the use and amount of factors or factor accumulation. Indirect approach further demonstrates that public expenditures on education, health, research and development for agriculture escalate towards improvements in human capital and the adoption of the new technology, which ultimately bring about burgeoning wellbeing in the rural sector and it enhances productivity of these factors.

Public spending on improving the rural infrastructure also leaves positive indelible effects on the agricultural wellbeing. Public spending on improving the transportation and extension in roads which links the rural market to developed markets or access to potential markets are the drivers which eventually enhance agricultural potential via reducing the transportation and transaction cost, integrating the markets and increasing farm gate prices due to perfect marketing information. It may have multiple effects which also cause an improvement in health, education and research and development (Benin et al, 2009).

Having above conceptual framework in view, this study seeks how spending on public goods are affecting per worker's value added of agriculture sector. In this study three kinds of public spending i.e., public spending on health, education while public spending on transport and communication (peroxide by road length in kilometers) are used to assess their impact on agriculture value added. Besides public spending there are many other variables that affect agriculture value added. Looking over the requirements of production, this study considered agriculture value added per worker as depended variable while the included explanatory variables were public expenditure on health sector, public expenditure on education sector, road length, import of pesticides, fertilizer off-take and labor force employed in agriculture sector and production of tractors.

4.2 Data Source and Description of the Variables

The data has been taken from two major sources, World Development Indicator (WDI) and Statistical Supplement to Economic Survey (SSES) for the period 1972 to 2013. Expenditures on education and agricultural value added per worker are taken from WDI, whereas, expenditures on health, Import of Pesticides, fertilizer off-take, production of tractors, labor force participating in agriculture and length of roads is taken from SSES.

Table 4.1 Definition of the Variables

Name of Variables	Description	Unit
Agriculture value added per worker (AGVAD)	Used as dependent variable and is representing agriculture value added per worker (constant, 2005)	$
Public expenditures on education (PEH)	Overall expenditures made by government in education sectors as a percentage of GDP during a year	Percentage
Public expenditures on health (PEED)	Overall expenditures made by government in health sector as a percentage of GDP during a year	Percentage
Agricultural labor force (LF)	Labor participating in agricultural sector	Thousands
Length of roads (RL)	Length of roads in Pakistan	Thousands Kilometer
Imports of pesticides (PES)	Total import of pesticides in a year	Thousands tones
Fertilizer off-take (FER)	Fertilizers off-take in agriculture during a year	Thousands Nutrient tones
Production of tractors (PT)	Total production of tractors in Pakistan	Thousand

4.3 Estimation Procedure

It is suitable to check the stationarity of data before estimation analysis as the nature of the data is time series. There are various unit root tests for this purpose, like Phillips-Perron test and Schmidt-Phillips test but to check the stationarity of data Augmented Dickey Fuller

(ADF) test is used here in this study. By using the test it is found that all variables were not stationary at level i-e: I=0. No variable was found to be integrated of order two [I(2)], dependent variable was stationary at first difference whereas some of the explanatory variables stationary at level and others at first difference. So the suited model in this case is Auto Regressive Distributed Lag (ARDL).

4.3.1 Augmented Dickey-Fuller (ADF) Test

First difference lags are included in ADF to make the error term μ_t white noise. In this case the regression equation can be written in the following form:

$$\Delta y_t = \alpha + \beta_t + \lambda y_{t-1} + \sum_{i=1}^{k} \beta t \, \Delta Y_{t-1} + \mu_t \qquad (4.1)$$

The above equation contains trend and intercept which accurately depicts the procedure of ADF test. Where intercept is α , coefficient of the time trend is β_t , coefficient of y_{t-1} is λ while lag order of the autoregressive process is k. First difference of y_t and y_{t-1} is given by $\Delta y_t = y_t - y_{t-1}$.

The testing procedure is illustrated below;

First to take null and alternative hypothesis as;

H_0: $\alpha = 0$ series is stationary

H_1: $\alpha < 0$ series is non-stationary

Determining test statistic using,

$$F\tau = \hat{\alpha} / SE(\hat{\alpha})$$

Where $SE(\hat{\alpha})$ is the standard error of α.

Then comparing test statistic calculated with critical value Dickey-Fuller table, either to accept the null hypothesis to reject it.

If $F\tau$ is less than the critical value, then alternate hypothesis will be accepted which mean variable of the series does not contain a unit root and are non-stationary and vice versa. If all variables are found to be stationary at level, then OLS will be applied and if the order of

differencing is same the appropriate technique is to use the Johansen Co-integration test. Also, if variables are found to be stationary at different levels then the study will use the Autoregressive Distributed Lagged (ARDL) approach.

4.3.2 Autoregressive Distributed Lagged (ARDL)

It is used when the variables are stationary at different levels, as in this technique all the variables are assumed to be integrated of different orders. One of ARDL procedure is that it does not involve pre testing of the variables, the variables can stationary at first difference or stationary at level be integrated at order of order one (I=1), or integrated at order (I=0) or mixed of both. So, in this situation standard co-integration becomes unstable because the power of the test to determine co-integration between variables is quite low. Autoregressive Distributed Lagged (ARDL) requires that no independent variables have integrated order higher than one with dependent variable stationary at first difference. While the standard co-integration estimates the long run relationship among variables involving a system of equations and the ARDL model only takes reduced form equation [Pesaran and Shin, (1995)]. Different variables are having different lags in ARDL technique which can't be estimated by standard co-integration, and most importantly, it can used with limited sample set of critical values developed by Narayan (2004) by using GUASS.

ARDL process compromises of two stages. First it tests the long run relationship by using the F-statistics for the determination of the significance of lagged variables in the unrestricted error correction model. Secondly, the coefficients of both long run and error correction model (short run) are estimated. Unrestricted error correction model (ECM), regression of y on the vector x, involved following method and can be written as;

$$\Delta AGVAD_t = a_0 + a_1 . t + \phi AGVAD_{t-1} + \delta_1 PEH_{t-1} + \delta_2 PEED_{t-1} + \delta_3 RL_{t-1} + \delta_4 FER_{t-1} + \delta_5 PES_{t-1} + \delta_6 LF_{t-1} + \delta_7 PT_{t-1} + \& + \sum_{i=1}^{P} \psi i \, \Delta AGVAD_{t-i} + \sum_{i=0}^{q} \varphi i1 \, \Delta PEH_{t-1} + \sum_{i=0}^{q} \varphi i2 \, \Delta PEED_{t-1} + \sum_{i=0}^{q} \varphi i3 \, \Delta RL_{t-1} + \sum_{i=0}^{q} \varphi i4 \, \Delta FER_{t-1} + \sum_{i=0}^{q} \varphi i5 \, \Delta PES_{t-1} + \sum_{i=0}^{q} \varphi i6 \, \Delta LF_{t-1} + \sum_{i=0}^{q} \varphi i7 \, \Delta PT_{t-1} + \mathcal{E}_t \quad (4.2)$$

with φ and δ's as the long-run multipliers, Ψ's and φ's as short-run dynamic coefficients, (p,q) as the order of the underlying ARDL-model (p refers to y i.e. AGVAD, q refers to x i.e. explanatory variables), t as a deterministic time trend, k as the number of 'forcing variables', Δ as the first difference operator or change between two consecutive periods and $\mathcal{E}_t$ as white noise error. Schwarz Bayesian Criteria (SBC) is used in this study for selecting the number of lags in the Auto Regressive Distributed Lag (ARDL) model.

For analyzing long run relation F-test is used to test null hypothesis which assumes the coefficients of lagged variables to be simultaneously equal to zero (0) implying the existing of long-run relation between variables. Alternative hypothesis assumes that at least one of these coefficients is not equal to zero. It is written as;

$H_0: \delta_K = 0$ for all k

$H_0: \delta_K \neq 0$ for at least one k

4.3.3. Long Run Analysis

Long run co-efficients are estimated by the following equation after the existence of long run relationship.

$$AGVAD_t = a_0 + a_1 . t + \sum_{i=1}^{P} \psi i \, AGVAD_{t-1} + \sum_{i=0}^{q} \varphi i \, PEH_{t-i} + \sum_{i=0}^{q} \varphi i \, PEED_{t-i} + \sum_{i=0}^{q} \varphi i \, RL_{t-i} + \sum_{i=0}^{q} \varphi i \, FER_{t-i} + \sum_{i=0}^{q} \varphi i \, PES_{t-i} + \sum_{i=0}^{q} \varphi i \, LF_{t-i} + \sum_{i=0}^{q} \varphi i \, PT_{t-i} + \mathcal{E}_t \quad (4.3)$$

4.3.4. Short run Analysis by Error Correction Model

When long run equilibrium relation is confirmed between dependent and independent variables, then it enables us to capture short run dynamics of the model by applying ECM. ECM is no longer applicable if there is no long-run relation amongst variables. Significant coefficient of ECM explains that a short run variation between dependent and independent variables will yield stable long run relation amongst these variables.

$$AGVAD_t = a_0 + a_1 . t + \sum_{i=1}^{P} \psi i \, \Delta AGVAD_{t-i} + \sum_{i=0}^{q} \varphi i1 \, \Delta PEH_{t-1} + \sum_{i=0}^{q} \varphi i2 \, \Delta PEED_{t-1} + \sum_{i=0}^{q} \varphi i3 \, \Delta RL_{t-1} + \sum_{i=0}^{q} \varphi i4 \, \Delta FER_{t-1} + \sum_{i=0}^{q} \varphi i5 \, \Delta PES_{t-1} + \sum_{i=0}^{q} \varphi i6 \, \Delta LF_{t-1} + \sum_{i=0}^{q} \varphi i7 \, \Delta PT_{t-1} + \Gamma ECM \quad (4.4)$$

Where the error correction term can be estimated from the following equation

$$\Gamma ECM = AGVAD_t - [\, a_0 + a_1 . t + \sum_{i=1}^{P} \psi i \, \Delta AGVAD_{t-i} + \sum_{i=0}^{q} \varphi i1 \, \Delta PEH_{t-1} + \sum_{i=0}^{q2} \varphi i2 \, \Delta PEED_{t-1} + \sum_{i=0}^{q} \varphi i3 \, \Delta RL_{t-1} + \sum_{i=0}^{q} \varphi i4 \, \Delta FER_{t-1} + \sum_{i=0}^{q} \varphi i5 \, \Delta PES_{t-1} + \sum_{i=0}^{q6} \varphi i6 \, \Delta LF_{t-1} + \sum_{i=0}^{q} \varphi i7 \, \Delta PT_{t-1}] \quad (4.5)$$

Γ =0 when dependent and independent variables are in their equilibrium. If ECM technique is proper, then -1 < Γ < 0. This long term effect will be distributed over future time periods according to the rate of error correction– Γ.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 Introduction

This chapter covers the detailed discussion about the results derived. Results of the Augmented Dickey-Fuller test followed by Auto Regressive Distributive Lag (ARDL) model along with diagnostics of the proposed model are given in the subsequent sections.

5.2 Stationarity Results Using ADF Test

Dealing with the time series data the estimation process is started by applying Augmented Dickey-Fuller (ADF) test. Results of ADF test is shown in table 5.1.

Table 5.1: Stationarity Results of Study Variables

	Level of difference	**ADF T Statistic**	**Critical value**	**Prob**
AGVAD	I(1)	-7.60	-4.19*	0.000
PEH	I(1)	-4.55	-4.23*	0.004
PEED	I(0)	-10.52	-4.19*	0.000
RL	I(1)	-3.69	-3.52**	0.034
FER	I(0)	-4.33	-4.19	0.006
PES	I(0)	-3.99	-3.52**	0.016
LF	I(1)	-6.85	-4.19*	0.000
PT	I(1)	-6.10	-4.20*	0.000

*1 % level of significance
**5 %level of significance

Above results of Augmented Dickey-Fuller test show that no variable is integrated of order 2 and all variables are stationary at first difference [I(1)] or stationary at level [I(0)] at 1 % and only 2 variables at 5 % level of significance. Agriculture value added per worker (dependent variable) is stationary at first difference [I(1)] at one percent level of significance.

Public expenditure on health is stationary at first difference [I(1)] at 1% level of significance. Public spending at education is stationary at level [I(0)] at 1 % level of significance. Road length is stationary at first difference [I(1)] at 5 % level of significance. Fertilizer off-take is integrated of order one [I(1)] at 1 % level of significance. Import of pesticides is also stationary at level [I (0)] but the level of significance is 5 %. Another variable, labor force participating in agriculture sector is also stationary at first difference [I(1)] at 1 % level of significance. And finally production of tractor is stationary at first difference [I(1)] at 1 % level of significance.

Above results of the Augmented Dickey-Fuller test show that no variable is integrated of order two [I(2)] at 5 % level of significance. These results further explain that dependent variable is integrated of order one while three of the explanatory variables are stationary at level and other are stationary at first difference. So these results motivate to use Auto Regressive Distributed Lag (ARDL) model which is the most suited model of co-integration for such type of data.

5.3. Investigation of Long-Run Relationship

The results of Wald (F-statistics) are given in the following table

Table 5.2: F-Statistics for Bound Test

Equation	**F-Calculated (P-Value)**	**F-statistics Critical values at 5% level ^ I(0)----------I(1)**	**Result**
FY(AGVAD/PEH, PEED,)	9.56(0.013)**	(4.1)---------(5.29)	CO-INTEGRATION

** REPRESENT SIGNIFICANT LEVEL AT 5% LEVEL

^ CRITICAL VALUES FOR THE WALD TEST (F-STATISTICS) ARE TAKEN FROM PESARAN ET. AL.(2001) TABLE CI(III), CASE III

Above table shows that the value of F-cal is greater than the upper bound critical value which confirms the existence of long run relationship. After the confirmation of long run relationships the long run and short run parameters are estimated in next step.

5.4. Long run Relationship Between Spending on Public Goods and Agriculture Growth

By applying ARDL model, the regression line is estimated firstly for long run relationship between dependent and independent variables. Long run coefficients of the estimates are given in table 5.3. Furthermore short-run coefficients of the estimates are given in table 5.4 and their interpretations are given in section 5.2.2.

Table 5.3 Long Run Effects of Spending on Agriculture Growth

Dependent Variable= Agriculture Value Added Per Worker			
Regressors	**Coefficient**	**T-Ratio**	**Probability**
PEH	0.893	1.830	0.079
PEED	1.234	2.646	0.014
RL	0.0005	5.624	0.000
FER	0.0012	1.919	0.066
PES	0.0176	1.146	0.262
LF	0.339	1.929	0.065
PT	0.027	1.405	0.172
INT	-0.805	-0.491	0.627
TRND	-0.174	-2.067	0.049

Estimated results obtained from Auto Regressive Distributed Lag model (ARDL) indicate that public spending on health has significantly positive effect on agriculture value added per worker in the long run. It shows that other things holding constant, as government increases her spending on health sector, it leaves positive effects on agriculture in long run. Intuitively, increase in health expenditures leaves indirect effects on agricultural value addition through total factor productivity growth. If government keeps more focus on health sector, it will throw positive effects on farmers' efficiency and their human capital which

consequently leads to increase farm productivity in the long run. This positive effect of public health spending on agriculture commensurate with the finding of (Benin et al: 2009, Olabisi, Oloni and Funlayo: 2012). It can be evidently viewed from table 5.3.

Public spending on education is found with significantly positive effect on agriculture value added per worker. Educated farmer is more likely to use new varieties of seeds, fertilizer and technology than the illiterate farmer (Yasmeen, Abbasain and Hussain: 2011). Education plays a vital role and household head's education is found to reduce risk aversion. Educated farmers are less risk averse than the one with no education (Knight, Weir and Woldehanna 2003). Thus more spending on education leaves a positive effect on agriculture productivity both through rise in labor productivity and usage of new technologies in the sector.

Estimated results further reveal that proxy for infrastructure development which is road length has positive and highly significant effect on agriculture value added. Logically, road length escalates towards market integration, lowering transaction cost and access to education and R&D spillins which consequently provocative to bring higher agricultural performance in long run. These results entertain enormous support by existing literature (Sun et al: 2009, Fan, Omilola and Lambert: 2009, Ali et al: 2008, Ali and Iqbal : 2005, Olabisi, Oloni and Funlayo 2012, Benin et al: 2009).

Fertilizer off-take, import of pesticides and production of tractors are used in this model as capital. Fertilizer off-take and pesticides both are apparently affecting agricultural performance positively in long run. These results are matched with the findings of the (Yasmeen, Abbasain and Hussain: 2011, Zuberi: 1989) Further results reveal that production of tractors are having positive effects but statistically insignificant. This study takes tractor production as a proxy for usage of the tractors in agriculture that's why it may have insignificant effects because it does not apparently explain exactly how much tractors are being used in agricultural sector.

The coefficient of agriculture labor force participation has positive sign and highly statistically significant effect on agriculture value addition per worker. It means that the more people participate in farm labor market, and the higher productivity would be in long run. It holds further justification that basically agriculture is a labor endowed sector where manpower plays its role significantly.

On the whole, public expenditures hold positive effects on the performance of agriculture sector.

5.5 Short Run Relationship Between Spending on Public Goods and Agriculture Growth.

Short-run coefficients of the estimates are given in table 5.4.

Table 5.4 Short Run Effects of the Spending on Agriculture Growth

Dependent Variable= Agriculture Value Added Per Worker			
Regressor	**Coefficient**	**T-Ratio**	**Probability**
Dpeh	0.653	1.743	0.092
dPEED	0.903	2.846	0.008
dRL	-0.000	-1.652	0.110
dFER	0.009	1.849	0.075
dPES	0.013	1.132	0.267
dLF	0.110	0.995	0.328
dPT	0.020	1.404	0.171
dINT	-0.589	-0.476	0.638
dTRND	-0.127	-1.916	0.066
ecm(-1)	-0.687	-6.712	0.000

Interestingly, more or less, behavior of above mentioned variables has been found similar even in short run. Notably, public expenditures on health have positive association with agriculture performance. It is witness, evidently, there is slight difference in the coefficient of the public spending on health (see table 5.4). It explains that government expenditures on health have positive influences upon performance of the agricultural sector through increase in total factor productivity. Comparing this result with long run findings, there is just lower effects than that of long run.

Again spending on education sectors is holding positive and significant effect on agricultural performance, even, in short run. Thus even in the short run education is positively associated with agriculture value addition in this study.

Road length is found negatively affecting the agriculture performance but it is statistically insignificant. This insignificant result is quite logical because expenditures on road length have slow but positive effects and it increases agriculture performance in long run. But, in short run, it does not have significant effects because road length is a time consuming project, therefore, in short it holds insignificant impacts on agricultural performance.

Farm sectors' inputs in this study i.e. fertilizer off-take, import of pesticides and production of the tractors have again the same relationship as it has been experienced in long run. Thus Import of pesticides, fertilizer off-take and production of the tractors possess positive effect on agricultural performances even in short run.

Agricultural labor force participation is also found positive but statistically insignificant in short run. It can be interpreted as holding other things constant, the more people participate in agriculture activities the higher agricultural performance would be experienced.

Furthermore the coefficient of the ECM term is -.68759 and statistically significant which shows that 68.75% adjustment will take place within one year towards equilibrium.

Having held erudite discussion of influences of the public spending on the wellbeing of agriculture sector, results obtained from applying ARDL indicate that spending on public goods i.e. education, extension of roads and health leave positive effects on agriculture value addition in Pakistan. Similarly usage of inputs such as import of pesticides, production of tractors, fertilizer off-take and labor force participation in agriculture sector have also positive effect on agriculture value addition per worker. Further, these relationships are found almost same both in long and short run.

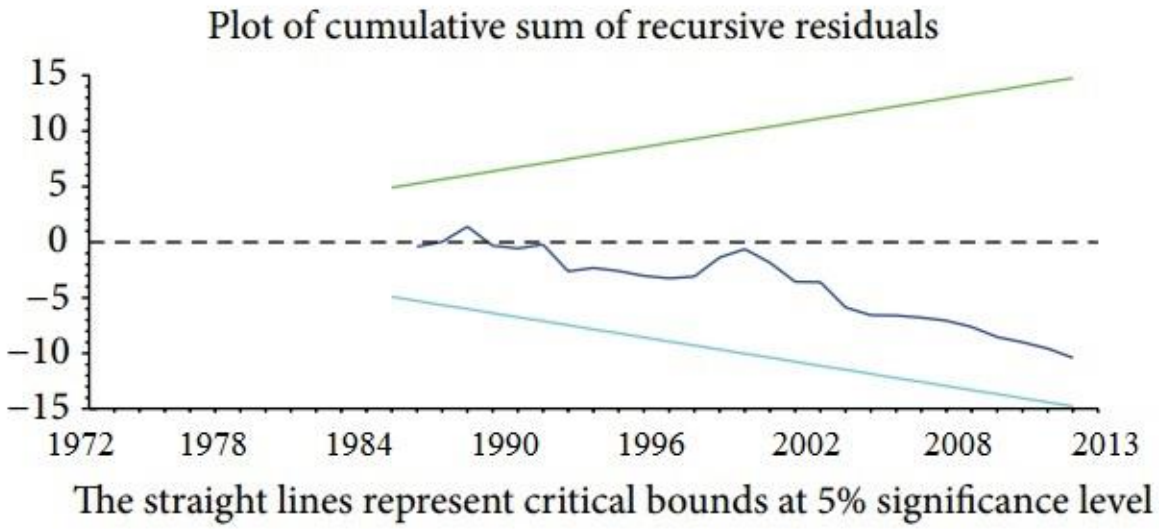
5.6 Results of Diagnostic Tests

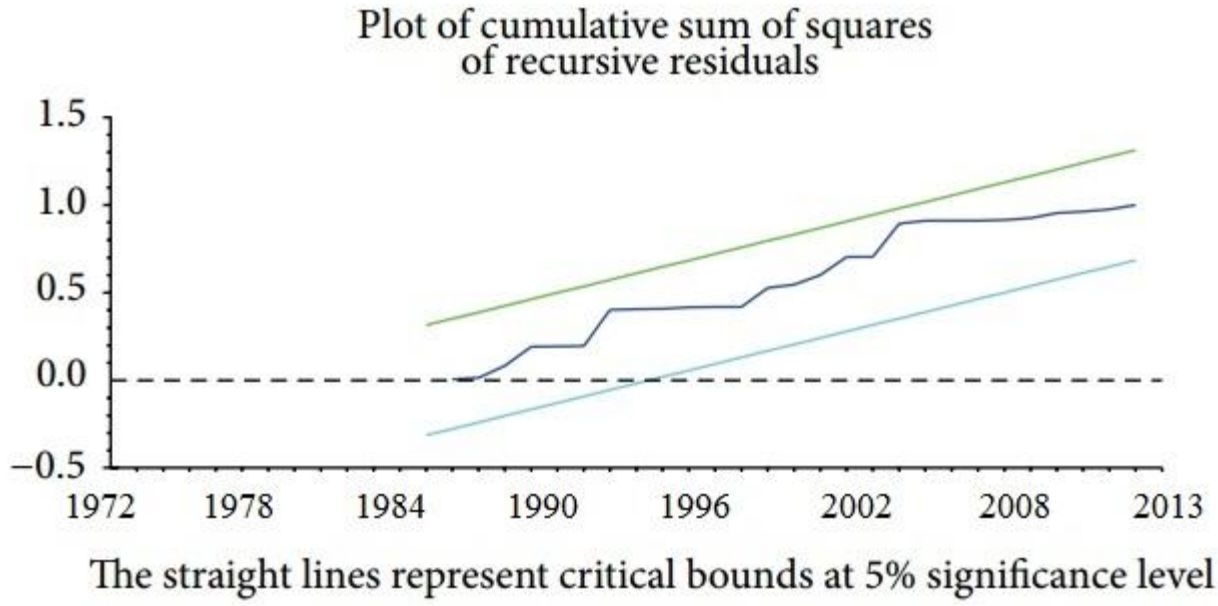
Final specification satisfies all the diagnostic including Lagrange multiplier test for serial correlation, Ramsey's RESET for functional form, Jarque–Bera test for normality and White test for heteroscedasticity. The plot of cumulative sum or recursive residuals (CUSUM) and cumulative sum of square recursive residual (CUSUMQ) confirms no evidence of mis-specification and structural instability for the estimation period of the model. Results of these tests and plotted residual are given in the following table (5.5) and figure 5.1.

Table 5.5: Diagnostics for the Estimated Model

Test Statistics	**LM Version (CHSQ)**	**Probability**
Lagrange multiplier test for serial correlation	0.035	[0.851]
Ramsey's RESET for functional form	3.366	[0.021]
Jarque–Bera test for normality	1.410	[0.494]
White test for heteroscedasticity	0.520	[0.410]

Figure 5.1


Plot of cumulative sum of recursive residuals
15
10
5
0
−5
−10
−15
1972
1978
1984
1990
1996
2002
2008
2013
The straight lines represent critical bounds at 5% significance level


Plot of cumulative sum of squares
of recursive residuals
1.5
1.0
0.5
0.0
−0.5
1972
1978
1984
1990
1996
2002
2008
2013
The straight lines represent critical bounds at 5% significance level

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Introduction

The role and volume of government expenditures is one of the most important issues discussed by economists. Fiscalists support this role of the governments in the subsequent economies due to the failure of the market economy in the provision of goods and services. Literature support the spending on public goods and these spending are being considered as a positive driver of the economic growth (Armas et al: 2012, Dodson: 2007). Government should play an active role in the economy to avoid market failure (Khan: 1997).

Furthermore agriculture sector does not only depend upon the inputs used in agriculture sector but also by other sectors in the economy directly or indirectly (Fan, Omilola and Lambert: 2009). This study focused on the role of public goods' spending on agriculture value addition per worker using the time series data for the period 1972-2013

6.2 Major Empirical Findings of the Study

Empirically obtained findings support the role of government and the spending on public goods for the agriculture value addition per worker. Mainly this study has taken three public goods for analyzing their impact on agriculture value addition i.e spending on health, education and Road length as a proxy of transport and communication. Public spending on health sector has been found positively and statistically significant to economic performance of the agricultural sector. This shows that public spending on health plays a vital role in agriculture value added per worker, as these spending improve human capital of farmer and thus lead to increase in the total factor productivity. Both in short and long run public spending on health has significantly positive effect on agriculture value addition which shows its importance in agriculture sector of Pakistan.

Public spending on education is also found positive and statistically significant both in the short and long-run. This shows that education plays a vital role both through the awareness and usage of new varieties of seeds, fertilizers pesticides and new technologies in agriculture sector.

Road length is taken as a proxy for public spending on transport and communication in this study. Total road length is positively associated in the long-run with the agriculture value added per worker and found statistically significant. This shows that road length reduce transportation cost, lead to technological spillins and favorable input and output prices for the farmers, and hence an incentive to produce more. In the short-run total road length shows insignificant result which is due to the time span of roads completion project.

Labour force participating in agriculture sector is positively and significantly associated with agriculture value added in long-run. Similarly other inputs i.e fertilizer off-take and import of pesticides are also positively associated with agriculture value added both in the long and short-run. Production of tractors is taken as a proxy of farm mechanization which is also positively associated with agriculture value added per worker both in long-run and short-run.

6.3 Conclusion

This study assessed some major public goods spending (i.e spending on health, spending on education and a proxy of spending on transport and communication i.e. Road Length) and their impact on agriculture value addition per worker. Furthermore fertilizer off-take, import of pesticides, production of tractors and labor force employed in agriculture sector are treated here as control variables.

Using time series data from 1972 to 2013 on the above mentioned variables this study concludes that public spending on health has significantly positive effect on agriculture value added per worker both in long and short run. Public spending on education has also significantly positive effect on agriculture value added whereas road length is found to be

having significantly positive effect on agriculture value addition. Similarly other inputs i.e. labor force participating in agriculture, fertilizer off-take, import of pesticides and production of tractors are also positively effecting agriculture value added per worker both in the long and short-run.

6.4 Recommendations

In light of the above findings and conclusions some recommendations are given as under

- As public spending on health has significantly positive effect on agriculture value added per worker. This suggests more public spending on health sector and specifically in rural areas to improve health status of the rural farmers which will finally add to agriculture value added.
- Public spending on education is positively affecting agriculture value added per worker. This suggests that government should spend more on education to spread awareness about new techniques in farming sector and improve human capital of labor associated with this sector.
- Total road length which is taken as the proxy of public spending on transport and communication, has also significantly positive effect on agriculture value added in the long run. This study suggest high public spending in transport and communication which will reduce transportation cost, lead to technological spillins and favorable input and output prices for the farmers, and hence an incentive to produce more.
- Labor force participating in agriculture sector has significantly positive effect on agriculture value added per worker in this study. The result recommends investment in human capital in the form of technical education and training so as to increase the productivity of the labor force.
- Fertilizers off-take, import of pesticides and production of tractors have significantly positive effect on agriculture value added per worker in this

study. This finding suggests an effective role by government in farm mechanization through subsidizing agriculture inputs specifically fertilizer off-take, import of pesticides and production of tractors.

6.5 Limitations of the Study

This study suffers from following limitations.

1. Data on agriculture subsidies is not available for the whole time period under consideration due to which this study is unable to consider this variable.
2. Overall expenditures on transport and communication for the said time period were also missing due to which its proxy i.e. total road length is used for analysis
3. Tractor used in agriculture sector is missing due to which its proxy i.e. overall production of tractors is used for the analysis.
4. Data on research and development spending in agriculture sector is missing for the time period concerned due to which the study is unable to analyze its effect on agriculture value addition.

6.6 Issues for Future Research

In future work it would be important to find out the impact of public spending on agriculture subsidies, agriculture research and development, extension services on agriculture growth rate. Furthermore public spending on rural education and health should be segregated from overall public spending and then their impact should be analyzed for proper policy formulation.

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