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Estimating Effects of Agricultural Inputs on Growth of Agricultural Production: A comparative study of India and Pakistan

Rajni Pathania[1]

Agriculture sector is backbone of development of any economy. In developing countries an average people still spends fifty percent of his total income on food and almost above than fifty percent people directly or indirectly are engaged in agriculture activities for their livelihood. It means agriculture sector has greater significance in providing food and livelihood for a large group of people. In developing countries more than five percent growth of agriculture sector is essential to provide employment to large population, to high growth of national income, to reducing poverty and for economic stability of economy.

Table-1 Total Geographical Area

India	328.73 million Hectares
Pakistan	79.61 million Hectares

Agriculture is a critical sector of the Indian and Pakistan Economy. The contribution of agricultural sector towards overall Gross Domestic Product of the Countries has decline in both economies. In India, the share of agriculture sector in GDP was 41.8 percent during 1950-51 and this fell to 24.5 per cent during 1990-91. There has been consistent decline in share of agriculture to GDP since 1950 onwards. It was 16 per cent during 2004-05, which came down to 11.5 percent during 2013-14. This shows that agricultural sector of Indian economy has undergone significant changes in the form of declining share of GDP since independence. It indicates that Indian economy is shifting from traditional agrarian economy towards a service dominated economy. This declining agricultural sector contribution to GDP has not been same in the share of agriculture employment. About 50 percent of the total work force is still engaged in agriculture sector for their livelihood.

Table 2- Total Cropped and Gross Irrigated Area in India (million Hectares)

Variable / year	1950-51	2003-04	2011-12
Total cropped area	131.89	189.66	195.25
Gross Irrigated area	22.56	78.00	91.53

Source: Agricultural statistics at Glance 2014

[1] Department of Business Economics, Faculty of Commerce, The M.S. University of Baroda, Vadodara Gujarat India. E-mail: rajnipathani@gmail.com

Table-3 Gross cropped area % of Distribution in India during 2013-14

Crop	Percentage of Distribution
Rice	22.33
Wheat	15.41
Cotton	6.23
Sugarcane	2.79

Source: Agricultural statistics at Glance 2014

Table-4 India

Year	**Agriculture share in Gross State domestic product(GDP) at constant prices(2004-05)**
1950-51	41.8
1990-91	24.9
2000-01	24.0
2004-05	16.0
2010-11	12.4
2011-12	12.3
2012-13	11.8
2013-14	11.5

Source: Pocket book of Agricultural Statistics 2014

In Pakistan, since the Independence the share of agricultural sector in Gross Domestic Product of Pakistan has fallen considerably. Its share in GDP was 53.3 percent during 1950-51, which was came down to 26 per cent in 1990-91. Its contribution to GDP again still decline to 25 percent during 2000-01 to 20.9 percent during 2013-14, while the share of other sectors like manufacturing and service sector has increase. But still major proportion of population is engaged in agriculture sector of economy. Around 45 percent of the population is involving in agriculture sector for their livelihood and food. At the time of partition, Pakistan inherited 55per cent of the population, 62 per cent of the area, 70 per cent of the canal irrigation and 70 per cent of the income. The exchange of people was almost equal; 4.3 million coming to India against 4.2 million coming to Pakistan. The total geographical area of Pakistan is 79.61 million hectares. around 27 percent of the geographical area is used for cultivation and 86 percent of agricultural land is irrigated. Pakistan's agriculture mainly depends on the canal

irrigation system. Growth of the cropped area in Pakistan is increased continuously since Independence. Major crops of Pakistan are wheat, Rice, cotton and sugarcane. These major crops accounted 29 per cent of the value added in overall agricultural and 6.0 percent to Gross Domestic Product of economy. Agriculture sector is main foundation of Exports. In Pakistan 99 percent of export are based on agriculture commodities. Employment share of agriculture is 44 percent.

Table- 5 Total Cropped and Gross Irrigated Area in Pakistan (million Hectares)

Variable / year	1991-92	2003-04	2011-12
Total cropped area	20.87	22.56	23.40
Gross Irrigated area	16.85	18.78	18.56

Source: *Agricultural statistics of Pakistan*

Table- 6 Gross cropped area % of Distribution in Pakistan

Year	Food crops	Cash Crops	Pulses	oilseeds	other	Vegetables	condiments	fruits
1993	55	18	7	2	13	1	1	2
2006	55	18	6	3	11	2	1	4
2010	56	21	6	3	8	2	1	4

Source: *Agricultural statistics of Pakistan*

Food Crops = Wheat, Rice, Jowar, Maize, Bajra and Barley, Cash crops = Sugarcane, Cotton, Tobacco, Sugar beet, Jute and Guarseed, Pulses = Gram, Mung, Mash, Masoor, Mattar, Other Kharif and Rabi Pulses, Oilseeds = Rapeseed & Mustard, Sesamum, Groundnut, Linseed, Castorseed and other oilseeds, Condiments = Chillies, Onion, Garlic, Coriander. Turmeric and Ginger

Table -7 Pakistan

Year	**Agriculture share in Gross State domestic product(GDP) at current prices**
1950-51	53.2
1990-91	26.0
2000-01	25.9
2004-05	22.2
2010-11	21.8
2011-12	21.5
2012-13	21.4
2013-14	20.9

Source: *Pakistan Bureau of Statistics*

Apart from this introduction, this paper is divided into five sections. Section two discusses the previous studies related to relationship between inputs of agriculture and agricultural production growth, source of data and methodology, while section three related to Frame work for assessing Agriculture Inputs and agricultural production in

India and Pakistan during 1991 to 2013-14, section four highlights and finally section six presented conclusion and suggestions.

II. Review of Literature, Objectives, Hypothesis, Sources of Data, Variables of Study and Study Period

II. I. Review of Literature

Since 1950 to till date there are numerous studies have been done on the different aspects agricultural Production growth at national and international level. A few studies have been taken for review:

Mukhopadyaya(1976) studied the sources of variations in agricultural productivity in 72 wheat growing districts of India over the period of 1959-60 to 1968-69. This study found that land, irrigation, fertilizers, tractors and literate labour contribute only 41 percent variation in agricultural output and remaining 59 percent due to regional affects and temporal effects.

Zuberi(1989) estimated the production function of agricultural sector of Pakistan by covering the period 1956 to 1986. Land, labour, seed, livestock, water, tractor and fertilizer were used as independent variables and agricultural output was used as dependent variables. This study concluded that the agricultural sector in Pakistan has experienced constant returns to scale over the period covered by this study. This study found that output of agricultural sector was positively explained by changes in the amount of fertilizer and seeds plus the number of labour force employed in farming in Pakistan, assuming all other inputs remaining constant.

Dholakia and Dholakia (1993) estimated the sources of growth of Indian agriculture sector for three sub period (pre green revolution period(1950-51 to 1966-67), initial phase of green revolution 1966-67 to 198081 and modernization phase 1980-81 onwards, during 1950-51 to 1988-89. This study found that the use of modern inputs like irrigation facilities, fertilizers and high yield varieties seeds in the Indian agriculture has been mainly responsible for stepping up the rate of resource utilization and hence in accelerating TFPG in agricultural sector.

Rosegrant and Evenson (1993) assessed the total factor productivity growth in India and Pakistan from the period 1956 to 1985. The result of this study reveals that public investment in research and extension, adoption of modern varieties, expansion of irrigated area, and expansion of literacy are the main variables to increase agricultural productivity in India and Pakistan.

Singh (1997) examined the agricultural situation in India and Pakistan. This study traces the development in agriculture in India and Pakistan with special focus on Punjab by covering the period of 1947 to 1997. This study found that after independence both economies India and Pakistan made essential efforts to increase agriculture output growth through different agricultural developmental programmes. Because of these types of programmes, there was spectacular increase in crop productivity, crop

production, fertilizer consumption, irrigated area and real per capita GDP in India as compared to Pakistan. These developmental efforts in the farm sector also lowered down the rate of population growth in India than in Pakistan. This study found that percentage irrigated area is more than double and fertilizer consumption 1.2 times higher in Pakistan than the average consumption of fertilizers in India.

Kurosaki (1999) investigated the performance of agricultural sector in India and Pakistan by focused on the period from 1900 to 1995. This study provided historical and comparative perspectives of agricultural sector. This study revealed that the stagnant performance of agriculture in India and Pakistan during the colonial period was turned into a sustained growth since 1947, with a stronger performance in India especially in terms of per capita food production. Agricultural sector both in India and Pakistan experienced a continuous increase in crop concentration ratios during the post-1947 period. Empirical investigation in this research study gives support to the view that institutional changes have significant effects on agricultural production in India and Pakistan.

Mari and Lohano (2007) estimated the technical efficiency of onion, tomato and chilies production in three districts of Sindh, Pakistan. The technical efficiency of these variables is measured by estimating a production function through stochastic frontier by using Cobb Douglas production function approach. The results of this study found that onion, chilies production, vegetables and tomato exhibited under constant returns to scale. The results revealed that majority of onion(38 percent) and tomato(39 percent) farmers were primarily educated, while the majority (42 percent) of chilies farmers was illiterate.

Tripathi and Prasad (2009) analyzed the sources of agricultural growth and determinants of agricultural production of Indian agricultural sector over the period 1950-51 to 2005-06. This study found that land has significantly affected the agricultural output growth during 1950-51 to 1964-65, after that land became less significant and now labour and capital were significantly affecting agricultural output growth. This study also highlighted that only 39 percent of net sown area is irrigated area and area under food crop shifted towards non food crops.

Raza and Siddiqi (2014) conducted a study on determinants of Agricultural output in Pakistan by using Johansen Co-integration Approach during 1972 to 2012. This study examined the impact of fertilizer consumption, seeds, labour, tractors, tube-wells used as independent variables and agricultural output as dependent variables. This study found that number of tractors is an important determinant of agricultural output and other independent variables are positively associated with agricultural output.

Moreover, a lot of studies have been done on the relation of inputs of agricultural sector and agricultural production growth at national and international level. Our research study is somewhat unique in the sense that so far, there are very few studies has been covered on the estimating effects of agricultural inputs on agricultural production

growth as a comparative study between India and Pakistan during the period 1991-92 to 2013-14. There is enough scope of research in this area.

II.II Objective of the study:

The specific goal of this study is to estimate the effects of selected inputs i.e. fertilizer usage, Irrigation, electricity consumption and Public Investment on the growth of agricultural production in India and Pakistan.

II.III Hypothesis

We have proposed the following hypotheses for this study:

1. **H0**: There is no significant effect of fertilizer usage, Irrigation, electricity consumption and Public Investment on the growth of agricultural production in India.
2. **H0**: There is no significant effect of fertilizer usage, Irrigation, electricity consumption and Public Investment on the growth of agricultural production in Pakistan

II.IV Sources of Data

The present study is based on National and International level time series data which are taken from: Handbook of Statistics on Indian Economy, different Issues of Agricultural Statistics at a Glance, Economic Survey of India, Handbook of Statistics on Pakistan, various issues of Pakistan Economic Survey, Power system Statistics of Pakistan etc, covering a period of 23 years commencing from 1991-92 to 2013-14.

II. V. Variables

1. Gross state domestic product from agriculture at constant prices 2004-05
2. Gross Irrigated Area as proxy for irrigation (total Area irrigated by tube wells, canals, wells, canal tube wells and other sources)
3. Fertilizer usages in agriculture
4. Electricity consumption in Agriculture Sector
5. Public Investment in Agriculture Sector

II.VI Study period:

This study has been conducted for a long period of about 23 years from 1991 to 2013-14. Selection of time period is largely guided by availability of data. India and Pakistan has been taken up for our study.

III. Frame work for assessing Agriculture Inputs and agricultural production

The basic empirical framework employed in this study is based on a simple model of agriculture production function

$$\mathbf{LOG(Y) = \alpha + \sum \beta_i \, LOG\,(X_i) + \mu}$$

Where, Y refers to agricultural production. X_i refers to the determinants of agriculture production and μ is the error term.

In order to establish the impact of various factor inputs on growth of agricultural production more precisely, the above equation is elaborated as follows:

$LOG(Y) = \alpha + \beta\ LOG\ (IRR) + \gamma\ LOG\ (FERT) + \delta\ LOG\ (ELECT) + \lambda\ LOG\ (PINVST) + \mu$

Where,

Y is value of agricultural output at constant prices
IRR is Irrigation (Gross Irrigated Area)
FERT is fertilizer usages
ELECT is electricity consumption in agricultural sector
PINVST is public investment in agricultural sector

IV. Empirical Results

Table-8 Dependent variable- (Log) value of agriculture output at constant prices (India)

Independent variable	Parameter	Estimated coefficient	T- ratio	SE	P-Value
	1.429886				
LOG(IRR)		0.414817	1.229702	0.337331	0.2346
LOG(FERT)		0.261201	2.039219	0.128089	0.0564
LOG(ELECT)		0.230159	2.238966	0.102797	0.0380
LOG(PINVST)		0.127169	2.297778	0.055344	0.0338

$R^2 = 0.96$ Adj $R^2 = 0.95$ D-W= 1.28, F-Statistics= 120.70, Prob (F-Statistics= 0.000)

Table – 9 Dependent variable- (Log) value of agriculture output at constant prices (Pakistan)

Independent variable	Parameter	Estimated coefficient	T- ratio	SE	P- Value
	7.578				
LOG(IRR)		0.178	0.188	0.942258	0.9345
LOG(FERT)		0.666	9.120	0.073108	0.0000
LOG(ELECT)		0.134	1.361	0.098933	0.1893
LOG(PINVST)		0.098	8.664	0.01139	0.021

$R^2 = 0.94$ Adj $R^2 = 0.93$ F-Statistics= 116.70, Prob (F-Statistics= 0.000)

The value of regression coefficient is more informative it indicates by how much the dependent variable changes as the independent variable changes. The estimated coefficient of any independent variable estimates the effect of that variable while holding the other independent variables constant.

Hence, from above table, it is clear that the estimated agricultural output as the function of Irrigation (IRR), fertilizer usages (FERT), consumption of electricity (ELECT) and public investment (PINVST) is given by:

$$\mathbf{Y = e^{1.42} .IRR^{0.41} .FERT^{0.26} ELECT^{0.23} PINVST^{0.12}} \quad \textbf{(India) …….. (i)}$$

$$\mathbf{Y = e^{7.57} .IRR^{0.07} .FERT^{0.66} ELECT^{0.13} PINVST^{0.09}} \quad \textbf{(Pakistan)…….. (ii)}$$

The results indicate that at national level (India) the value of agricultural output at 2004-05 prices is (significantly) positively dependent on the Irrigation (IRR), fertilizer usages (FERT), consumption of electricity (ELECT) and public investment (PINVST). The result shown in above equation (i) indicate that holding fertilizer usage, electricity and public investment constant, an increase of one percent in Irrigation is associated with 0.41 percent increase in agricultural production. Similarly, the results suggest that a one percent increase in fertilizer consumption in agricultural sector leads to 0.26 percent increase in agriculture production, while other independent variables hold constant. The value of estimated coefficient of electricity is 0.23, it indicate that one percent increase in electricity consumption leads to 0.23 percent increase in agriculture production. The estimated coefficient of public investment indicates that for one percent deviation in public investment leads to 0.12 percent variation in value of agricultural production. The value of coefficient of determination is 0.96; it means that 96 percent of the variation in the dependent variable has been explained by variation in the independent variables. All estimated parameters in regression model are significant at 5% level of significance.

The result shown in equation (ii) indicates that holding other independent variables, an increase of one percent in Irrigation is associated with 0.17 percent increase in agricultural production in Pakistan. The regression coefficient of electricity consumption in agriculture is 0.66. It indicates that, a one percent change in electricity consumption in agriculture leads to 0.66 percent increases in agriculture production. The positive effect is high and significant in case of fertilizer usages. The value of estimated coefficient of electricity is 0.13, it indicates that one percent increase in electricity consumption leads to 0.13 percent increase in agriculture production, while other independent variables remain constant. The regression coefficient of public investment in agricultural sector is positive (0.09). This show that a one percent increases in public investment leads to 0.09 percent increase in agricultural production. The impact of fertilizer usage, electricity consumption and public investment has positive and significant, only one independent variable i.e. irrigation, individually is not significant at 5%significance level. From the above regression result, it is found that coefficient of determination is about 0.94. This implies that about 94% of the total variation in the growth of agriculture production is explained by Irrigation (IRR),

fertilizer usages (FERT), consumption of electricity (ELECT) and public investment (PINVST) in Pakistan, remaining only 6% left unaccounted for by the model is attributed to the error term.

V. Conclusion

The above analysis shows that Irrigation, public investment, fertilizer usage and electricity consumption for agriculture are the main factors in determining the growth of agricultural production. Finally, it is suggested that there is need to increase public investment in agriculture sector it may be in area of agriculture research, rural infrastructure, storage and marketing facilities. More public investment should be encouraged in agricultural backward regions of both nations. It is suggested that Government of India and Pakistan should increase subsidy on important agricultural inputs like seeds, fertilizers, pesticides and electricity, so that other financially week farmers can purchase these inputs at low cost easily. In both countries Government should give attention towards conducting awareness seminars for the better use of new & available technology, proper use of fertilizers in rural areas, so that farmers can use agricultural inputs efficiently. Government should take steps to improving seeds quality of major and commercial crops.

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