Impact of Agriculture Subsidies on Productivity of Major Crops in Pakistan and India:

A Case Study of Fertilizer Subsidy

By:
Muhammad Hassan Danish
Dr. Muhammad Avais Tahir
Hafiz Syed M. Azeem

General Editor
Dr. Mumtaz Anwar

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RESEARCH INSTITUTE (PERI)

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Muhammad Hassan Danish
Assistant Research Fellow

Dr. Muhammad Avais Tahir
Research Fellow

Hafiz Syed M. Azeem
Assistant Research Fellow

General Editor

Dr. Mumtaz Anwar
Director
Punjab Economic Research Institute (PERI)
Planning and Development Department
Government of the Punjab

PUNJAB ECONOMIC RESEARCH INSTITUTE (PERI)

PLANNING & DEVELOPMENT DEPARTMENT
GOVERNMENT OF THE PUNJAB

Preface

The basic purpose of agricultural subsidies is to stabilizing food prices, food security, food production, guaranteeing farmer's basic incomes, and strengthening the agricultural sector of the economy. Because of the importance of agriculture subsidies in increasing output of this sector, this research report presents the subsidies trends in agriculture sector in Pakistan and India. The major focus of the research is to develop the relationship between fertilizer subsidy and productivity of five major crops (wheat, rice, maize, cotton and sugarcane).

This study revealed that real fertilizer subsidies have increased in both Pakistan and India in recent past three decades. The results of the study also show the positive correlation between fertilizer subsidy and productivity of major crops in both Pakistan and India. Moreover, regression analyses have also confirmed the strong relation between the fertilizer subsidy and crop yield but these results are more robust in India as compared to Pakistan.

On the basis of the findings of the study, the institute is of the view that some other inputs like seeds, pesticides and water irrigation etc. are the possible factors or inputs for the productivity and yield of major crops. It is therefore proposed; these agricultural inputs should also be subsidized by diverting some funds from fertilizers subsidy to the other inputs where they needed. The saving from allocation for fertilizer subsidy program could be channeled to construction of new irrigation scheme for water shortage areas.

Dr. Mumtaz Anwar
Director

About Punjab Economic Research Institute

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A dynamic and vibrant research institute that provides inputs for the formulation of forward looking provincial development strategies, and also undertakes high quality, evidence based research to broadly improve public policy making in the province.

Mission

To be Punjab's leading provider of socio-economc insight on evidence based research by adopting proactive and new ideas orientation to assist in policy making in the province.

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Research and Consultancy: To present neutral, independent and objective analyses nd solutions and major policy issues; and undertake research projects and consultancy work.

Think Tank: To contribute to debate on public policy issues and undertake a strong advocacy role on issues of vital significance; and through intense study and interaction, provide strategy analysis and policy prescription of the concepts and doctrines in selected areas of public policy.

Education and Learning: To formulate and conduct education and training courses in the field of public policy and leadership; and enhance capacity and competency for public policy development and implementation.

Knowledge Management: To collate, generate, store, exchange and share knowledge, publications, knowledge products, best practices etc. facilitate knowledge transfer between research institutions and relevant stake holders; produce publications, journals, and analytical note on public policy.

Acknowledgement

Great acknowledgement is here made to National Fertilizer Development Center (Islamabad), which helped the researchers to provide the data on fertilizer subsidies for this report. This work would not have reached its present form without their un-conditional suport.

We would also like to pay special gratitude to eminence economists and professionals of the sector, who read the draft report and gave their valuable comments and suggestions. In this regard, we would like to pay gratitude to the following professionals: Professor Dr. Irfan Ahmad Baig (Muhammad Nawaz Shareef University of Agriculture, Multan), Prof. Dr. Abdul Salam (Department of Economics, Punjab University) and Dr. Muhammad Arif Raza (Assistant Chief, Agriculture, Planning and Development Department, Government of the Punjab).

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Symbols, Notations And Abbreviations

Notation	Description
GOI	Government of India
IFA	International Fertilizer Association
FAO	Food and Agriculture Organization
DAP	Diammonium phosphate
US	United States
GNP	Gross National Product
CPI	Consumer Price Index
KPK	Khyber Pakhtunkhwa
NFDC	National Development Fertilizer Center
GOP	Government of Pakistan
IFPRI	International Food Policy Research Institute
Kg/Hectare	Kilogram per Hectare
2SLS	2 Stages Least Square
S.E	Standard Error
GDP	Gross Domestic Product
OLS	Ordinary Least Square
R&D	Research and Development

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Executive Summary

Agriculture subsidy is a financial assistance provided by the government to farmers and agri-businesses to increase their income and to manage the supply of agricultural commodities. It plays a vital role in the growth of agriculture sector particularly in developing countries where economy is mainly depending upon agriculture. This study is also designed to analyze the trends of agriculture subsidies and to investigate the impact of fertilizers subsidy on yield of major crops in Pakistan and India.

Fertilizer subsidy in Pakistan and India has increased in past decade as compared to 1980's and 1990's. Correlation analysis confirms the positive relation between fertilizer subsidy and crop yield in both Pakistan and India. For regression analysis, five models are used to empirically examine the relationship between fertilizers subsidy on yield of crops in case of both Pakistan and India. First model is regressed over yield of wheat on fertilizer subsidy. Second model is regressed over yield of rice on fertilizer subsidy. Third, fourth and fifth models are regressed to analyze the impact of fertilizer subsidy on cotton, maize and sugarcane respectively. The results of the study are mentioned below in detail:

- Both countries are showing significant contribution of fertilizer subsidies on crop wise yield but results are more robust in India as the proportionate change in crop wise yields are more in India than Pakistan.
- Elasticity's of yields with respect to fertilizer subsidies also confirms the results of regression analyses. Although yield is inelastic to subsidies in both countries, but difference is not wider in case of India as compared to Pakistan.
- One percent increase in fertilizer subsidy is resulting in 0.26 percent increase in yield of maize in both Pakistan and India. Similarly, one percent increase in fertilizer subsidy results in 0.07 percent increase in sugarcane in Pakistan and 0.03 percent in India. Elasticity of rice and cotton yield is also inelastic but in India, showing relatively more elasticity than Pakistan. The results also demonstrate that crops yield is more in India without fertilizer subsidies than Pakistan.
- These results indicate that India is subsidizing more to agriculture sector rather it can produce more without subsidies than Pakistan because constant values in regression are greater in India than Pakistan. Analysis indicates that allocation of subsidies is not properly disbursed according to need of both countries. But because of positive sign of coefficients, there is need of the distribution and allocation of subsidies to agriculture sector on the basis of need.

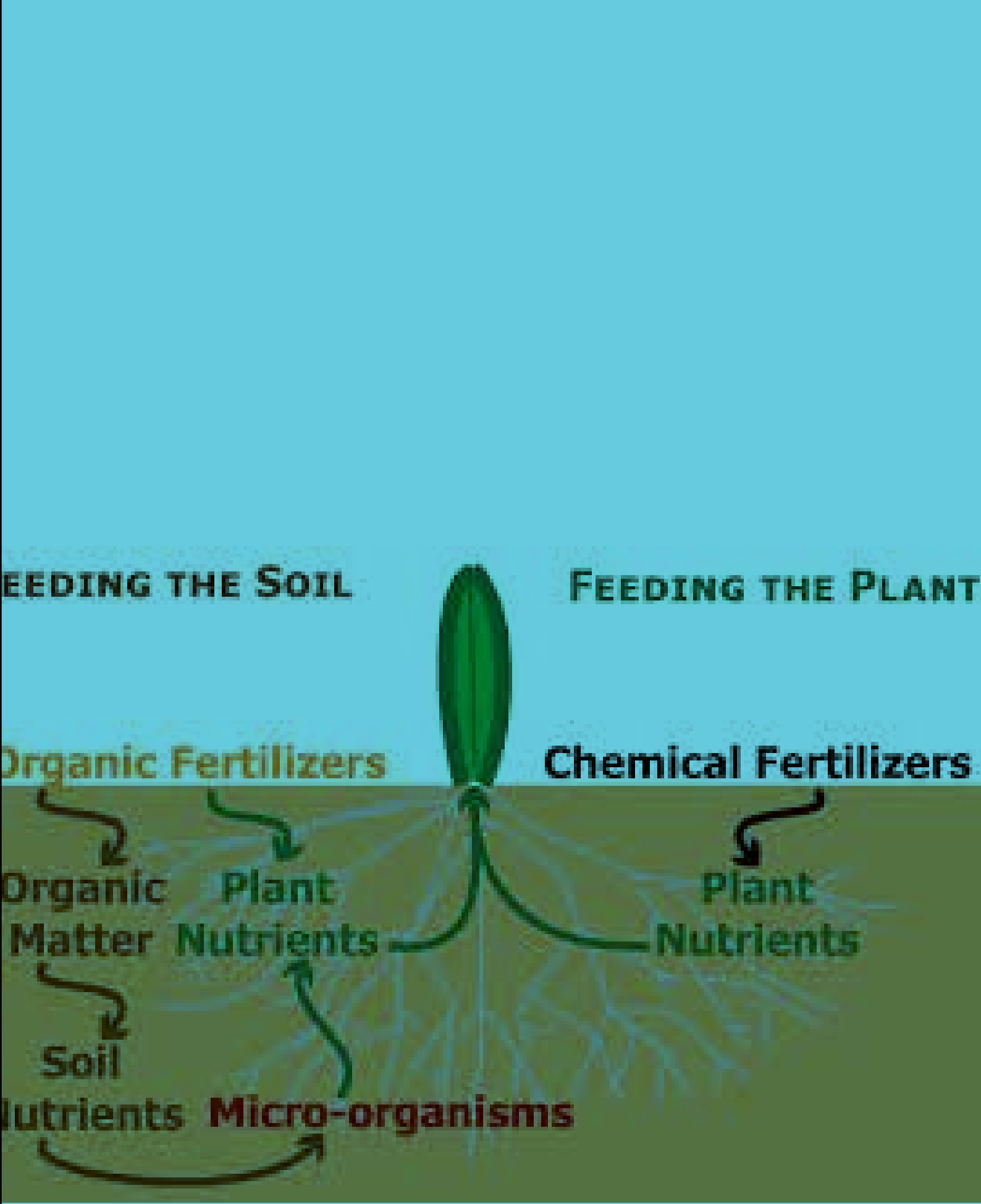
Policy Implications

- It is revealed that the balanced use of fertilizer lead to building up soil health and could increase the yield of major crops while imbalanced fertilization leads to soil mining and its sickness which will cause to degradation of soil and also pollute the environment. It is therefore extensive services should be enhanced to educate and motivate the farmers to use fertilizers in right time and in right quantity. So, activities/ workshops must be planned to promote the balanced use

of fertilizers. These activities would lead to awareness in farmers and it is hoped that balanced use of fertilizer would become a reality in future.

- The empirical results confirm that the impact of fertilizer subsidy on major crop yield is positive but the yield of major crops is inelastic with respect to fertilizers subsidy. It indicates that the large amount of fertilizers subsidy has a small effect on the yield of crops. So, some other inputs like seeds, pesticides and water irrigation etc. are the possible factors or inputs for the productivity and yield of major crops. It is therefore proposed; these agricultural inputs should also be subsidized by diverting some funds from fertilizers subsidy to the other inputs where they needed. The saving from allocation for fertilizer subsidy program could be channelled to construction of new irrigation scheme for water shortage areas.

CHAPTER 1
Introduction


EEDING THE SOIL
FEEDING THE PLANT
Organic Fertilizers
Chemical Fertilizers
Organic Matter
Plant Nutrients
Plant Nutrients
Soil Nutrients
Micro-organisms

1.0 Background of the Study

The economy of Pakistan is mainly dependent on agriculture sector that contributes 19.5 percent in national Gross Domestic Product (GDP) and provides employment to 42.3 percent of the total labour force and 72 percent of the rural population (GOP, 2016). This sector also provides raw materials to the industries. Similarly, the economy of India is also dependent on agriculture sector which is considered to be the backbone of the economy. This sector is one of the largest sectors of Indian economy as it contributes 18 percent of national GDP and provides livelihood to 49 percent of total and 70 percent to the rural population (GOI, 2015). These figures indicate that agriculture development has a significant impact on national economies of both countries and if productivity is increased in agriculture, it may stimulates employment, increases income level, and help the household to escape from a vicious cycle of poverty.

In fact, in both countries, dependency on agriculture sector is the main source of income generation and to get basic amenities of life. However, besides significant contribution of agriculture sector in national GDP, the majority of the farmers in both countries are not in a position to secure key inputs from their own sources. While, financial markets in these countries are imperfect and are likely to affect decision-making behavior of economic agents, especially small landholders to invest on advanced technologies. Thus agriculture production remains below than actual level. In this situation, subsidies on agricultural inputs (fertilizer, plant protection, improved seeds, irrigation etc.) have great importance. Developed countries including the United States have introduced different subsidized schemes to provide financial and technological inputs to farmers that help improve their quality of life and help ensure adequate farm produce.

In a broader sense, agriculture subsidy is a financial assistance provided by the government to farmers and agri-businesses through government-sponsored price support programs that increase their income, manage the supply of agricultural commodities, and influence the cost and supply of agricultural commodities. The basic purpose of this financial assistance is to stabilizing food prices, food security, food production, guaranteeing farmer's basic incomes, and strengthening the agricultural sector of the economy (Gilbertt and Jayne, 2009; Bunde et al., 2014; Sibande et al., 2015). Similarly, a study by Wohlgenant (1986) argued that export subsidy increases the level of income of cotton producers in case of US. Additionally, agriculture subsidies can affect the prices, demand, supply, and productivity of agriculture products.

Subsidies can be granted in two different forms: direct subsidy (cash grants and interest-free loans/interest on subsidized rates) and indirect subsidy (tax breaks, insurance, low-interest loans, accelerated depreciation, and rent rebates). Similarly, in case of agriculture, there are two major kinds of subsidies, first one is direct and another is indirect. Agricultural subsidies are usually granted to the farmers to support their operational expenses. Subsidies may be provided directly, in the form of cash payments, or may be taken in the form of indirect support. A government might offer low-cost crop insurance scheme, e.g., to retain prices at an artificial

level, or assist farmers in other ways. Whenever a subsidy takes in the form of cash payment or grants to a recipient, it is characteristically considered as a direct subsidy. On the other side, any non-cash benefits that recipients receive that help to operate or compete are regarded as an indirect subsidy.

Similarly, the explicit subsidy is a subsidy that a government makes clear what will go to firms/farmers. For this purpose, the government generally announces budgetary outlays e.g., government purchase of agricultural surpluses, government payments or interest grants to farmers. In contrast, an implicit subsidy is when the government suppresses supply and hence raises the price. This means now the firms in the industry are able to charge higher prices and therefore make higher profits, but it usually doesn't cost the government as much. A study by Gilbert and Jayne (2009) found a positive relation of fertilizer subsidy on the production of maize crop in Malawi. In a similar experiment, Shivashankar and Uma (2014) concluded that agricultural inputs subsidies have a positive impact on the production and export of food grains. Some other studies also revealed that withdrawals of agriculture inputs subsidies have a negative impact on the productivity of crops that may affect the income and living standard of the farm households.

On the contrary, the study by Quizon (1985) analyzed that withdrawal of fertilizer subsidy has declined its consumption and lead to decrease in imports of fertilizers in India. In fact, removing of subsidies from agricultural inputs could affect the economy in a number of ways. The withdrawal of agricultural subsidy or increase in input prices without any compensating changes in product price will reduce the profitability of farmers and also has adverse effects on the growth of agricultural output. This may cause decrease/negative rates of profits on the cultivation of major crops that may reduce the farmer's saving and profitability. Furthermore, removing agricultural inputs subsidies could have an adverse effect on small landholders and being financially constrained, they take much longer time to overcome the effect of price shocks. The immediate effect of price shock on them reduces the recommended dose of fertilizer use. The study by Naqvi et al. (1989) observed that in 1980-81 when the fertilizer prices were increased by 50 percent, small farmers reduced the use of fertilizers by 54 percent as compared to the large farmers Similarly, in 1993-94, Chuadhry et al. (1993) reported that small farmers reduced the use of water for irrigation by 2-3 times as compared to the large farmers after an increase in intensity-based water rates.

Many countries continue to subsidize agriculture heavily today, and it has also been observed that the agricultural input subsidies promote the productivity of agriculture sector in those countries. Beside the positive outcome of agricultural subsidies, it is a major obstruction to trade negotiations at WTO and to regional trade agreement negotiations. Therefore it is critical to say that government should withdraw the agriculture input subsidies or continue to subsidize the agriculture sector.

Due to loss of soil fertility, there is a severe threat of food production in many developing countries and it will affect the lives and livelihood of millions of people. The loss of soil fertility reduces the crops yield and negatively affects the water holding capacity which will lead to a great drought. Therefore, improvement in production technologies of the crop is greatly linked with the efficient use of fertilizer. This artificial substance contacts the chemical elements that particularly improve plant's productiveness and enhance natural fertility of the soil. On the other side, it is also observed that the excessive use of fertilizer is not helpful for soil fertility and soil health (Dubey et al., 2012). Balance use of fertilizer leads to building up soil health, while imbalanced fertilization leads to soil mining. Therefore, it is worth noted that what is the crop requirement for various nutrients and what is their actual use and the accurate time of their usage. For the production of 5 tons of rice grain, the requirement of nutrients is 304 kg (111 kg N. 35.5 kg P205 and 148 kg K20). Similarly, for the production of 8.8 ton of wheat and rice under rice-wheat, 663 kg nutrients (235 kg N. 92 kg P205 and 336 kg K202) are required (International Fertilizer Association).

In Pakistan, cost of production of different crops is higher than other countries. The only cost of fertilizer counts 15-20 percent of total cost of production. Therefore, by subsidizing fertilizer prices, usage of fertilizer will be increased that may enhance the productivity. The government of Pakistan has a long history of providing agricultural inputs on subsidized rates. This process was initiated in the late 1950s by introducing the subsidy on synthetic fertilizers in order to promote their use, however, size of agricultural inputs subsidies was expanded throughout 1960s. The study by (Kuhnen et al., 1989) observed that at the end of the sixties the agricultural inputs like fertilizers, insecticides, seeds, canal irrigation, and machinery were provided to farmers on subsidized rates. In the 1970s, raise in oil prices, credit crunch, the war with India, and devaluation of Pakistani Rupee, the government of Pakistan had partially withdrawn the subsidies granted on agricultural inputs (Chaudhry et al., 1995).

Similar to Pakistan, the government of India is also providing agricultural inputs on subsidized rates for farmers' compensation and development of agricultural sector since long. In 1980-81, the government of India provided a subsidy of Rs. 4.7 billion of fertilizers which were increased Rs. 95 billion in 2000-01 and Rs. 309 billion in 2008-09, respectively. The subsidy on irrigation was witnessed of Rs. 3.991 billion in 1980-81, Rs. 25.71 billion in 1990-91 and was further increased to Rs. 55 billion in 2000-01, which was the period of post-liberalization in India. Similarly, the government of India also paid subsidy on electricity. In 1980-81, the government provided subsidy on electricity of Rs. 3.576 billion which was increased to Rs. 46.210 billion in 1990-91 and further increased to Rs. 269 billion in 2000-01, but in 2008-09 it was declined to Rs. 147.7 billion.

In India, there was a declined in the percentage share of fertilizer subsidies in total agricultural subsidies from 38.41 percent to 35.20 percent and further declined to 24.80% in 1980-81, 1990-91 and 2000-01 respectively, but in 2008-09 this percentage share of fertilizer subsidy was increased to 87.26 percent. In case of electricity subsidy, the percentage share was witnessed by 29.10 percent in 1989-90, 35.07 percent in 1990-91 and in 2000-01 it was further increased to

48.62%. However, its contribution was decreased to 12.74 percent in 2008-09. On the other side, the percentage share of irrigation subsidy was 32.49%, 34.76% and 26.58% in 1980-81, 1985-86 and 2000-01, respectively. Recently, the Government of India has introduced Direct Benefit Transfer (DBT) system for fertilizer subsidy. However, this project is introduced on Pilot Basis with effect from October, 2016.

1.1 Fertilizers and their use in Pakistan

The fertilizers contribute as a key factor in feeding the growing population of Pakistan. According to the Food and Agriculture Organization (FAO), balanced use of fertilizers has increased the crop productivity to about 50 percent in different crop production regions of Pakistan. One kg of fertilizer nutrient produces almost 8 kg of grain (wheat, rice and maize), 2.5 kg of cotton and 114 kg of stripped sugarcane. There is a huge deficiency of nitrogen found in the soil of Pakistan, about 80-90 percent are deficient in phosphorus and 30 percent in potassium, while deficiencies in other micronutrients are also found in different areas. Soil fertility is continuously decreasing due to mining of essential plant nutrients from the soils under intensive cultivation (GOP, 2016).

Because of the importance of fertilizers in increasing agricultural output in country, government intervenes in the fertilizer market to encourage its more widespread production. Government of Pakistan had paid Rs. 20.3 billion as subsidy on imported fertilizers (NFDC, 2015). The government is paying Rs. 200 per bag subsidy to support the farming community and agriculture sector. The fertilizer industry of Pakistan is already playing a vital role in economic growth by making large scale investment by promoting modern farming and encouraging technology for higher crop yields (GOP, 2015).

1.2 Objectives of the Study

- To analyze the trends of agriculture input subsidies particularly fertilizers subsidies in Pakistan and India.
- To examine the impact of fertilizer subsidies on yield of major crops in Pakistan and India.

1.3 Significance of the Study

Agriculture subsidies are very vital in the growth of agriculture sector particularly in developing countries where economy is mainly depending upon agriculture. The basic purpose of agricultural subsidies is to stabilizing food prices, food production, guaranteeing farmer's basic incomes, and strengthening the agricultural sector of the economy. Agriculture subsidies can affect the prices, demand, supply and productivity of agriculture products. In this regard, vast literature is available on fertilizer subsidies and its impact on crop sector and also provided strong evidence in favour of fertilizer subsidies (Quizon, 1985; Gilbert and Jayne, 2009; Bunde et al., 2014; Shivashankar and Uma, 2014). In this context, very few studies were found on fertilizer subsidies in Pakistan. Chaudhry et al. (1995) analysed the agriculture input subsidies in Pakistan. Khan et al. (2010) evaluated the impact of fertilizer prices on production of crops. Similarly, Naimatullah et al. (2010) investigated the impact of support price of fertilizer on acreage of wheat and rice. But no study

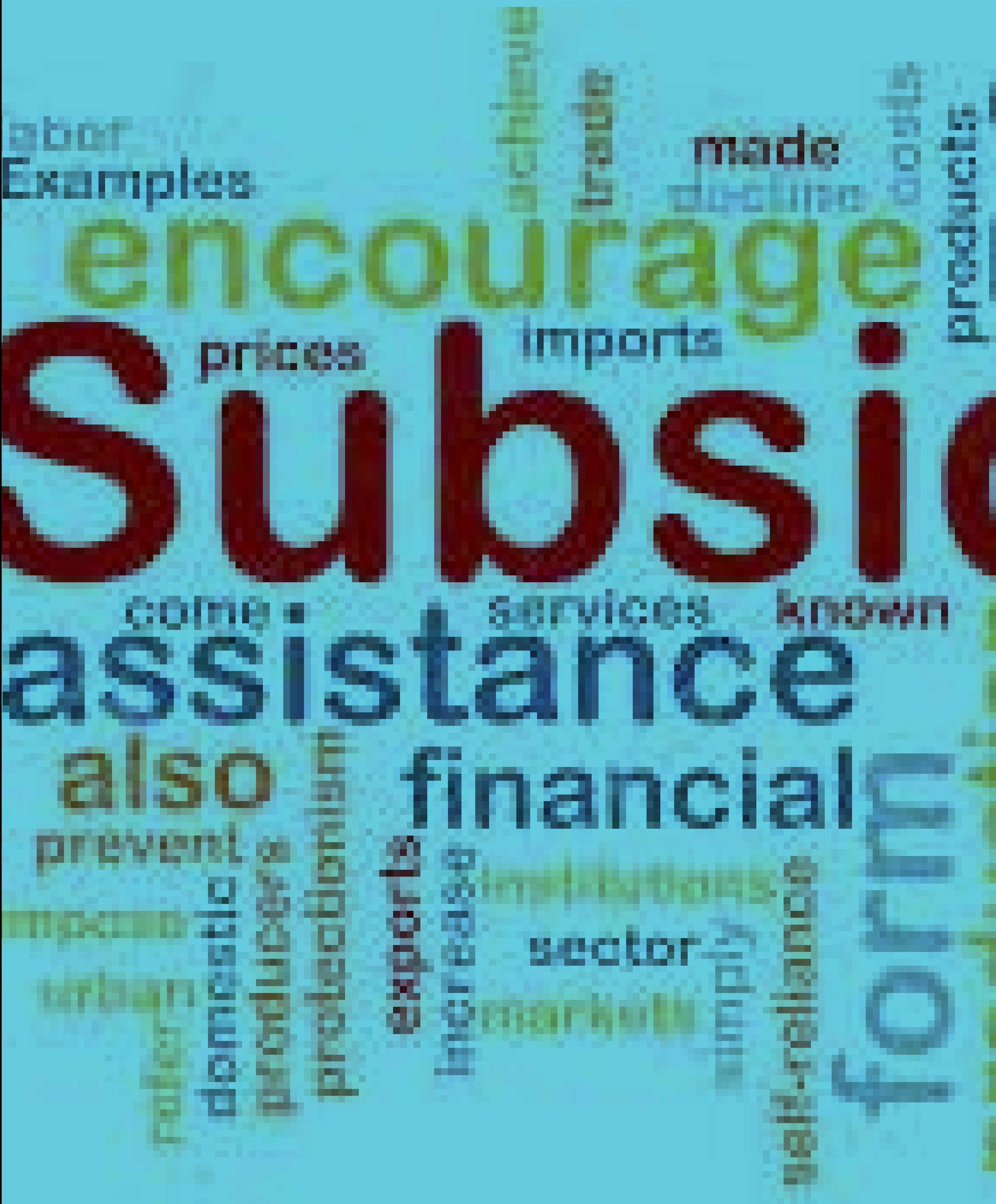
was found in Pakistan, which empirically analysed the impact of fertilizer subsidy on crop yield. So, keeping in view the literature and to fill the gap, this study is designed to reap out the trends and impacts of fertilizer subsidy on crops in Pakistan and India.

1.4 Organization of Study

The rest of the study is organized as follows: chapter 2 is fixed for the literature review. Trends of subsidies are explained in chapter 3. Chapters 4 and 5 present methodology and empirical results of the study. Finally, conclusions and recommendations are made in chapter 6.

CHAPTER 2

Literature Review



Examples
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increase
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production

2.0 Literature Review

A vast literature is available on fertilizer prices and subsidies at national and international levels. At national level, agriculture price policy, fertilizer off-take and trends of agriculture subsidies are discussed and at international level, fertilizer subsidies and its trend on different crop sectors are analysed with the help of time series and panel data. The brief summaries of some previous literature are given below.

Fox (1955) examined the theoretical relation between farm support price and economic stability in case of US. He argued that if there is no price support on agricultural products then the prices of these products are subjected to impact from all part of world's economy. The reason discussed in the study is that after the production expenditure, a 10 percent drop in the price of farm product results a decline of 20 percent in the net income from a given volume of product. As a result farmer's income will decline and there will be a decline in the demand of non-farm products. According to the theoretical analysis, without the price support program farm prices are decreased by 21 percent as against 12 percent with price support. Without price support, the farmers bear a loss of about US$ 2 billion annually and this loss is the 20 percent of net farm income. During recession, in the absence of price support the disposable income is projected as US$ 4 billion lower than the present of price support program. In 1952 the share of farm economy of US about in GNP is 7 percent. The author argues that, although the role of agriculture in any economy is very vital but how single agriculture sector with the share of 7 percent in GNP, can stabilize the whole economy. So, the study concludes that the price support program alone can't avert recession, but as one member of a stabilization team it can certainly help.

Quizon (1985) discussed the nature and scope of fertilizer's subsidies and its withdrawal impact on agricultural sector in India. A partial equilibrium analysis shows that when initial retail price of fertilizer was set up to the world price, withdrawal of fertilizer subsidy has declined its consumption and led to decrease in imports of fertilizers in India. In an alternative, when initial retail price and producer price was set same as world price, withdrawal of subsidy on fertilizer has declined its production and increased in its consumption of imports.

Wohlgenant (1986) investigated the impact of export subsidy on the domestic cotton industry by using the annual data from 1965-1980 in case of US. The study uses the linear elasticity model that includes relationships for the major markets affected by a subsidy, in order to quantify the impact of export subsidy on domestic cotton industry. Ordinary Least Square method is used to estimate the domestic demand and supply elasticities, export demand elasticity and the elasticity of price transformation. The result suggests that an increase in export subsidy will increase the level of income of cotton producers in short run. The results also indicate that an export subsidy is a costly way to permanently increase the producer's income. For a 35 percent subsidy, which raise the producer's income no more than 26 percent, the sum of direct subsidy costs and losses to consumers would amount to almost US$ 1 billion for a crop with a current value of production of $3 billion. This is the deadweight loss of consumers due to transfer to foreigners resulting from an export subsidy.

Lutz and Saadat (1988) reveal the effects of agricultural pricing policies on interlinked agricultural commodities (Wheat, Maize, Tea and Coffee etc.) in case of 7 developing countries. Their study included both demand and supply side analysis. Cross-price elasticities of demand and supply are used in order to capture the effects of agricultural price distortion on the demand and supply of agricultural commodities and to calculate the gain and loss of consumer and producers of the selected nations. Their study concludes that the imposition of export tax on agricultural commodities and the price distortion have very strong effects on nation's welfare. Total net social losses in production by country, Kenya witnessed the lowest of US$ 2.2 million while the highest loss is witnessed by Brazil of amount US$ 50.0 million. In terms of consumption, the total net social loss is highest for Mexico with US$45.9 million while for the other countries it ranges from US$1.3 million for Kenya to US$32.3 million for Brazil. In terms of welfare loss the study argues that the welfare losses to producers in Egypt, Thailand, Argentina and Indonesia are US$505, 568, 1,183; 2,082 million, respectively. In Mexico, Kenya and Brazil the procurers gain is US$ 57, 27 and 400 million respectively.

Farmers collect payments greater than the quantities they produced by over reporting. Giannakas and Fulton (2000) examined the consequences and reasons of farmer's representations. A model was designed on the basis of sequential game between the regulators, enforcement agency and farmers. The study demonstrated that lower level of enforcement or imperfect enforcement tend to higher the misrepresentation by farmers and to collect above and over subsidies to the quantities they produced. Moreover, subsidy level is lower with the lower program enforcement resulting from the greater weight to producer surplus by policy enforcer but when there is costly program enforcement, the avoidance of misrepresentation on output subsidies can never be optimal.

US farm bill introduced in 2002 significantly increased the local support to agriculture producers. This economic and environmental impact of agricultural subsidy was captured by Osorio et al. (2011) analysed the impact of fertilizers subsidies on rice production in case of Indonesia. The objective of their study is to reveal that who is getting more benefits from the fertilizers subsidies and to check the impact of removal of fertilizers subsidy of rice production. For this purpose they used data from Agricultural Census 2003 and the Rice Household Survey 2008 for Indonesia. By employing the Ordinary Least Square and 2 Stage Least Square techniques, their study concluded that the fertilizers subsidies has positive and significant impact on rice production, as fertilizer used in adequate quantities increased the production of rice. But it is also observed that over-using fertilizers has an adverse effect on the productivity of rice. Moreover, 60 percent of the subsidy has been captured by the 40 percent largest farmer.

Mayrand et al. (2003) used wheat as a descriptive example, which not only effected US agriculture production but also the world market. Developing countries are hurt more from these impacts as they tend to lower the world prices and increased flow of subsidized exports. Economically, US farm bill has also tended to increase the planted area of cotton and grain and subsequently lower their prices between the periods 2002 to 2010. Moreover these subside to the producer for the environmental cost

of production has also diminished environmental loss and also supported greener practices through the technological impact.

Government of Pakistan made wheat policy to equilibrate the supply and demand for producers and consumers in their interest by enhancing productivity of wheat and farmer's income on production side and to supply wheat at affordable price for consumers. Dorosh and Salam (2008) presented the same kind of analysis of the wheat procurement, supply, demand and prices of Pakistan's government. During 1990's wheat support price in Pakistan was below the price level of import parity but in late 2004-05 it reaches to the import parity price level in Sindh and cross the level above 18 percent in Punjab. The study also implied that government procurement and trade policies raise the market price of wheat and this would also raise the CPI. A similar analysis was also conducted by Khan and Qasim (1996), who found that one percent raise in wheat procurement price, would raise overall food price index by 0.74 percent.

Ekanayake (2009) examined the impact of fertilizer subsidy on paddy cultivation in case of Sri Lanka. The study used the simple regression model (OLS) to estimate the fertilizers demand functions. The study concluded that the fertilizer usage does not get affected from the fluctuations in the prices of fertilizers and paddy, suggest that fertilizer subsidy has no significant effect on fertilizer use for paddy cultivation. The findings also concluded that there is a high correlation between fertilizer usage and paddy prices. Khan et al. (2010) analyzed the impact of rising fertilizers prices on the production of crops In case of Pakistan. By using the secondary data and employing the descriptive analysis, their study revealed that the productivity of major crops is highly affected from the balanced use fertilizers and from the fertilizers prices. The study also confirmed that the crop productivity and fertilizers prices are negatively related to each other, as the productivity of crops is declined when there is increase in the prices of fertilizers.

Gilbert and Jayne (2009) investigated the impact of fertilizer subsidy on well-being of rural household in Malawi using the agriculture input support surveys. The well-being was measured through five different factors including; planted area by household, maize production, household assets, life satisfaction and food consumption. Analyses revealed the positive relation of fertilizer subsidy on planted area and maize production and area planted by male heads is more than females and those households who have more young children due to more availability of labour. Although, households have no dynamic effect on assets accumulation and consumption pattern after receiving subsidy on fertilizer but they are still satisfied with their lives.

Niamatullah et al. (2010) evaluated the impact of support price and off-take of fertilizers on acreage of wheat and rice production in KPK, Pakistan for the period of 1975-76 to 2007-08. Support price was a significant contributor towards rise in rice production but have no impact on wheat acreage. Moreover, wheat acreage and rice production was showing negative relationship with the fertilizer take-off. The study also revealed that due to technical constraints wheat acreage is very low.

Kaur and Sharma (2012) examined the impact of electricity subsidy to Punjab farmers on various aspects of economy like Punjab State Electricity Board, Punjab Government and farmers etc. Both primary and secondary data are used for analysis. Primary data are collected from the twelve villages Punjab State while secondary data are collected from Punjab State Electricity Board, Statistical Abstract of Punjab, Economic Survey of Punjab, Punjab Human Development Report and Punjab State Electricity Regulatory Commission. The study concludes that farmers are ready to pay electricity bills for irrigation as uninterrupted supply of electricity is given to agriculture sector, so government should impose flat rates on electricity supply given to agriculture sector.

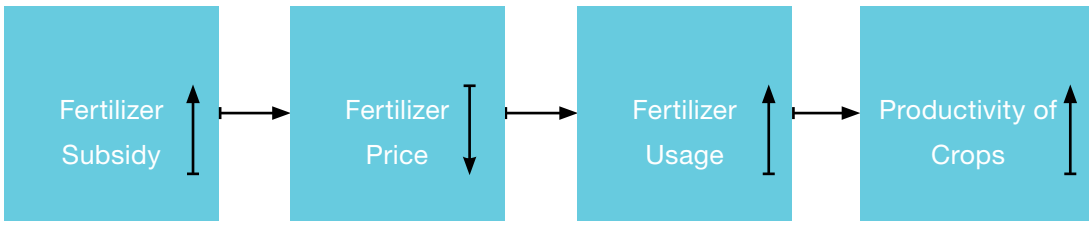
Ramli et al. (2012) examined the impact of fertilizer subsidy on the yield and production of rice in case of Malaysia. By using the system dynamics model, their study revealed that the fertilizer subsidy has a strong and significant effect on rice industry. Fertilizer subsidy increases the yield and hence the production of rice. The study also revealed that the removal of fertilizer subsidy decreases the rice production and also the self-sufficiency level. The results also suggest that there is increase in the import of rice due to the reduction in rice production.

The role of food prices cannot be neglected in the determination of well-being and reduction in poverty in developing countries. Sharma (2012) empirically determined factors of food subsidy in India and found that high food price in domestic and world market is one of the major factors of rising food subsidy in India. He argued that rising economic cost of the food grains is the result of minimum support price, distribution cost and procurement cost, which subsequently rise in food subsidy. Empirical analysis also declared that increase in procurement price and volume significantly raises the food subsidy but central issue price tends to decrease in subsidy of food grain. Although, distribution cost was also a rising factor of subsidy, but it was not statistically significant.

After the agriculture reforms, India highly emphasized and depended upon price policy as compared to pre-reforms period. Tripathi (2013) examined the link between agriculture price policy, output and farm profitability in India after reforms. Minimum support price systems is the insurance cover for the farmers at the time of post-harvest crash in prices and provide incentives to farmers and increase production by using modern inputs. Moreover, profitability in wheat cultivation has also been doubled during the post-reform period in India. Only few years from 2001-02 to 2004-05 witnessed growth reduction and squeezing of profit due to rise in input cost but later on there was a significant improvement in farm's net income after 2005-06.

Bunde et al. (2014) addressed the relationship between subsidy on fertilizer input and maize production in Kenya using rural household survey in 2012. They observed that maize yield has increased by 17.2 percent of those households having less than 10 acres of land after the fertilizer subsidy program and this proportion was increasing up to 30 acres of land. The study also revealed that input subsidy on fertilizer has also improved the farmers' lives through the food security program.

Shivashankar and Uma (2014) explored the impact of agricultural input subsidies on SC/ST farmers by using the survey data of two districts Mandya and Raichur (Karnataka, India). The purpose of their study is to compare and contrast the fertilizer and power subsidy between general farmers and SC/ST farmers in Mandya and Raichur districts. The study concludes that the agricultural input subsidies have positive impact on the production and export of food grain. It also exhibits that the government's initiative is successful in benefiting the farmer community.



CHAPTER 3

Data and Methodology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3.0 Methodology

This section provides the detail about the data sources and methodology used for the analysis. In order to identify the relationship between fertilizer subsidy and its impact on crop sector, this study comprises three types of analyses.

- Trend analysis
- Correlational analysis
- Regression analysis

3.1 Trend Analysis

The detail of trends of agriculture subsidies in Pakistan and India along with trends of yields of different crops in both countries have been computed. Growth rates of fertilizer used in major crops along with the trends of yield of respective crops are also represented through line chart for Pakistan in chapter 4. Due to unavailability of data for fertilizer usage of in crops of India, trends for only agriculture subsidies and yield of major crops are presented.

3.2 Correlational Analysis

To check the bi-variate relationship between two variables, correlational analyses are used. Higher value of coefficient of correlation shows stronger relation between the variables. Product moment coefficient of correlation by Pearson (1896) is used to report this type of information. Correlation can be computed from the following formula using i rows and j columns;

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$

3.3 Regression Analysis

Main purpose of this study is to evaluate the impact of agriculture subsidies. For this purpose, fertilizer subsidies are taken to investigate its impact on crop-wise yield of major agriculture crops. Five major agriculture crops yield (wheat, rice, cotton, maize and sugarcane) are taken for the purpose of regression analysis. Some recent studies are conducted on fertilizer subsidies and its impact on different crops. Ramli et al. (2012) examined the impact of fertilizer subsidy on the yield and production of rice in case of Malaysia by using the system dynamics model. Ekanayake (2009) examined the impact of fertilizer subsidy on paddy cultivation in case of Sri Lanka by using OLS. Osorio et al. (2011) analysed the impact of fertilizers subsidies on rice production in case of Indonesia by applying Ordinary Least Square (OLS). By following the methodology of Ekanayake (2009) and Osorio et al. (2011), this study used OLS for the analysis of regression.

If regression model is linear, OLS estimates are best. But it has certain problems like heteroscedasticity and autocorrelation in the model. To remove these problems, Robust Standard error is used to analyse the regression model (White, 1980). Robust model has following features;

- Reasonably efficient and unbiased.
- Small deviations from the model assumptions will not substantially impair the performance of the model.
- Somewhat larger deviations will not invalidate the model completely.

3.3.1 Model Specification

The model specified for this research purpose is given as follow;

$$Yi = \beta_0 + \beta_1 X_1 + \varepsilon$$

Where Yi expresses crop-wise yield. Here five models are measured to empirically examine the relationship between fertilizers subsidy on yield of crops in case of both Pakistan and India. First model is regressed over yield of wheat on fertilizer subsidy. Second model is regressed over yield of rice on fertilizer subsidy. Third, fourth and fifth models are regressed to analyse the impact of fertilizer subsidy on cotton, maize and sugarcane respectively.

$Yield_i$ = f (Fertilizer Subsidy)

$$Yi = \beta_0 + \beta_1 \mathrm{FS} + \varepsilon$$

3.4 Data Sources

Availability of data is the core matter and for the regression analysis of yield of crops on fertilizer subsidies, data from 1980-2015 are taken for Pakistan and for India, data from 1990-2015 are part of analysis. Data for agriculture subsidies for Pakistan are taken from budget reports (GOP) and yield of crops are extracted from economic survey of Pakistan (various issues). Data of fertilizer subsidies and crop-wise usage of fertilizer subsidies are taken from the National Fertilizer Development Centre (NFDC, Islamabad) after the official visit. Data of India are extracted from Union Budget reports (GOI), Economic Survey of India (various Issues) etc. Agriculture statistics of Pakistan and India were also taken into account for the data purposes.

3.5 Hypothesis

Null hypotheses of the statistical analyses are as follows;

H_{01}: Fertilizer subsidy is not associated with yield of wheat.

H_{02} : Fertilizer subsidy is not associated with yield of rice.

H_{03} : Fertilizer subsidy is not associated with yield of cotton.

H_{04} : Fertilizer subsidy is not associated with yield of maize.

H_{05} : Fertilizer subsidy is not associated with yield of sugarcane.

CHAPTER 4

Trends of Subsidies in Pakistan and India

Planting fertilizer

4.0 Subsidies Trends in Pakistan

This section provides a detail of subsidies trends in Pakistan. Section 4.0.1 reflects the trends in fertilizer subsidies and wheat subsidies are shown in section 4.0.2.

4.0.1Fertilizers Subsidies

Table 4.1 shows the data of local and imported fertilizer subsidies in Pakistan during 1975-2015. Wide ranges of fluctuations are seen in the subsidy trends in different periods or regimes. During the period of 1975-1977 subsidies on local fertilizers have been increased from Rs. 10 million to Rs. 140 million. In late 70's, there was a remarkable increase in subsidies on fertilizers and total amount was increased up to Rs. 2448 million in 1980 from Rs. 600 million in 1975. In early 80's, share of local fertilizer subsidies have been increased while share of subsidies on imported fertilizers have been decreased. On local fertilizers, this share was 23% in 1980 and reached up to 77% in 1983-84. While share of subsidies on imported fertilizers have been decreased to 22% in 1983-84 from 98% in 1975 to encourage the usage of local fertilizers. In the early 90's, subsides trends on fertilizers were significantly condensed during 1990's. In 1992, only 810 million were released for subsidies on fertilizers against Rs. 1200-2400 million during some last years and this amount were more shrink to only Rs. 40 million in the second half of 90's. From 1984-85 to 1992-93, local fertilizers subsidies have been reduced from Rs. 830 million to 110 million. This trend was again peeped up after 2005 and amount of Rs. Fifty thousand million were released to give subsidy to farmers only on fertilizers in 2011-12, which was the highest ever during the period of 1980-81 to 2011-12. This increasing trend could not sustain after 2011and more than sixty percent decline is seen on fertilizer subsidies during the last five years.

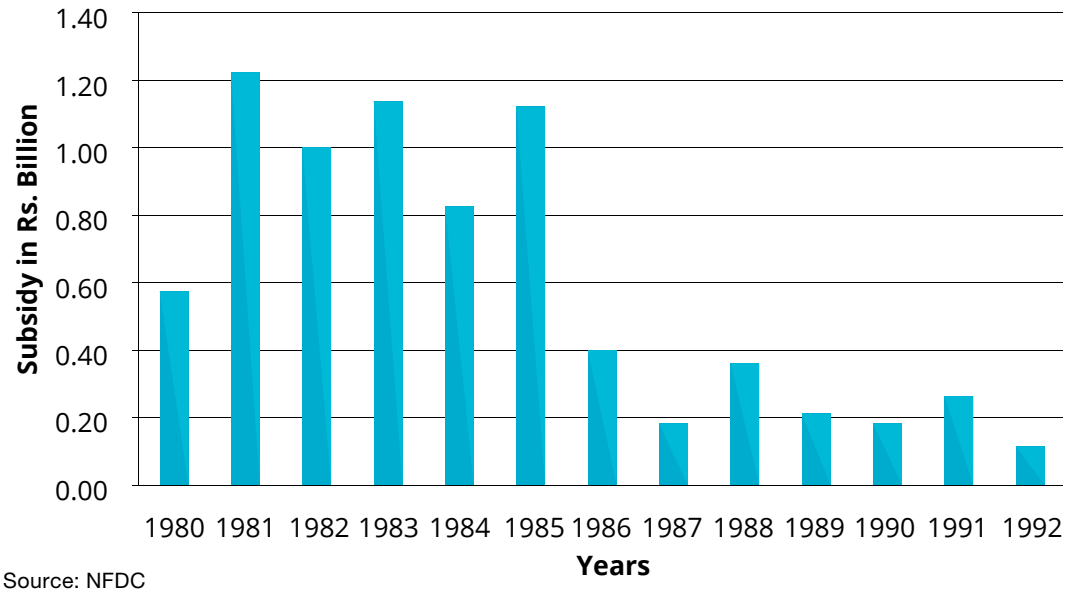
Table 4.1: Fertilizer Subsidies in Pakistan (1975-2015)

Year	Subsidy on Local Fertilizers		Subsidy on Imported Fertilizers		Total Subsidies
	Rs. Billion	Percentage of Total	Rs. Billion	Percentage of Total	Rs. Billion
1975	0.01	1.3316	0.5928	98.6684	0.6008
1976	0.05	39.1635	0.0800	60.8365	0.1315
1977	0.14	23.2672	0.4716	76.7328	0.6146
1978	0.24	13.9902	1.4552	86.0098	1.6919
1979	0.59	23.9469	1.8668	76.0531	2.4546
1980	0.57	23.4775	1.8735	76.5225	2.4483
1981	1.22	69.8485	0.5275	30.1515	1.7495
1982	1.01	51.6939	0.9411	48.3061	1.9482
1983	1.14	77.8687	0.3244	22.1313	1.4658
1984	0.83	55.2547	0.6710	44.7453	1.4996
1985	1.13	46.9484	1.2778	53.0516	2.4086
1986	0.4	31.0791	0.8846	68.9209	1.2835
1987	0.19	9.3133	1.8092	90.6867	1.9950
1988	0.37	15.1365	2.0492	84.8635	2.4147
1989	0.21	16.5301	1.0493	83.4699	1.2571
1990	0.19	15.3846	1.0560	84.6154	1.2480
1991	0.26	21.5225	0.9608	78.4775	1.2243
1992	0.11	14.0000	0.6966	86.0000	0.8100
1993[1]	-	-	0.5826	100.0000	0.5826
1994	-	-	0.0666	100.0000	0.0666
1995	-	-	0.0467	100.0000	0.0467
1996	-	-	-	-	-
1997	-	-	-	-	-
1998	-	-	-	-	-
1999	-	-	-	-	-
2000	-	-	-	-	-
2001	-	-	-	-	-
2002	-	-	-	-	-
2003	-	-	-	-	-
2004	-	-	8.0000	100.0000	8.0000
2005	-	-	10.1000	100.0000	10.1000
2006	4.63	28.6085	11.5540	71.3915	16.1840
2007	5.44	26.4014	15.1510	73.5986	20.5860
2008	18.93	45.8676	22.3410	54.1324	41.2710
2009	0.5	2.5126	19.4000	97.4874	19.9000
2010	0	0.0000	9.2000	100.0000	9.2000
2011	0	0.0000	50.6000	100.0000	50.6000
2012	0	0.0000	12.7000	100.0000	12.7000
2013	0	0.0000	11.0000	100.0000	11.0000
2014	0	0.0000	4.1000	100.0000	4.1000
2015	0	0.0000	20.3000	100.0000	20.3000

Source: National Fertilizer Development Center (NFDC), Islamabad

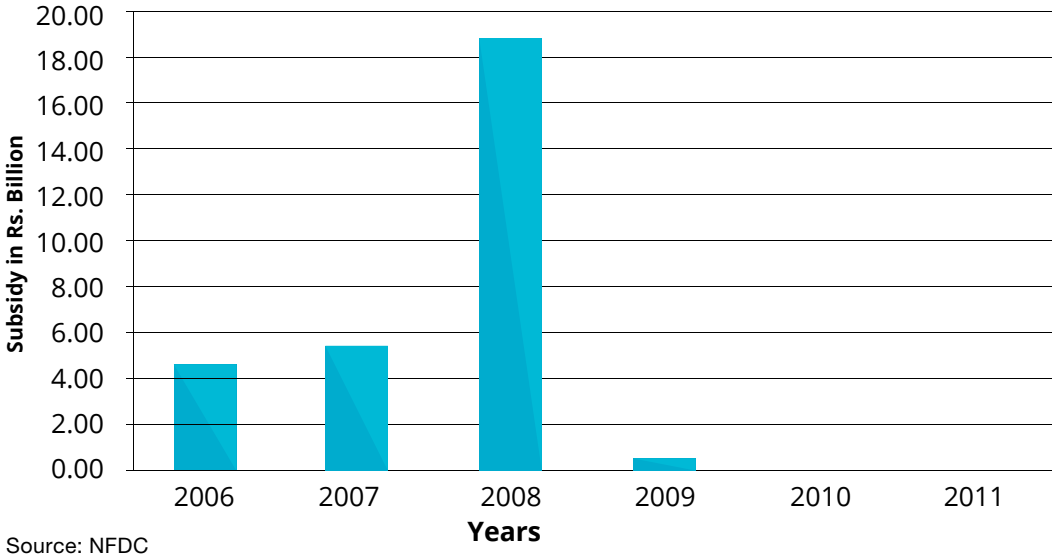
[1]Subsidies were not disbursed by Government of Pakistan on local fertilizers from 1993 to 2005 and from 1996- 2003 on Imported Fertilizers. (Source: NFDC).

Figure 1: Subsidies on Local Fertilizers in Pakistan (1980-1992)



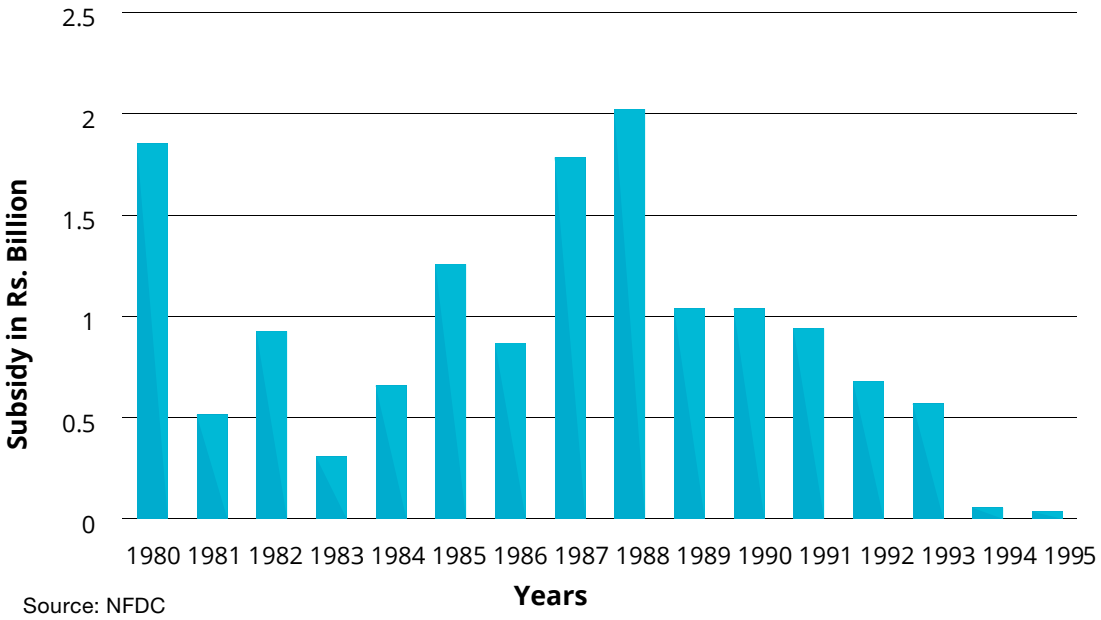
Source: NFDC

Figure 2: Subsidies on Local Fertilizers in Pakistan (2006-2011)



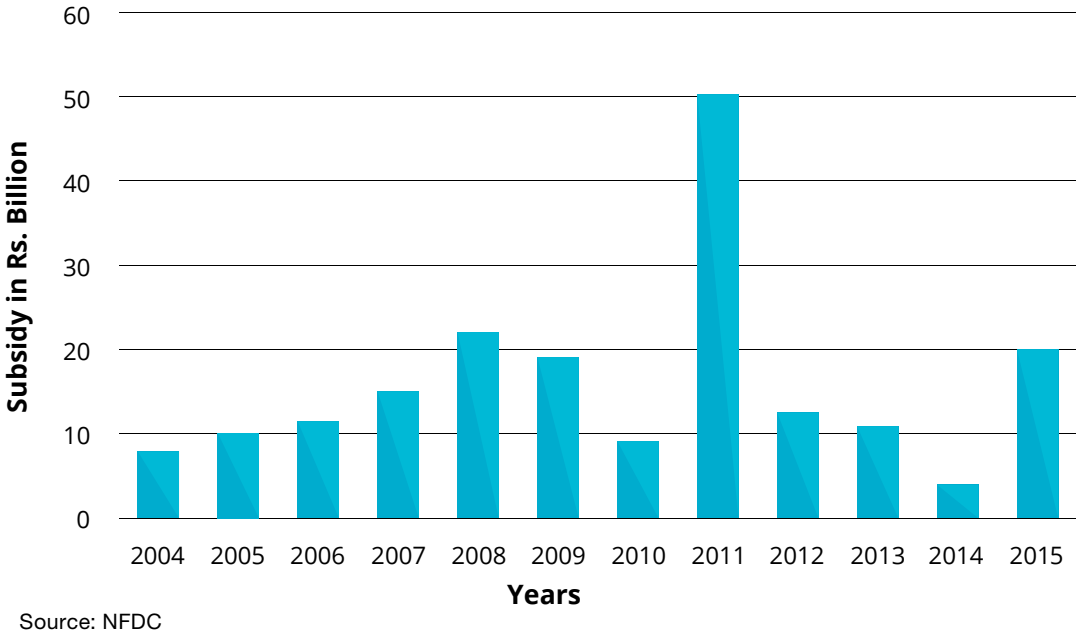
Source: NFDC

Figure 3: Subsidies on Imported Fertilizers in Pakistan (1980-1995)



Source: NFDC

Figure 4: Subsidies on Imported Fertilizers in Pakistan (2004-2015)



Source: NFDC

4.0.2 Trends in Wheat Subsidies

Table 4.2 shows the details of wheat subsidies in Rs. Million from 1990-91 to 2015-16. Subsidy on wheat has also had varying history like fertilizers. An amount of rupees above four thousands million were given for wheat subsidy to give relief for both farmers and consumers in 1991-92. The highest amount is recorded in 2008-09 of an amount Rs. 20481 million during the observed period and the lesser subsidy on wheat is given in 1989-90 of an amount Rs. 266 million.

Table 4.2: Subsidy on Wheat in Pakistan

Years	Rs. Million
1991	4049.8
1992	2551.3
1993	1279.1
1994	1009.5
1995	645.7
1996	6338.5
1997	4345.3
1998	423.7
1999	1422
2000	400
2001	943
2002	2982
2003	4164
2004	2277
2005	957
2006[2]	-
2007	-
2008	20481
2009	26315
2010	13492
2011	5387
2012	3739
2013	5098
2014	6693
2015	5303

Source: Ministry of Finance, Government of Pakistan

[2]Data for 2006 and 2007 are not available.

4.1 Subsidies Trends in India

Trends on agriculture subsidies in India are shown in section 4.1. Trends in fertilizer subsidies are provided in section 4.1.1. Food and irrigation subsidies are explained in the head of other subsidies, which are shown in section 4.1.2. All the figures are shown in Indian currency (Indian Rupee).

4.1.1 Subsidies on Fertilizers

According to planning commission report of India, 2006, input subsidies in agriculture sector can also create unintentional effects. According to the reports of Government of India (GOI), overutilization of inputs is the main result of subsidies on these inputs, which in turn lead to inefficiency and ineffectiveness in the use of inputs due to soil degradation, imbalance of soil nutrient and depletion of ground water. After the year 2002, the GOI gradually moved towards a more liberalized regime, while highlighting the need for investment in power, irrigation and agriculture. The Ministry for Finance, GOI increased distribution of resources for agriculture, irrigation and credit to improve agriculture sector and broadening of crops. For this purpose GOI ensured to make these fertilizers offered to farmers at lower prices, and enhanced balanced use of fertilizers among farmers. Total subsidy on fertilizer in 2001-02 was Rs. 74 billion, down from Rs. 94 billion in 2000-01 and Rs. 97 billion in 1995-96. But after 2002-03, there was significant increase in fertilizer subsidy and it reached to the amount of Rs. 115 billion in 2005-06 and during next five years, there was about four times increase in fertilizer subsidy and an amount of Rs. 549 billion was authorized for fertilizer subsidies in India. GOI under Fertilizer New Pricing Scheme (NPS) included Freight Subsidy for production of urea. The subsidy scheme is intended to make fertilizers available to the farmers at reasonable prices and to give producers of fertilizers a reasonable return on their investment (GOI, 2010).

There was also seen a huge increase in subsidy on fertilizers during the period 2010-11 to 2015-16, which added up in the total subsidy on fertilizer and reached up to Rs. 724 billion in 2015-16. Provision is for payment to the manufactures/importers of fertilizers under the Nutrient Based Subsidy (NBS) scheme of sale of decontrolled Phosphatic and Potassic fertilizers at concession to the farmers. The concession would lead to balanced use of fertilizers (NPK) nutrients for better soil health and productivity (GOI, 2015).

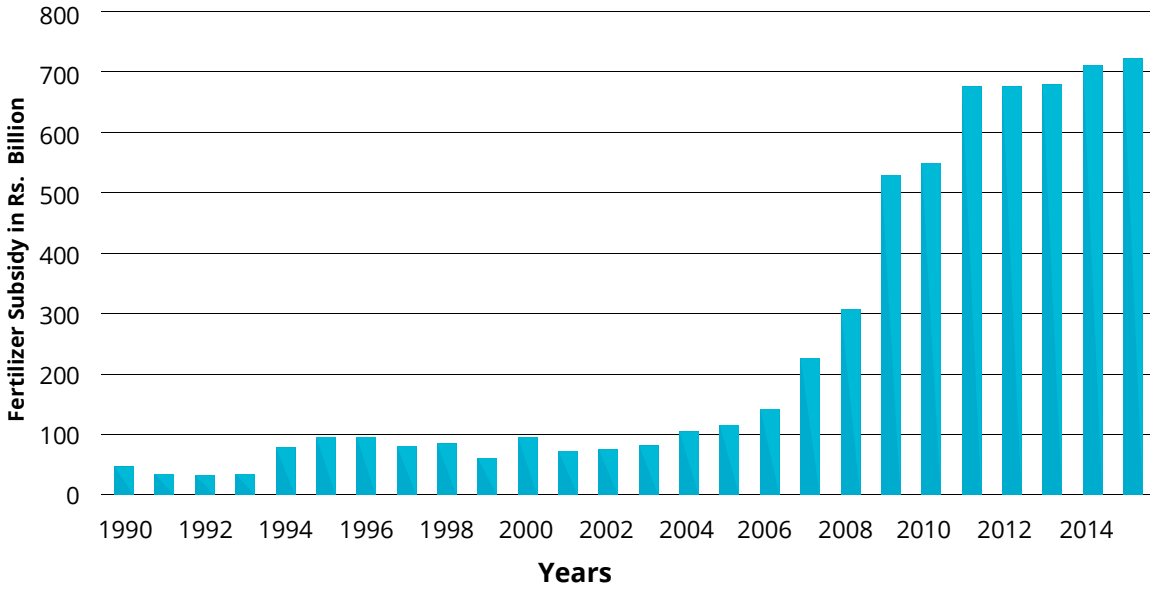
Table 4.3: Agriculture Subsidies in India

Subsidy (Ind. Rs. Billion)			
Year	Fertilizer	Food Grain	Irrigation
1990	45.58	24.5	25.71
1991	35.07	28.5	28.68
1992	32.61	28	32.88
1993	33.52	55.37	34.41
1994	78.89	51	39.54
1995	96.94	53.77	44.12
1996	96.32	60.66	44.39
1997	81.59	79	46.56
1998	83.14	91	49.37
1999	62.07	94.34	52.18
2000	72.61	120.6	54.95
2001	66.34	174.99	57.76
2002	69.97	241.76	60.56
2003[3]	117.9655	252	-
2004	156.6215	258	-
2005	172.531	232	-
2006	467.5201	242.0392	-
2007	305.0101	315.4559	-
2008	766.0238	437.51	-
2009	529.8025	560.0201	-
2010	623.0121	638.4379	-
2011	671.9894	728.23	-
2012	656.1081	850	-
2013	679.715	920	-
2014	710.75	1176.7116	-
2015	724.3758	1394.19	-

Source: Union Budgets India (Various Issues)
Mullen et al. (2005)

[3]Data for irrigation subsidies in India are not available after 2003

Figure 5: Fertilizer Subsidy in India



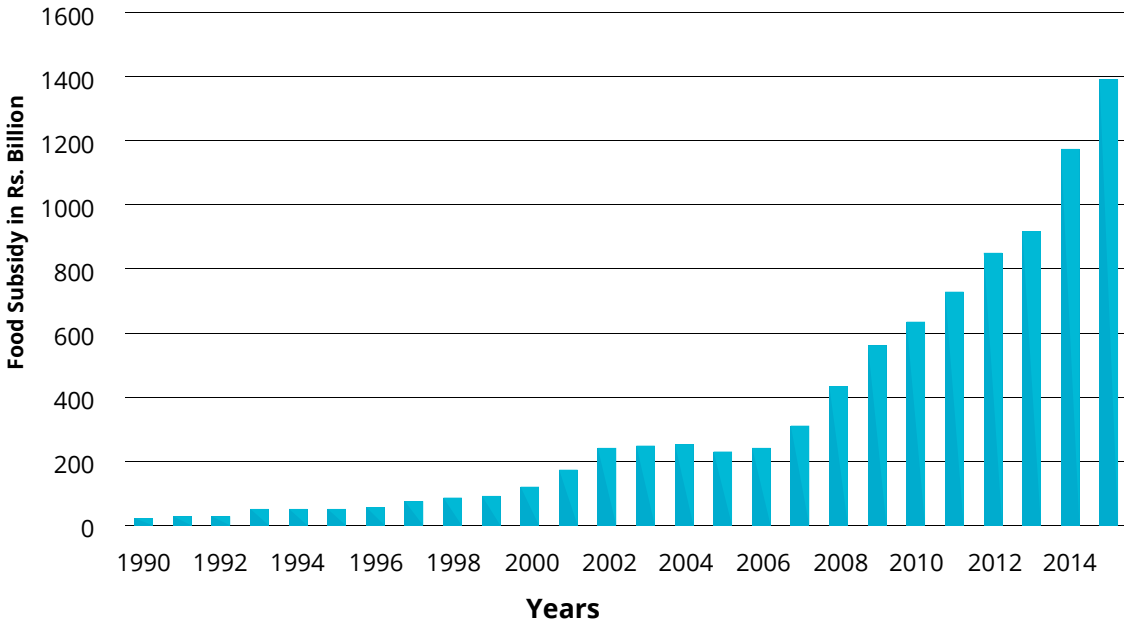
4.1.2 Other Subsidies in India

In addition to the fertilizer subsidy, Government of India (GOI) has also disbursed subsidies on irrigation and food. To provide the proper irrigation facilities, GOI has provided subsidy to farmers for irrigation purpose up to Rs. 60.5 billion in 2002-03 which was doubled to an amount as compared to 1992-93.

In developing countries, prices of food also played a vital role in reduction of poverty and well-being of people. After the world war-II, government interventions either as a direct intervene (buyer) of food grain or indirect intervene (subsidies and taxes etc.) have also been realized in developing countries. Indian government has also established Commission for Agriculture Costs and Prices (formerly Agriculture Price Commission) in the mid of 1960's and food corporation of India to regulate the prices of food grains.

The main kind of intervention by GOI included procurement of food grains at subsidised prices in order to enhance the production of food grains. Which in turn stabilized food prices and availability of these food grains in the country. To ensure all these targets, GOI has remarkably increased the subsidy on food grains during the late 1990's. GOI has provided Rs. 54 billion of food subsidies in 1995-96, which was increased up to Rs. 120 billion in 2000-01. In 2010-11, this amount was catched up to Rs. 638 billion, which was three times more as compared to the last decade. In 2015-16, the amount was also doubled to Rs.1394 billion as compared to 2010-11.

Figure 6: Food Subsidy in India

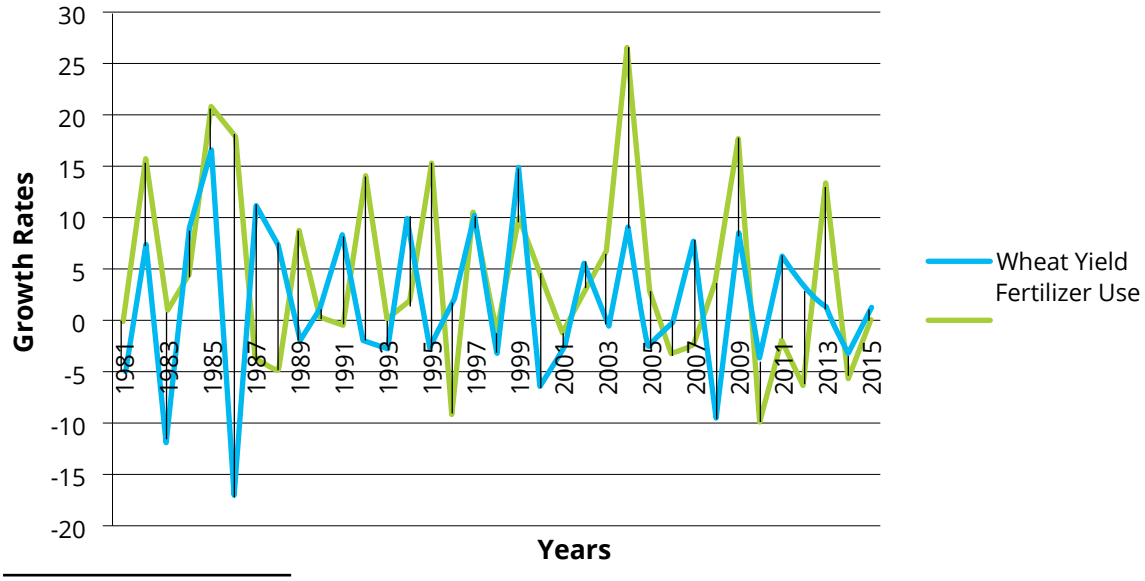


4.2 Fertilizer use and Yield of Major Crops in Pakistan

4.2.1 Fertilizer use and Yield of Wheat

From figure 7 to figure 11, trends in growth rate of fertilizer use in crops (wheat, rice, maize, cotton and sugarcane) along with trends in growth rate of respected crops are sketched. Figure 7 displays growth of fertilizer use in wheat and growth of wheat yield, which shows the positive bilateral trend of both variables (fertilizer use and yield) and also evident from correlation analysis in the chapter 5.[4]

Figure 7: Growth Rates of Fertilizer use in Wheat and Yield of Wheat

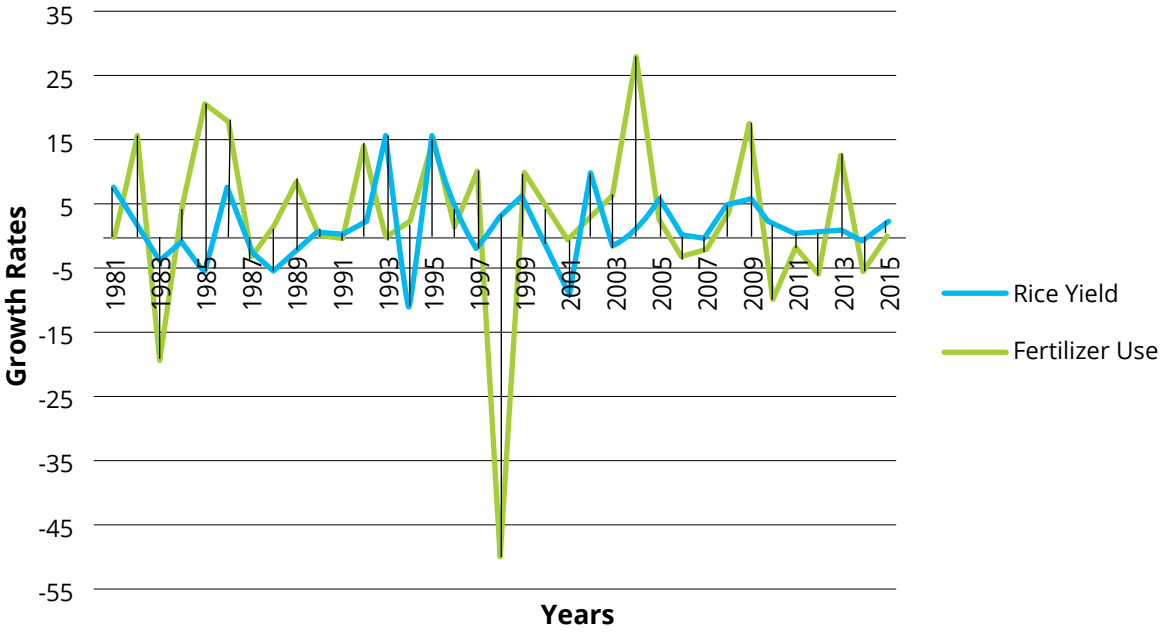


[4]Data for usage of fertilizer and Crops yield are given in Appendix A and B respectively.

4.2.2 Fertilizer use and Yield of Rice

Growth rate of fertilizer use in rice and growth rate of rice yield is displayed in figure 8, which also shows the positive bilateral trend of both variables (fertilizer use and yield) except in few years. Table 5.2 also confirms the positive relation between fertilizer use in rice and yield of rice through correlation analysis.

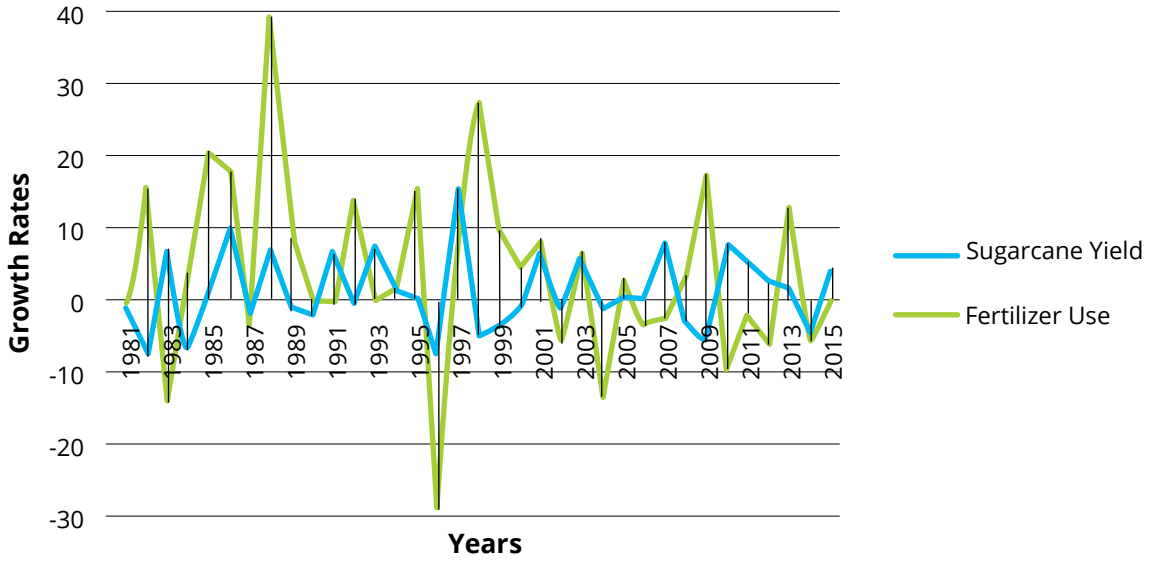
Figure 8: Growth Rates of Fertilizer use in Rice and Yield of Rice



4.2.3 Fertilizer use and Yield of Sugarcane

Figure 9 exhibits trends in growth rates of fertilizer use in sugarcane and its growth rate of yield. Starting from 1981-82 to 1987-88, graph is showing somewhat negative bilateral trends, in most subsequent periods, these trends are moving in same direction. (For correlation, see table 5.3).

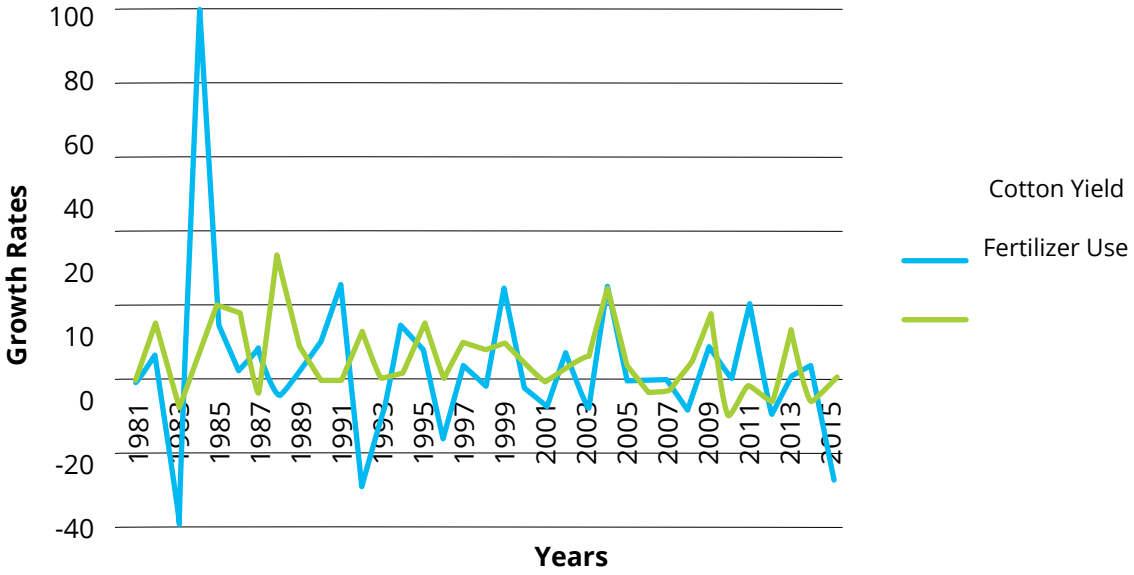
Figure 9: Growth Rates of Fertilizer use in Sugarcane and Yield of Sugarcane



4.2.4 Fertilizer use and Yield of Cotton

Trends in growth rates of fertilizer use in cotton and growth rate of cotton yield are exhibited in figure 10. Figure 10 exhibits that as the fertilizer use in cotton is growing, growth of cotton yield is also growing in same direction but these trends are heterogeneous. For further clarification, correlation matrix is presented in table 5.4.

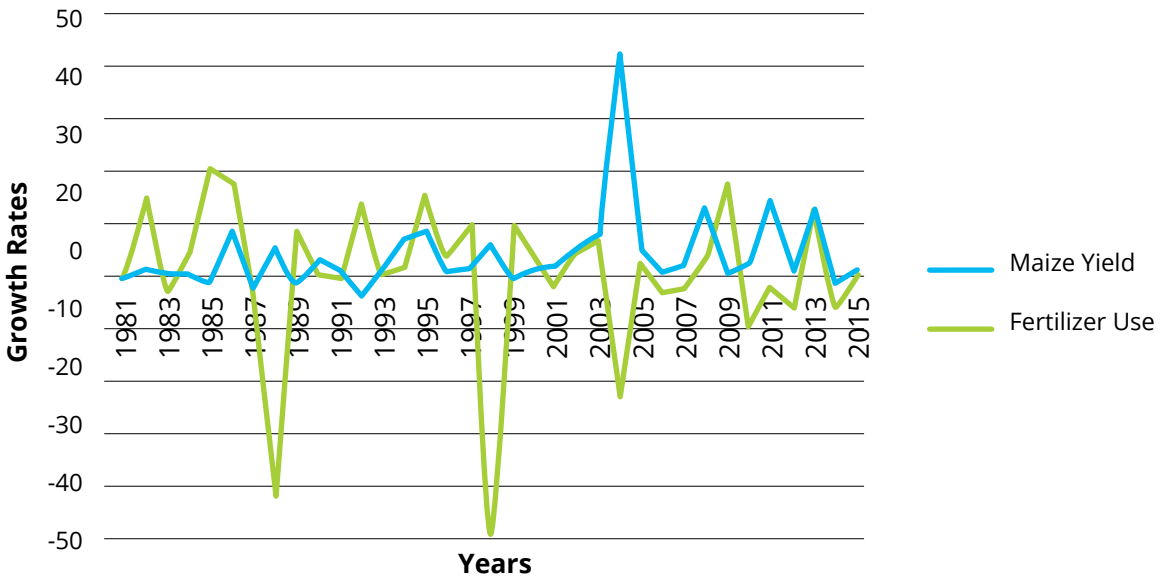
Figure 10: Growth Rates of Fertilizer use in Cotton and Yield of Cotton



4.2.5 Fertilizer use and Yield of Maize

Figure 11 exhibits trends in growth rates of fertilizer use in maize and growth rate of maize yield. Figure displays that as the fertilizer use in maize is increasing or decreasing, its yields is not growing or declining with same proportion and also showing some negative trends in some years. After 2001, fertilizer use in maize has fallen up to significant volume but in same years, yield of maize is rising. Agriculture mechanization can have an important role in this regard. For further explanation, correlation matrix is presented in table 5.5.

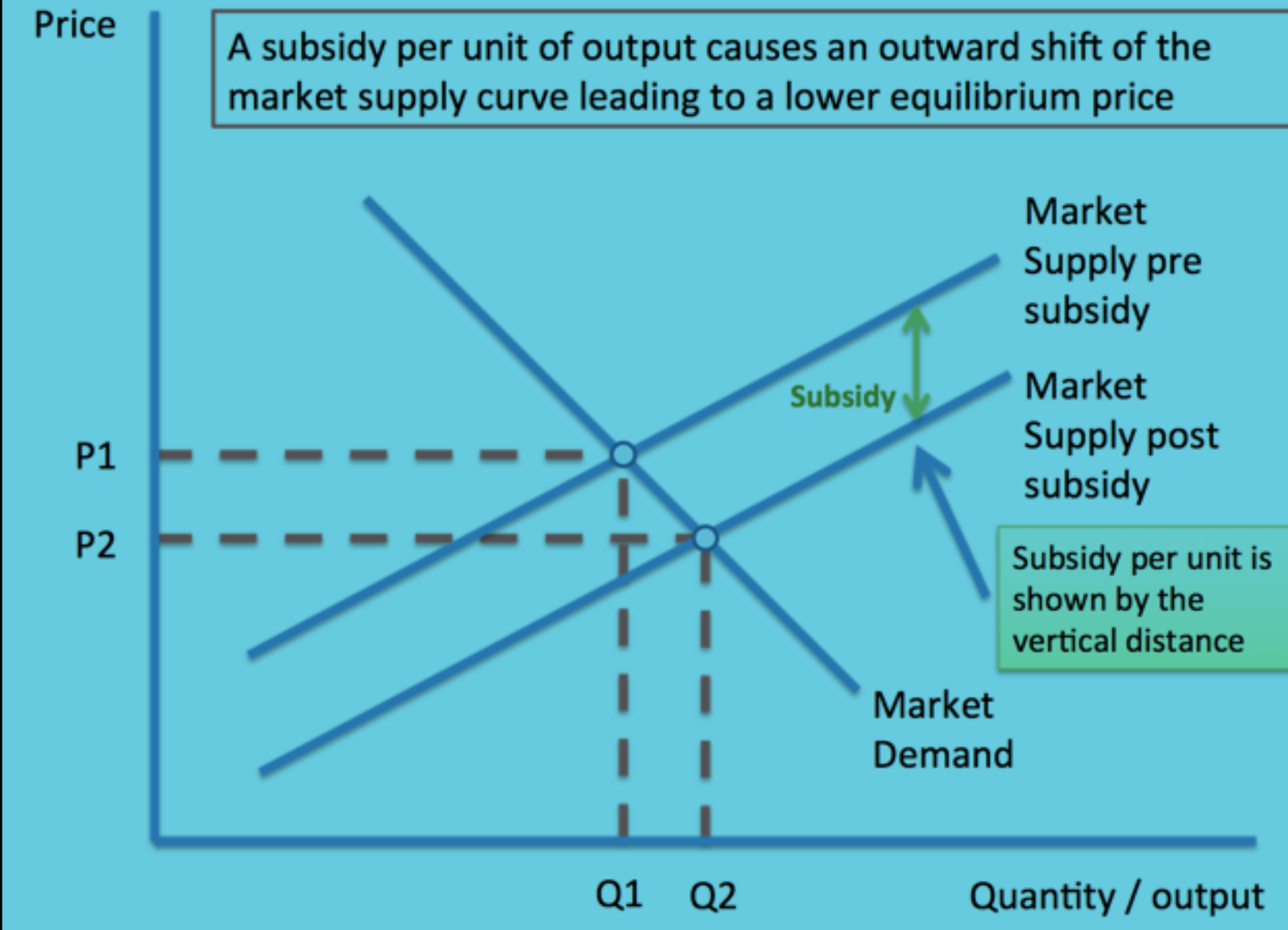
Figure 11: Growth Rates of Fertilizer use in Maize and Yield of Maize



CHAPTER 5

Empirical Analysis

Basic Subsidy Diagram – For Producers



5.0 Introduction

This chapter provides correlational and regression analysis of Pakistan and India. Section 5.1 is constituted for correlational analysis in Pakistan. Section 5.2 depicts the correlational analysis for India. Section 5.3 is reserved for regression analysis of fertilizer subsidies and its impact on yield of crops and elasticity analysis of crop yield with respect to fertilizer subsidies are presented in section 5.4.

5.1 Correlation Analysis for Pakistan

This section providet the detail of correlation analysis between fertilizer subsidy, fertilizer use in each crop and the respective crop yield (kg/hectare) in Pakistan. For this analysis, data from 1980-2015 are used for all variables.

5.1.1 Correlation analysis for Wheat

Table 5.1 shows the correlational analysis of fertilizer subsidy, fertilizer use in wheat and yield of wheat in kg/hectare. The value of correlation coefficient between fertilizer subsidy and fertilizer use in wheat, fertilizer subsidy and yield of wheat and fertilizer use in wheat and yield of wheat is 0.6223, 0.5473 and 0.9517 respectively which indicates that all the concerned variables are positively correlated to each other. The results suggest that if government increases the fertilizer subsidy then it will increase the yield of wheat and vice versa. In addition, fertilizer use in wheat is highly correlated with yield of wheat as the correlation between them is above 95%, depicts that if Government of Pakistan wants to increase the yield of wheat then it should encourage the use of fertilizer.

Table 5.1: Correlational Analysis for Wheat

	Fertilizer Subsidy	Fertilizer use in Wheat	Yield of Wheat
Fertilizer Subsidy	**1.0000**	**-**	**-**
Fertilizer use in Wheat	**0.6223**	**1.0000**	**-**
Yield of Wheat	**0.5473**	**0.95171**	**1.0000**

Source: Author's own calculation

5.1.2 Correlational analysis for Rice

Correlational analysis of fertilizer subsidy, fertilizer use in rice and yield of rice displays in table 5.2. The value of correlation coefficient between fertilizer subsidy and fertilizer use in rice, fertilizer subsidy and yield of rice and fertilizer use in rice and yield of rice is 0.3961, 0.6112 and 0.5350 respectively which indicates that all the variables (FS, FUR & YOR) are positively correlated to each other. Correlation between fertilizer subsidy and yield of rice is slightly above 61%, indicates that as fertilizer subsidy increases then it will increase the yield of rice.

Table 5.2: Correlational Analysis for Rice

	Fertilizer Subsidy	Fertilizer use in Rice	Yield of Rice
Fertilizer Subsidy	1.0000	-	-
Fertilizer use in Rice	0.3961	1.0000	-
Yield of Rice	0.6112	0.5350	1.0000

Source: Author's own calculation

5.1.3 Correlational analysis for Sugarcane

Similarly, table 5.3 represents the correlational analysis of fertilizer subsidy, use of fertilizer in sugarcane and yield of sugarcane. Value of correlation coefficient between fertilizer subsidy and yield of sugarcane and fertilizer use in sugarcane and yield of sugarcane is 0.5397, and 0.8451 respectively, indicates that fertilizer subsidy and yield of sugarcane and fertilizer use in sugarcane and yield of sugarcane are positively correlated. The results suggest that if government increases the fertilizer subsidy then it will increase the yield of sugarcane and vice versa. In addition, fertilizer use in sugarcane is highly correlated with its yield as the correlation between them is above 84%.

Table 5.3: Correlational Analysis for Sugarcane

	Fertilizer Subsidy	Fertilizer use in Sugarcane	Yield of Sugarcane
Fertilizer Subsidy	1.0000	-	-
Fertilizer use in Sugarcane	0.3734	1.0000	-
Yield of Rice	0.5397	0.8451	1.0000

Source: Author's own calculation

5.1.4 Correlational analysis for Cotton

Table 5.4 shows the correlation of fertilizer subsidy, its use in cotton and yield of cotton in kg/hectare. Fertilizer subsidy and fertilizer use are positively correlated with the yield of cotton and the strength of this relationship is up to 60%. As fertilizer usage is increasing in cotton, its yield (kg/hec) is also increasing and vice versa and fertilizer use in cotton is also positively correlated with fertilizer subsidy, which depicts that increase in fertilizer subsidy is also cause to an increase in yield of cotton directly and indirectly with the usage of fertilizer. Degree of relationship between fertilizer subsidy and yield of cotton is up to 49%.

Table 5.4: Correlational analysis for Cotton

	Fertilizer Subsidy	Fertilizer use in Cotton	Yield of Cotton
Fertilizer Subsidy	45.58	-	-
Fertilizer use in Cotton	0.5977	1.0000	-
Yield of Cotton	0.4921	0.8022	1.0000

Source: Author's own calculation

5.1.5 Correlational analysis for Maize

Table 5.5 shows the correlation of fertilizer subsidy, fertilizer use in maize and yield of maize in kg/hectare. Fertilizer subsidy is negatively correlated with the use of fertilizer in maize and consequently its usage is also negatively correlated with yield of maize and excess use of fertilizer in maize is reducing the yield of maize by 65%. Which demonstrates that over usage of fertilizer reduce the fertility of land and hence it yield.

Table 5.5: Correlational Analysis for Maize

	Fertilizer Subsidy	Fertilizer use in Maize	Yield of Maize
Fertilizer Subsidy	1.0000	-	-
Fertilizer use in Maize	-0.4694	1.0000	-
Yield of Cotton	0.6989	-0.6503	1.0000

Source: Author's own calculation

5.2 Correlation analysis for India

This section will briefly analyze the correlational analysis between fertilizer subsidy and yield of crops (kg/hectare) in India. As the data for crop-wise use of fertilizer are not available for India data on fertilizers subsidy are available only from 1990-2015, so for analysis correlation matrix will construct for the given time period.

Correlational analysis between fertilizer subsidy and yield of crops are providing evidence in favour of subsidy in India. Fertilizer subsidy is positively correlated with all the five major crops which include wheat, rice, cotton, maize and sugarcane. This demonstrates that an increase in fertilizer subsidy will also cause a substantial increase in yield (kg/hectare) of these crops in India. The highest correlation of fertilizer subsidy lies with yield of rice and maize which is about 89% and yield of sugarcane is less affected by subsidy, which is 45% but the positive correlation yields the importance of fertilizer subsidy in the sugarcane crop in India (Table 5.6).

Table 5.6: Correlation between Fertilizer Subsidy and Yield of Crops in India

Yield of Major Crops	Fertilizer Subsidy
Yield of Wheat	0.8607
Yield of Rice	0.8911
Yield of Cotton	0.866
Yield of Maize	0.8900
Yield of Sugarcane	0.4509

Source: Author's own calculation

5.3 Regression Analysis

This section represents the impact of fertilizer subsidies on five major crops (Wheat, Rice, Maize, Cotton and Sugarcane) for Pakistan and India. Fertilizer subsidies are taken in real form in Rs. Billions on constant base of 2000 of respective countries; Pakistan and India. While yield of crops are taken in kg/hectare. Table 5.7 to 5.11 represents the impact of fertilizer subsidies on different crops in Pakistan while table 5.12 to 5.16 represents analyses of India. Results reveal that fertilizer subsidies have positive and significant impact on yield of all crops under study in both Pakistan and India. Our findings are in line with Quizon (1985), Ekanayake (2009), Ramli et al. (2012), Bunde et al. (2014) and Shivashankar and Uma (2014).

5.3.1 Regression analysis for Pakistan

From table 5.7 to 5.11, yield of major crops (Wheat, Rice, Sugar cane, Maize and Cotton) is regressed on fertilizer subsidy for Pakistan. Data from 1980-2015 is used for regression analysis to analyze the impact of fertilizer subsidies on crop yield[5].

5.3.1.1 Regression Analysis of Wheat

The impact of fertilizer subsidy on yield of wheat in Pakistan is exposed in table 5.7. Rupees of one billion subsidy is significantly increasing the yield of wheat by 1.81 kg/hectare at 1% level of significance ($p<0.01$) and increases the productivity of wheat by Rs. 0.49 billion in real valued terms[6] . Constant value shows that without fertilizer subsidies, yield of wheat will be 2052 kg/hectare in Pakistan.

[5]Values of fertilizer subsidy are treated as zero in which years, government has not disbursed the fertilizer subsidy.

[6]Calculations are presented in Appendix D.

Table 5.7: Impact of Fertilizer subsidy on Yield of Wheat
Dependent Variable: Yield of Wheat

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	1.8068	0.4751	0.0001
Constant	2052.445	66.9947	0.0000
F-Stat (1,34)	14.46	Prob.>F	0.0006

Source: Author's own calculation

5.3.1.2 Regression Analysis of Rice

Rice yield is also significantly increasing by fertilizer subsidy in Pakistan. An amount of rupees of one billion subsidy on fertilizer is increasing the yield of rice by 1.49 kg/hectare at 1% level of significance ($p<0.01$) and resulting in an increase of Rs. 0.13 billion value of rice in real footings. Constant value shows that without fertilizer subsidies, average yield of rice will be 1817 kg/hectare in Pakistan (Table 5.8).

Table 5.8:Impact of Fertilizer subsidy on Yield of Rice
Dependent Variable: Yield of Rice

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	1.4906	0.3334	0.0000
Constant	1817.049	44.6196	0.0000
F-Stat (1,34)	19.98	Prob.>F	0.0001

Source: Author's own calculation

5.3.1.3 Regression Analysis of Sugarcane

Table 5.9 displays the impact of fertilizer subsidy on yield of sugarcane in Pakistan. Outcomes show that an amount of rupees of one billion subsidies on fertilizer in Pakistan is significantly increasing the yield of sugarcane by 27.20 kg/hectare. By the given prices and area of sugarcane, this contribution will result in increase of sugarcane yield by an amount of Rs. 0.13 billion in real monetary terms. These results are also significant at 1% level ($p<0.01$). Constant value shows that without fertilizer subsidies, yield of sugarcane will be 44225 kg/hectare in Pakistan which is more than twenty times as compared to wheat and rice.

Table 5.9: Impact of Fertilizer subsidy on Yield of Sugarcane
Dependent Variable: Yield of Sugarcane

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	27.2021	6.1978	0.0000
Constant	44224.82	1014.979	0.0000
F-Stat (1,34)	19.26	Prob.>F	0.0001

Source: Author's own calculation

5.3.1.4 Regression Analysis of Maize

Impact of fertilizer subsidies on maize yield is demonstrated in table 5.10. Outcomes illustrates that an additional amount of rupees of one billion subsidy on fertilizers will increase the yield of maize by 5.93 kg/hectare or by Rs. 0.15 billion in Pakistan. Constant value shows that without fertilizer subsidies, yield of maize will be 1746 kg/hectare in Pakistan.

Table 5.10: Impact of Fertilizer subsidy on Yield of Maize
Dependent Variable: Yield of Maize

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	5.9272	1.2356	0.0000
Constant	1745.863	129.06	0.0000
F-Stat (1,34)	23.01	Prob.>F	0.0001

Source: Author's own calculation

5.3.1.5 Regression Analysis of Cotton

Impact of fertilizer subsidies on cotton yield is presented in table 5.11. Findings explain that an additional amount of rupees of one billion subsidy on fertilizers will increase the yield of maize by 0.55 kg/hectare or by an amount of Rs. 0.12 billion at 1% level of significance ($p<0.01$). Although these results are not much robust as compared to other crops but positive sign exemplifies the importance of fertilizer subsidy on this crop as well. Constant value shows that without fertilizer subsidies, yield of cotton will be 551 kg/hectare in Pakistan.

Table 5.11: Impact of Fertilizer subsidy on Yield of Cotton
Dependent Variable: Yield of Cotton

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	0.5484	0.1013	0.0000
Constant	551.0915	24.1395	0.0000
F-Stat (1,26)	29.28	Prob.>F	0.0000

Source: Author's own calculation

5.3.2 Regression Analysis for India

From table 5.12 to 5.16, yield of crops are regressed on fertilizer subsidies in India. For the analysis, data from 1990 to 2015 are used for regression.

5.3.2.1 Regression Analysis of Wheat

Impact of fertilizer subsidies on yield of wheat is demonstrated in table 5.12 for India. Results illustrate the positive and statistically significant relationship of fertilizer subsidy and yield of wheat at 1% level ($p<0.01$). A rise in one billion rupees subsidies on fertilizers leads to increase in wheat acreage by 4.19 kg/hectare in India and resulting in ninety two percent more benefit in

terms of monetary benefits[7], which is more as compared to Pakistan. Constant value shows that without fertilizer subsidies, yield of wheat will be 2545.73 kg/hectare in India.

Table 5.12: Impact of Fertilizer subsidy on Yield of Wheat
Dependent Variable: Yield of Wheat

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	4.1872	0.5342	0.0000
Constant	2545.733	61.45	0.0000
F-Stat (1,24)	61.42	Prob.>F	0.0000

Source: Author's own calculation

5.3.2.2 Regression Analysis of Rice

Coefficient value of fertilizer subsidy reveals that rise in subsidies by rupee one billion leads to increase in rice acreage by 4.34 kg/hectare or Rs.1.90 billion in monetary terms by given prices of rice and area under rice crop in India, which is also more as compared to Pakistan. Constant value shows that without fertilizer subsidies, yield of rice will be 1859.05 kg/hectare in India (see table 5.13).

Table 5.13: Impact of Fertilizer subsidy on Yield of Rice
Dependent Variable: Yield of Rice

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	4.3443	0.3310	0.0000
Constant	1859.052	31.0257	0.0000
F-Stat (1,24)	172.24	Prob.>F	0.0000

Source: Author's own calculation

5.3.2.3 Regression Analysis of Cotton

Table 5.14 represents the Impact of fertilizer subsidies on cotton yield for India. Coefficient value of fertilizer subsidy reveals that rise in subsidies by rupee one billion leads to increase in cotton acreage by 2.13 kg/hectare or by Rs.1.09 billion in monetary value in India. Constant value shows that without fertilizer subsidies, yield of cotton will be 233.97 kg/hectare in India.

[7]Calculations are presented in Appendix E.

Table 5.14: Impact of Fertilizer subsidy on Yield of Cotton
Dependent Variable: Yield of Cotton

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	2.1313	0.1616	0.0000
Constant	233.9768	15.7499	0.0000
F-Stat (1,24)	173.74	Prob.>F	0.0000

Source: Author's own calculation

5.3.2.4 Regression Analysis of Maize

Fertilizer subsidy is also significantly increasing the maize yield in India. An increase in subsidy by one billion leads to increase in maize yield by 7.37 kg/hectare in India and results are also statistically significant at 1% level ($p<0.01$).In monetary terms, effect of fertilizer subsidy on maize yield in India is relatively six time more than in Pakistan. Constant value shows that without fertilizer subsidies, yield of maize will be 1663.29 kg/hectare in India.

Table 5.15: Impact of Fertilizer subsidy on Yield of Maize
Dependent Variable: Yield of Maize

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	7.3726	0.5699	0.0000
Constant	1663. 285	45.1070	0.0000
F-Stat (1,24)	167.35	Prob.>F	0.0000

Source: Author's own calculation

5.3.2.5 Regression Analysis of Sugarcane

Impact of fertilizer subsidy on yield of sugarcane in India is almost the same as in case of Pakistan but in monetary terms, it is much higher than that of Pakistan. An increase in subsidy by one billion leads to increase in maize yield by 29.05 kg/hectare in India or added yield by more than 4.6 billion in real monetary value. Constant value shows that without fertilizer subsidies, yield of sugarcane will be 66546.17 kg/hectare in India.

Table 5.16: Impact of Fertilizer subsidy on Yield of Sugarcane
Dependent Variable: Yield of Sugarcane

	Coefficients	Robust S.E	p-value
Fertilizer Subsidy	29.0469	8.7643	0.0003
Constant	66546.17	852.9781	0.0000
F-Stat (1,24)	10.98	Prob.>F	0.0029

Source: Author's own calculation

5.4 Elasticity Analysis of Crop Yield with respect to Fertilizer Subsidy

Elasticity of variable is measured to check the percentage change in dependent variable due to an independent variable. In the linear regression model, elasticity can be computed by using the following formula:

$$e_{xy} = \hat{\beta} \frac{\bar{X}}{\bar{Y}}$$

where;

ß is the estimated coefficient of respective regression.

$\bar{X}$ is the mean value of independent variable, which is same in all model denoting the mean value of fertilizer subsidy.

$\bar{Y}$ is the mean value of dependent variable, which denotes the average of yield of respective crop in all regressions.

In previous section, detailed analyses are done to explore the impact of fertilizer subsidies on different crop yields in Pakistan and India. Both countries are showing significant contribution of fertilizer subsidies on crop wise yield but results are more robust in Pakistan as the proportionate change in crop wise yields are more in Pakistan than India. But due to the differences in data set, further inferences are made on the basis of elasticities of yield with respect to fertilizer subsidies in both countries. Elasticity of yields with respect to fertilizer subsidies also confirms the results of regression analysis. Although yield is inelastic to subsidies in both countries, but difference is not wider in case of India as compared to Pakistan. Yield elasticity of wheat, rice and cotton is more in India as compared to Pakistan. While, elasticity of maize is same in both countries and yield elasticity of sugarcane with respect to fertilizer subsidy is more in Pakistan than in India. One percent increase in fertilizer subsidy is resulting in 0.06 percent increase in yield of wheat in Pakistan and India the proportionate increase in yield of sugarcane in India is half than that of Pakistan. Elasticity of rice and cotton yield is also inelastic but in India, showing relatively more elasticity than Pakistan. The results also demonstrate that crops yield is more in India without fertilizer subsidies than Pakistan. This indicates that India is subsidizing more to agriculture sector rather it can produce more without subsidies than Pakistan as the coefficient value of constant terms in regression analysis are more in India than Pakistan. Analysis indicates that allocation of subsidies is not properly disbursed according to need in both countries. But because of positive sign of coefficients, there is need of the distribution and allocation of subsidies to agriculture sector on the basis of need.

Table 5.17: Elasticity of Crop Yields with Respect to Fertilizer Subsidy

Crops	Pakistan	India
Wheat	0.06	0.06
Rice	0.06	0.08
Cotton	0.07	0.20
Maize	0.20	0.13
Sugarcane	0.04	0.02

Source: Author's own calculation

5.5. Limitations of the Study

Data collection and availability of data are always the challenge in the research. As the major share of agricultural input subsidy is provided only on fertilizers by Pakistan government. In future aspects, other input subsidies on agriculture can also be the part of research on the basis of data availability. But due to limited time and data availability, present research is restricted to analyze the impact of fertilizer subsidy on crop sector in Pakistan and India.

Conclusions, Recommendations and Policy Implications

6.0 Conclusions and Recommendations

Based on research findings, some conclusions and relevant policy recommendations are devised. Section 6.1 is reserved for conclusions while policy recommendations are given in section 6.2.

6.1 Conclusions

Agriculture production is the major source of income for the majority of household in India and Pakistan where most of the population is engaged with agriculture and its allied activities. Majority of the farmers in these countries are not in a position to secure key inputs from their own sources. Thus, subsidies on agricultural inputs (improved seed, plant protection, formal credit, irrigation and particularly on fertilizers) have great importance. Agricultural subsidies allow the farmers to use balance inputs that enhance the productivity of crops and help drive prices down to benefit consumers. This study was, therefore, designed to explore the impact of fertilizer subsidy on crops' yield in India and Pakistan. The following are:

- Trends in fertilizer subsidies show that India is subsidizing more than Pakistan. From 1990-2015, Pakistan has disbursed Rs. 227 billion for fertilizer subsidy and during 1996-2003, subsidy on fertilizer was not disbursed by Government of Pakistan while in the same period India has disbursed Rs. 7436 billion of subsidy which is almost 35 times more than Pakistan.
- Real subsidy in Pakistan has been decreased during the period after 1980-81 till 1995-96 and showing increasing trend from 2004-05 to 2011.
- Real subsidy in India is showing increasing trend throughout the period under consideration.
- Correlation analysis for Pakistan and India also indicates the positive correlation between fertilizer subsidy, use of fertilizer in crop and yield of respective crop. Correlation coefficients of India are also greater than correlation coefficients in Pakistan.
- Regression analysis demonstrates that yield of wheat is positively affected by fertilizer subsidy in Pakistan as well as in India but slope coefficient is more robust in India than Pakistan.
- The results indicate that yield of rice, cotton, maize and sugarcane are also positively affected by fertilizer subsidy in both countries and have heterogeneous results in both countries. However, regression results are more robust in India than Pakistan. Findings of regression are also in line with Gilbert and Jayne (2009), who found the positive relation of fertilizer subsidy on planted area and maize production in Malawi. Ekanayake (2009) and Ramli et al. (2012) found positive relation of paddy rice with fertilizer subsidies. Bunde et al. (2014) also examined positive and significant effect of fertilizer subsidies on maize production in Kenya.
- Regression coefficients of wheat, rice and cotton yield in India are four times that of Pakistan. Similarly, effect of fertilizer subsidy on yield of sugarcane and maize in India is more than in Pakistan.
- Elasticity of yield of rice and cotton with respect to fertilizer subsidy is greater in India than Pakistan. One percent increase in fertilizer subsidy leads to increase rice and cotton yield by 0.06 percent and 0.07 percent respectively in Pakistan, while this proportionate change is 0.08 percent and 0.20 percent respectively in India.
- In monetary terms, India is gaining more from fertilizer subsidies as compared to Pakistan.

- Coefficient values of elasticities are very low but due to positive impact of fertilizer subsidy, role of fertilizer subsidy in agriculture sector cannot be neglected and strong policy is needed to enhance the productivity of agriculture sector.

6.2 Recommendations and Policy Implications

Some recommendations and policy implications are reflected below.

- The investments in R&D from government and other stakeholders must continue in fertilizer industry in order to improve and strengthen the quality of fertilizers. This will increase the productivity of major crops and to ensure the adequate supply of food grain for the population.
- It is revealed that the balanced use of fertilizer leads to building up soil health and could increase the yield of major crops while imbalanced fertilization leads to soil mining and its sickness which will cause to degradation of soil and also pollute the environment. It is therefore extensive services should be enhanced to educate and motivate the farmers to use fertilizers in right time and in right quantity. So activities/ workshops must be planned to promote the balance use of fertilizers. These activities would lead to awareness in farmers and it is hoped that balanced use of fertilizer would become a reality in future.
- Some other inputs like seeds, pesticides and water irrigation etc. are the possible factors or inputs for the productivity and yield of major crops. It is therefore proposed, these agricultural inputs should also be subsidized by diverting some funds from fertilizers subsidy to the other inputs where they needed. The saving from allocation for fertilizer subsidy program could be channelled to construction of new irrigation scheme for water shortage areas.
- The basic purpose of subsidy is to finance the poor or marginal farmers, but in Pakistan it is observed that a huge amount of subsidy has been caught by the larger farmers. As in recent years, government paid fertilizer subsidy on per bag basis. For example in current fiscal year, Rs. 390 were given as a subsidy on 50 kg urea and Rs. 300 on DAP bag (Government of Pakistan, 2016). As a result the rich farmers who have a large amount of cultivated area got a huge amount of subsidy as they used higher quantity of fertilizers. So it is the need of hour to channelize the budget of subsidy in some targeted way that the poor and marginal farmers got benefit from Government's policies so the true purpose of subsidy could be achieved.
- It has also been observed that all the farmers get equal amount of fertilizer without considering the degree of land fertility. Generally, high fertile land needs low amount of fertilizer to get higher productivity. If the subsidy granted on the basis of fertility of land then it would increase the productivity of crops.
- As far as advancement in fertilizer production around farmers, our outcomes clearly hint at that future arrangement and investment stress, if be on enhancing fertilizer-use effectiveness instead of pushing higher for every hectare utilization of fertilizer.
- The Agricultural Input Subsidy has not to be a political agenda in the political parties but must be a reform measure or a tool to the small and marginal farmers to serve its intended purpose. Thereby, nutrient based subsidy on agriculture input is to be promoted to bring reforms in agriculture sector.

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Appendix

Appendix A: Crop Wise Use of Fertilizers in Pakistan (000 Nutrient Tonnes)

Year	Wheat	Rice	Maize	Cotton	Sugarcane
1980	517.92	129.48	75.53	172.64	97.11
1981	517.44	129.36	75.46	172.48	97.02
1982	597.12	149.28	87.08	199.04	111.96
1983	601.5	120.3	84.21	180.45	96.24
1984	626.5	125.3	87.71	187.95	100.24
1985	756	151.2	105.84	226.8	120.96
1986	892	178.4	124.88	267.6	142.72
1987	860	172	120.4	258	137.6
1988	817.8	174	69.6	348	191.4
1989	888.3	189	75.6	378	207.9
1990	889.71	189.3	75.72	378	208.23
1991	885.48	188.4	75.36	376.8	207.24
1992	1009.38	214.76	85.9	429.52	236.24
1993	1009.09	214.2	85.88	429.4	236.17
1994	1026.05	218.31	87.32	436.62	240.14
1995	1182	251.5	100.6	503	276.7
1996	1076	253	104	500	196
1997	1186	279	114	551	215
1998	1171.65	138.97	57.87	596.67	274.06
1999	1285.05	152.42	63.47	654.42	300.58
2000	1344.02	159.41	66.37	684.45	314.37
2001	1328.59	157.58	64.61	676.6	340.77
2002	1369.87	162.48	67.65	697.62	320.42
2003	1461.5	173.34	72.17	744.28	341.85
2004	1847	221.64	55.41	923.5	295.52
2005	1902.1	228.25	57.06	951.05	304.43
2006	1835.8	220.29	55.07	917.9	293.72
2007	1790.5	214.86	53.72	895.25	286.48
2008	1855.5	222.66	55.67	927.75	296.88
2009	2180	261.6	65.4	1090	348.8
2010	1966.5	235.98	59	983.25	314.64
2011	1930.45	231.65	57.91	965.23	308.87
2012	1810.75	217.29	54.32	905.38	289.72
2013	2044.55	245.35	61.34	1022.28	327.13
2014	1928.58	231.43	57.86	964.30	308.57
2015	1927.96	231.36	57.84	963.99	308.47

Source: NFDC

Appendix B: Yield of Major Crops in Pakistan (kg/ hectare)

Year	Wheat	Rice	Sugarcane	Maize	Cotton
1980	1643.00	1616.00	39223.00	1262.00	339
1981	1565.00	1736.00	38627.00	1259.00	338
1982	1678.00	1741.00	35673.00	1273.00	364
1983	1482.00	1671.00	38224.00	1270.00	223
1984	1612.00	1659.00	35553.00	1271.00	450
1985	1881.00	1567.00	35713.00	1256.00	515
1986	1559.00	1688.00	39273.00	1361.00	527
1987	1734.00	1651.00	39227.00	1320.00	572
1988	1865.00	1567.00	42094.00	1391.00	544
1989	1825.00	1528.00	41562.00	1367.00	560
1990	1841.00	1543.00	40712.00	1401.00	615
1991	1990.00	1546.00	43376.00	1419.00	769
1992	1946.00	1579.00	43023.00	1364.00	543
1993	1893.00	1826.00	46142.00	1380.00	488
1994	2081.00	1622.00	46747.00	1481.00	557
1995	2018.00	1835.00	46963.00	1602.00	601
1996	2053.00	1912.00	43544.00	1607.00	506
1997	2238.00	1870.00	50279.00	1627.00	528
1998	2170.00	1928.00	47780.00	1730.00	512
1999	2491.00	2050.00	45883.00	1718.00	641
2000	2325.00	2021.00	45385.00	1741.00	624
2001	2262.00	1836.00	48056.00	1768.00	579
2002	2388.00	2013.00	47341.00	1857.00	622
2003	2373.00	1970.00	49738.00	2003.00	572
2004	2586.00	1994.00	48906.00	2849.00	714
2005	2519.00	2116.00	49229.00	2984.00	714
2006	2519.00	2116.00	49246.00	2984.00	714
2007	2716.00	2107.00	53199.00	3037.00	711
2008	2451.00	2212.00	51507.00	3427.00	649
2009	2657.00	2347.00	48635.00	3415.00	713
2010	2553.00	2387.00	52357.00	3488.00	707
2011	2714	2396	55196.00	3990.00	855
2012	2796	2415	56475	3983	768
2013	2824	2437	57511	4315	774
2014	2725	2422	55063	4242	802
2015	2754	2482	57483	4283	581

Source: Economic Survey of Pakistan (Various Issues)

Appendix C: Yield of Major Crops in India (kg/ hectare)

Year	Wheat	Rice	Cotton	Maize	Sugarcane
1990	2679	1740	225	1518	65000
1991	2503	1742	241	1597	64500
1992	2327	1744	257	1676	64000
1993	2380	1888	249	1602	67000
1994	2559	1911	257	1448	71000
1995	2483	1797	242	1595	68000
1996	2679	1882	265	1720	66000
1997	2485	1900	208	1711	71000
1998	2590	1921	224	1797	71000
1999	2778	1986	225	1792	71000
2000	2708	1901	190	1822	69000
2001	2761	2077	186	1963	67000
2002	2618	1804	193	1638	65000
2003	2713	2078	307	2041	59000
2004	2602	1984	318	1907	65000
2005	2619	2102	362	1938	67000
2006	2708	2131	421	1912	69000
2007	2802	2202	467	2335	69000
2008	2907	2178	403	2414	65000
2009	2839	2125	403	2024	70000
2010	2989	2239	499	2540	70000
2011	3178	2393	491	2478	72000
2012	3117	2462	486	2566	68000
2013	3145	2416	510	2676	71000
2014	2872	2390	461	2557	70000
2015	3045	2423	486	2600	69667

Source: Union Budget, GoI (Various Issues)

Appendix D: Estimated Value added in Pakistan after Fertilizer Subsidy

Crop	Coeff. Value	Area (Hectares)	Price/kg	Value
Wheat	1.8068	9224000	29.5	4.92E+08
Rice	1.4906	2739000	31.75	1.3E+08
Cotton	0.5484	2902000	72.45	1.15E+08
Maize	5.9272	1191000	21.5	1.52E+08
Sugarcane	27.2021	1130000	4.3	1.32E+08

Source: Author's Own Calculations

Appendix E: Estimated Value added in India after Fertilizer Subsidy

Crop	Coeff.	Area (Hectares)	Price/kg	Value
Wheat	4.1872	30227597	15.21	1.93E+09
Rice	4.3443	43388080	15.41	2.9E+09
Cotton	2.1313	11872000	43.11	1.09E+09
Maize	7.3726	8691244	14.45	9.26E+08
Sugarcane	29.0469	4953402	32.5	4.68E+09

Source: Author's Own Calculations

Punjab Economic Research Institute (PERI)
Planning & Development Department
Government of the Punjab
48 Civic Centre Johar Town, Lahore,
Pakistan.

Tel: +92-42-99233441 E-mail: director@peri.punjab.gov.pk Web: www.peri.punjab.gov.pk