An Analysis of Determinants of Agriculture Sector Out-Put In Jammu and Kashmir Economy

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**Abstract:** The state of Jammu and Kashmir is basically an agrarian economy where 65 percent of the population is dependent upon agriculture sector for their livelihood and employment opportunities. In the present paper, Double- log multivariate regression model and simple linear multivariate regression model were employed to identify the major determinants of agriculture sector out-put of Jammu and Kashmir economy. It is apparent from the results as shown by log regression model that number of tractors and rain fall (in mm) are positively related to the agriculture sector output and both these variables are highly significant. While as net area irrigated and total distribution of fertilizer are negatively related to agriculture sector out-put, and both these variables are also highly significant and all these explanatory variables are statistically significant at 0.00 percent except the exact level of significance of Annual rainfall (in mms) is 7. Furthermore, it is apparent from the results as shown by simple regression model that number of tractors and loans disbursed are positively related to the agriculture sector output and while as only number of tractor variable is statistically highly significant due to its lower p-value. While as deviation from Average Annual rainfall (in mms) and total distribution of fertilizer are negatively related to agriculture sector out-put, while as only total distribution of fertilizer variable is statistically highly significant due to its lower p-value. From the analysis of this research paper it becomes clear that determinants of agriculture sector out-put of Jammu and Kashmir economy are not being properly utilized which leads to mis-allocation of determinants of agriculture sector which finally leads to low productivity of the said sector.

**Keywords:** Agriculture output, determinants, Regression Analysis, Productivity, Net Area Sown, Fertilizers, Annual Rainfall.

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1. **INTRODUCTION**

The fundamental role that agriculture plays in development has long been recognized. Agriculture has been a way of life and continues to be the single most important livelihood of the masses. Agriculture forms the resource base for sizeable number of agro based industries and agro services. Agriculture income has also created demand for industrial goods.

Achieving agricultural growth is important and it can be achieved with an increase and rational use of inputs and secondly increasing the productivity. The first component of agriculture growth includes labour, capital, irrigation, pesticide, credit facility, land and fertilizer consumption which are the vital physical inputs that are being employed in Jammu & Kashmir State’s agriculture production process. The second component of agricultural growth is the increase in productivity. This productivity growth is very important as it can be considered as a crucial condition or even a pre-condition for growth to take place in the entire economy.

Agriculture is still the lifeline and soul of majority of the people in Jammu & Kashmir State. A large proportion of the population (about 65%) in Jammu & Kashmir State lives is rural areas whereas agricultural and allied sector is the main source of livelihood in the rural areas. Therefore, improvements of agriculture sector in Jammu & Kashmir State directly imply improvement in the lives of about 70% people which from the statistical point of view is a very significant level. Therefore, an enhanced and stable growth of the agriculture & allied sector is important, as it plays a vital role not only in generating purchasing power among the rural population by creating on-farm and off-farm employment opportunities but also through its contribution to livelihood creation and ensuring the price stability in the economy as whole. Although the share of agriculture in Jammu & Kashmir State in real NSDP has been declined below one-third from 43% in 1980-81 to 15% in 2014-15, but it continues to be an important sector of economy as it employs around 42 per cent of the workforce and indirectly more than 60 percent population of Jammu & Kashmir State still depends upon the sector.

The growth in area is essential determinant to increase the agricultural production. In Jammu and Kashmir state net area sown has increased from 715.3 thousand hectares to about 739.14 thousand hectares from 1980-81 to 2015-16 respectively, which means that there is only a marginal increase about 3.63% in the net area sown during our study period. The irrigation being an important component for agriculture productivity and it is highly positively correlated with the increase in productivity, which ultimately affects the growth rate of
agriculture sector output. It may be because of this reason that the cropping intensity, productivity of important crops and level of agricultural growth in Jammu and Kashmir State was lower than national level. The use of fertilizer is very low in Jammu and Kashmir. It alone uses about 3 per cent of national fertilizer consumption. The use of fertilizers was estimated at 51 kgs per hectare in 2007-08 in Jammu and Kashmir state The fertilizer consumption in this state is even below than national average, which is somewhere around 65 kg per hectare. Farm mechanization plays an important role in bringing multiple cropping system and precision and timeliness in the farming operations in the agriculture sector. Due to mechanization especially tractorisation and installation of tube wells in Jammu and Kashmir, the cropping intensity has gone up marginally from 121.45 per cent in 1960-63 to 152.15 per cent in 2006-08.

**Objectives**
- To investigate the main determinants of agricultural sector output in state economy

**Hypothesis**
There is no rational use of inputs in agriculture sector in J&K state economy.

### II. DATA AND METHODOLOGY

**Data Collection**
Keeping in view the present status and objective of research paper work, secondary sources of data been collected to make our study more realistic and scientific. The secondary source of data has been used for detailed analysis of determinants of agriculture sector output in the state of Jammu and Kashmir.

Secondary source of data has been collected from books, government official records, valid records of state government, department of agriculture, Cooperation and Farmers welfare (Govt. of India), District at a glance, Anantnag, Sher-e-Kashmir University of Agriculture Science and Technology Srinagar (SKUAST), reports, newspapers, magazines, research journals and articles, websites and other active related agencies of the department of agriculture in the state.

**Statistical and Econometrical Tools**
The following appropriate statistical and econometrical tools have been employed to analyze and interpret data.

1) Analysis of Determinants of Agriculture Sector Out-Put Models

We have chosen a given functional forms of regression models to explain the relationship between the agricultural output and its determinants. A description of this model is given below.

- **Double Log Multivariate Regression Model-I**

\[
X = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u_1
\]

\[
\log (X) = a + b_1\log (X_1) + b_2\log (X_2) + b_3\log (X_3) + b_4\log (X_4) + u_1
\]

Where; as dependent variable \( X = \) Agricultural Sector Out-put (in Rs. Crores at constant prices) and explanatory variables in terms of log values are given below:

- \( X_1 = \) Net area irrigated (000 hectares)
- \( X_2 = \) Total distribution of fertilizer (tones)
- \( X_3 = \) Total number of tractors
- \( X_4 = \) Annual rainfall (in mms)
- \( u_1 = \) error term assumed to follow normal distribution with zero mean and constant variance.

- **Simple Linear Multivariate Regression Model-II**

\[
X = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u_1
\]

Where; as dependent variable \( X = \) Agricultural Sector Out-put (in Rs. Crores at constant prices) and explanatory variables are given below:

- \( X_1 = \) Deviation from Average Annual rainfall (in mms)
- \( X_2 = \) Total number of tractors
- \( X_3 = \) Total distribution of fertilizer (tones)
- \( X_4 = \) Loans Disbursed by regional Rural Banks
- \( u_1 = \) error term assumed to follow normal distribution with zero mean and constant variance.

### III. ANALYSIS OF DETERMINANTS OF AGRICULTURE SECTOR OUT-PUT

Depending on the availability of the authentic statistical data regarding the determinants of agricultural sector production, we have incorporated four variables in our regression analysis. Accordingly we have chosen a given functional forms of regression models to explain the relationship between the agricultural output and its determinants. A description of this model is given below.

- **Double Log Multivariate Regression Model**

\[
X = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u_1
\]

\[
\log (X) = a + b_1\log (X_1) + b_2\log (X_2) + b_3\log (X_3) + b_4\log (X_4) + u_1
\]
Where; as dependent variable \( X = \text{Log of Agricultural Sector Out-put} \) (in Rs. Crores at constant prices) and explanatory variables in terms of log values are given below:

\[
X_1 = \text{Net area irrigated (000 hectares)}
\]
\[
X_2 = \text{Total distribution of fertilizer (tones)}
\]
\[
X_3 = \text{Total number of tractors}
\]
\[
X_4 = \text{Annual rainfall (in mms)}
\]
\[u_i = \text{error term assumed to follow normal distribution with zero mean and constant variance.}\]

**The regression equation is**

\[
\text{Log}(X) = 10.5 - 0.96 \times X_1 + 0.27 \times X_3 + 0.06 \times X_4
\]

**Table 1.1: Double Log Regression Results of Determinants of Agriculture Sector Output at Constant Prices (1980-2015)**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>S.D</th>
<th>t</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>10.5</td>
<td>3.42</td>
<td>3.07</td>
<td>0.005</td>
</tr>
<tr>
<td>(X_1)</td>
<td>-0.96</td>
<td>0.55</td>
<td>-1.73</td>
<td>0.096</td>
</tr>
<tr>
<td>(X_2)</td>
<td>-0.11</td>
<td>0.05</td>
<td>-2.25</td>
<td>0.033</td>
</tr>
<tr>
<td>(X_3)</td>
<td>0.27</td>
<td>0.05</td>
<td>4.91</td>
<td>0.000</td>
</tr>
<tr>
<td>(X_4)</td>
<td>0.06</td>
<td>0.03</td>
<td>1.83</td>
<td>0.078</td>
</tr>
</tbody>
</table>

**R-Sq = 89.6%**

**F=55.77**

Source: Computed by Researcher on the basis of data obtained from office of the Financial Commissioner Revenue, Government of Jammu and Kashmir

It is apparent from the results as shown by log regression model that number of tractors and rain fall (in mm) are positively related to the agriculture sector output and both these variables are highly significant. While as net area irrigated and total distribution of fertilizer are negatively related to agriculture sector out-put, and both these variables are also highly significant and all these explanatory variables are statistically significant at 0.00 percent except the exact level of significance of \(X_4\) - Annual rainfall (in mms) is 7%. Total distribution of fertilizer is negatively related to agriculture sector out-put may be due to irrational use of it by farmers because of lack of awareness in the farmers about the prescribed norm of rational use of this type of input and secondly some type of fertilizers specially urea have been subsidized heavily which provides an incentive to the farmers to use more quantity of them which disturbs the prescribed and in this way a technological gap widens which reduces the productivity in the agricultural sector instead improving it.

Similarly, the contribution of net area irrigated to agriculture sector output is negative which is a paradoxical situation which is beyond explanation and it needs further investigation and therefore, it keeps doors open for new researchers to try to investigate it in depth and find the real cause of it. The number of tractors determinant can be treated as a proxy variable for capital. Therefore, this reflects that for the increase in production and productivity of agriculture sector, mechanization of it is a pre-requisite. In our model all these determinants are strongly related with agriculture sector output as together they explain about 56% change in the dependent variable (i.e. \(R^2 = 55.77\%\).)

**Simple Linear Multivariate Regression Model-II**

\[ X = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + u_1 \]

Where; as dependent variable \( X = \text{Agricultural Sector Out-put} \) (in Rs. Crores at constant prices) and explanatory variables are given below:

\[
X_1 = \text{Deviation from Average Annual rainfall (in mms)}
\]
\[
X_2 = \text{Total number of tractors}
\]
\[
X_3 = \text{Total distribution of fertilizer (tones)}
\]
\[
X_4 = \text{Loans Disbursed by regional Rural Banks}
\]
\[u_1 = \text{error term assumed to follow normal distribution with zero mean and constant variance.}\]

**The regression equation is**

\[
\text{Log}(X) = 2111 - 0.01 X_1 + 0.020 X_2 - 0.86 X_3 + 0.01 X_4
\]

**Table 1.2: Simple Linear Multivariate Regression Results of Determinants of Agriculture Sector Output at Constant Prices (1980-2015)**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Coefficient</th>
<th>S.D</th>
<th>T</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>2110.98</td>
<td>50.98</td>
<td>41.49</td>
<td>0.00</td>
</tr>
<tr>
<td>(X_1)</td>
<td>-0.01</td>
<td>0.06</td>
<td>0.11</td>
<td>0.91</td>
</tr>
<tr>
<td>(X_2)</td>
<td>0.02</td>
<td>0.01</td>
<td>3.03</td>
<td>0.01</td>
</tr>
<tr>
<td>(X_3)</td>
<td>-0.85</td>
<td>0.38</td>
<td>-2.23</td>
<td>0.04</td>
</tr>
<tr>
<td>(X_4)</td>
<td>0.01</td>
<td>0.01</td>
<td>1.2</td>
<td>0.25</td>
</tr>
</tbody>
</table>

**R-Sq = 57.5%**

**F=5.07**

**P=0.01**
It is apparent from the results as shown by simple regression model that number of tractors and loans disbursed are positively related to the agriculture sector output and while as only number of tractor variable is statistically highly significant due to its lower p-value. While as deviation from Average Annual rainfall (in mms) and total distribution of fertilizer are negatively related to agriculture sector out-put, while as only total distribution of fertilizer variable is statistically highly significant due to its lower p-value. Therefore, this clearly depicts that number of tractors variable only contribute positively to the production and productivity to the agriculture sector and is statistically significant while as utilization of fertilizer is not being properly utilized by the farmers as it is not being utilized efficiently that is why its contribution is negative instead of positive.

Secondly, any deviation of rain fall from the average causes loss to the agriculture sector output. Therefore, this makes it a gamble of monsoon.

The analysis of regression model also depicts the magnitude of the coefficients of the variables which contribute positively to the production and productivity of agriculture output are not significant which indicates that their usage is feasible and not optimum .Therefore, their contribution to the productivity can be enhanced if they will be used properly. Here, government intervention is required to make proper allocation of these determinants sure and help farmers to enhance the productivity of the agriculture sector.

### Hypothesis testing

**H:** There is no rational use of inputs in agriculture sector in J&K state economy.

**Results:** This null hypothesis has been accepted by our study in case of the most of the determinants as we have observed above. It is apparent from the results as shown by log regression model that net area irrigated and total distribution of fertilizer are negatively related to agriculture sector out-put, and both these variables are also highly significant because their P-Values are lower than 5%. Total distribution of fertilizer is negatively related to agriculture sector out-put may be due to irrational use of it by farmers because of lack of awareness in the farmers about the prescribed norm of rational use of this type of input and secondly some type of fertilizers specially urea has been subsidized heavily which provides an incentive to the farmers to use more quantity of it which disturbs the prescribed norm and in this way a technological gap widens which reduces the productivity in the agricultural sector instead improving it. Similarly, the contribution of net area irrigated to agriculture sector output is negative which is a paradoxical situation which is beyond explanation and it needs further investigation and therefore, it keeps doors open for new researchers to try to further investigate it in depth and find the real cause of it. The number of tractors determinant can be treated as a proxy variable for capital.

### IV. SUMMARY OF FINDINGS

The salient findings of this research paper are summarized below:

1. There is only a marginal increase about 3.63% in the net area sown during 35 years of our study period which is not a significant increase so for economic standards are concerned. Therefore, one of the feasible ways to increase the area in the state is to expand the gross cropped area for augmenting production through double cropping which has increased from 36.22% in 1980-81 to 56.54% in 2015-16, that means about 20 percentage point’s increase only which is not the satisfactory improvement.

2. The level of irrigation is highly positively correlated with the increase in productivity, which ultimately affects the growth rate of agriculture sector output. It may be because of this reason that the cropping intensity, productivity of important crops and level of agricultural growth in Jammu and Kashmir was lower than national level.

3. The use of fertilizer is very low in Jammu and Kashmir. It alone uses about 3 per cent of national fertiliser consumption. The use of fertilizers was estimated at 51 kgs per hectare in 2007-08 in Jammu and Kashmir state. The fertiliser consumption in this state is even below the national average, which is somewhere around 65 kg per hectare. There could be many reasons for lower use of fertiliser in Jammu and Kashmir; low level of cropping intensity in this state may be partially responsible for lower use of fertilizers. Therefore, lower use of fertiliser and pesticides may be responsible for lower levels of productivity especially of wheat, and rice in Jammu and Kashmir and in order to increase the productivity of the crops in the state, the use of fertilizers shall have to be enhanced.

4. It is apparent from the results as shown by log regression model that number of tractors and rain fall (in mm) are positively related to the agriculture sector output and both these variables are highly significant. While as net area irrigated and total distribution of fertilizer are negatively related to agriculture sector out-put, and both these variables are also highly significant and all these explanatory variables are statistically significant at 0.00 percent except the exact level of significance of \(X_1\) - Annual rainfall (in mms) is 7%.

5. Total distribution of fertilizer is negatively related to agriculture sector out-put may be due to irrational use of it by farmers because of lack of awareness in the farmers about the prescribed norm of rational

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use of this type of input and secondly some type of fertilizers specially urea have been subsidized heavily which provides an incentive to the farmers to use more quantity of them which disturbs the prescribed and in this way a technological gap widens which reduces the productivity in the agricultural sector instead improving it.

6. Similarly, the contribution of net area irrigated to agriculture sector output is negative which is a paradoxical situation which is beyond explanation and it needs further investigation and therefore, it keeps doors open for new researchers to try to investigate it in depth and find the real cause of it.

7. The number of tractors determinant can be treated as a proxy variable for capital. Therefore, this reflects that for the increase in production and productivity of agriculture sector, mechanization of it is a pre-requisite. In our model all these determinants are strongly related with agriculture sector output as together they explain about 56% change in the dependent variable (i.e. \( R^2 = 55.77\% \)).

V. CONCLUSION

From the analysis of this paper it becomes clear that determinants of agriculture sector out-put of Jammu and Kashmir economy are not being properly utilized which leads to mis-allocation of determinants of agriculture sector which finally leads to low productivity of the agriculture sector. There has been an inadequate growth rate of the agriculture sector output during our reference period. This is accompanied with recent decline in yields per hectare for number of food crops. The slow growth rate in the productivity of agricultural sector output in Jammu and Kashmir State is due to lack of availability of qualitative capital and the irrational use of inputs in the said sector. Therefore, to stimulate agricultural growth, simultaneous efforts on several fronts specially making rational use of inputs are required.

VI. REFERENCES

[18] Reports, journals, magazines and newspapers.
[22] In addition to the above sources relevant information has been collected from the following departments:
   5. Central Statistical Organization (CSO), Government of India.