Agricultural Development Disparities in Odisha: A Statistical Study

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Abstract

Agriculture plays a dominant role in the economy of the State with contribution of 25.75% to Net State Domestic Product (Census report, Govt. of India, 2000-01). Its contribution has declined to 16.46 per cent in GSDP in 2011-12 (Economic survey 2011-12, Odisha). The contribution of agriculture and allied sectors coming under primary sector to NSDP is more than 40 per cent during past seven years except in 2000-01 (39.50%). In this study an attempt has been made to measure the levels of agricultural development for the State of Odisha by 2010. The findings of the study revealed that 7 out of 30 districts of Odisha have come under the category of backward districts, which showing that large regional disparities exist in levels of agricultural development in the State. Agricultural development is the highest in Kendrapara district and the lowest in Jharsuguda district.

Keywords: Principal Component, Agricultural Development, Development Disparities

Introduction

Agricultural development is a continuous process of improvement of crop production. The level of agricultural development is affected by several factors such as size of cultivable area, infrastructural facilities, state of farm technology and a balanced human resource etc. Thus, the extent of development in agriculture cannot be captured on the basis of any single indicator.

Development disparities in India continued to remain a serious problem despite the centralised planning effort by the Government (Joshi, 1997; Krishan, 2001; Singh, 2006).

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There is clear evidence that since 1980-81 regional divergence in agricultural productivity and income have grown and the gap between underdeveloped and developed, and, poor and rich States has continued to increase. This has happened despite special efforts made to reduce inter-state disparities by promoting level of agricultural development in underdeveloped States (Chand and Chauhan 1999). Thus, the reasons cited above have led to the skewed development of agriculture across the States in India. It would not be out of context to point out here that what is true of Odisha in comparison to India in terms of agricultural development is also true of its backward districts in respect of the State itself.

A number of authors like Swain and Mohanty (2010), Mohanty and Ram (2001) and Gulati (1991) have developed different ranking techniques including multivariate ones to rank the districts / states of the country. Iyengar and Sudarshan (1982) attempted to classify regions using multivariate data relating to major development basing on composite index method and using theoretical Beta distribution.


In the present study principal component analysis approach has been adopted to classify the districts of Odisha according to different levels of agricultural development on the basis of some selected indicators mentioned below in the methodology section.

**Objectives of study**

The specific objectives of the present study are:

1. To classify the districts of Odisha according to different levels of agricultural development by using principal component analysis approach
2. To study the disparities among districts of Odisha as regards certain indicators relating to agricultural development.
Sources of Data

The present study is based on secondary data collected from the publications of Govt. of Odisha namely Odisha Agriculture Statistics, District statistical Handbook, Economic Survey, District Statistical Abstract and District at a Glance of 2009-10.

Methodology

A. Selection of Indicators for the Present Study

In the present study seven important indicators as proposed by R.K Meher(1999) have been selected to measure agricultural development. These are:

1. Percentage of cultivable land to total land area
2. Percentage of net area sown to total cultivable area
3. Percentage of gross irrigated area to net area sown
4. Number of electric/ diesel pump per 1,000 hectares of area sown
5. Number of tractors/ power Tiller per 1,000 hectares of area sown
6. Cropping intensity
7. Average yields of foodgrains per hectare

B. Method

For this study, Principal Component Analysis (PCA) has been used to measure district-wise agricultural development differential at various principal component levels as well as the aggregate level of development for the year 2009-10(Swain & Mohanty: 2010)
### Table 1: Indicators of Agricultural Development

<table>
<thead>
<tr>
<th>SL NO</th>
<th>DISTRICT</th>
<th>X₁</th>
<th>X₂</th>
<th>X₃</th>
<th>X₄</th>
<th>X₅</th>
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<td><strong>MEAN</strong></td>
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<td><strong>168.97</strong></td>
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<td><strong>7.94</strong></td>
<td><strong>24.61</strong></td>
<td><strong>389.46</strong></td>
<td><strong>241.06</strong></td>
<td><strong>22.84</strong></td>
<td><strong>325.87</strong></td>
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</tr>
</tbody>
</table>

Source: Odisha Agricultural Statistics 2009-10, Directorate of Agriculture and Food Production Govt. of Odisha, Bhubaneswar

PCA is a technique to find a few uncorrelated linear combinations of original variables which can be used to summarize the data, losing as little information as possible in other words it is a technique to transform the original set of variables into a smaller set independent linear combinations so that most of the variations in the original data set is explained by those linear combinations. The linear combinations so selected are called Principal Components.
The main purpose of this analysis is to reduce the number of variables into a few ones that can explain most of the variance of the original data set.

C. Data and Analysis

In this study the following indicators have been considered:

\[ X_1 = \text{Percentage of cultivable land to total land area} \]
\[ X_2 = \text{Percentage of net area sown to total cultivable area} \]
\[ X_3 = \text{Percentage of gross irrigated area to net area sown} \]
\[ X_4 = \text{Number of electric/diesel pump per 1,000 hectares of area sown} \]
\[ X_5 = \text{Number of tractors/power Tiller per 1,000 hectares of area sown} \]
\[ X_6 = \text{Cropping intensity} \]
\[ X_7 = \text{Average yields of foodgrains per hectare} \]

For the data presented in Table 1, the correlation matrix \( R \) is computed in Table 2.

**Table 2: Correlation Matrix(R)**

<table>
<thead>
<tr>
<th></th>
<th>( X_1 )</th>
<th>( X_2 )</th>
<th>( X_3 )</th>
<th>( X_4 )</th>
<th>( X_5 )</th>
<th>( X_6 )</th>
<th>( X_7 )</th>
</tr>
</thead>
<tbody>
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<td>( X_1 )</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( X_2 )</td>
<td>0.067</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( X_3 )</td>
<td>0.611</td>
<td>-0.137</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( X_4 )</td>
<td>0.305</td>
<td>0.140</td>
<td>0.169</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( X_5 )</td>
<td>0.544</td>
<td>0.016</td>
<td>0.468</td>
<td>0.191</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( X_6 )</td>
<td>0.013</td>
<td>-0.265</td>
<td>0.513</td>
<td>0.173</td>
<td>-0.014</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>( X_7 )</td>
<td>0.507</td>
<td>0.331</td>
<td>0.452</td>
<td>0.096</td>
<td>0.242</td>
<td>-0.043</td>
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</table>

The eigenvalues (\( \lambda_i \)) and the percentage of variance explained by the principal component derived from the correlation matrix (\( R \)) are presented in Table 3.
Table 3: The Eigen Values and the Percentage of Variance

<table>
<thead>
<tr>
<th>Components</th>
<th>Eigen values (li)</th>
<th>% of Variance</th>
<th>Cumulative % of Variance</th>
</tr>
</thead>
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<tr>
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<td>2.591</td>
<td>37.011</td>
<td>37.011</td>
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<td>2</td>
<td>1.524</td>
<td>21.767</td>
<td>58.778</td>
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<tr>
<td>3</td>
<td>.982</td>
<td>14.033</td>
<td>72.811</td>
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<tr>
<td>4</td>
<td>.878</td>
<td>12.548</td>
<td>85.360</td>
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<td>.535</td>
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<td>7</td>
<td>.169</td>
<td>2.411</td>
<td>100.000</td>
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</table>

The weights of the principal components corresponding to first six eigenvalues computed by using the correlation matrix are presented in the Table 4. The reason for computing first six principal components corresponding to eigenvalues greater than 0.5 is due to the fact that they explain 93.007% of variation in data.

Table 4: Weights of the Principal Components

<table>
<thead>
<tr>
<th>INDICATOR</th>
<th>PC1</th>
<th>PC2</th>
<th>PC3</th>
<th>PC4</th>
<th>PC5</th>
</tr>
</thead>
<tbody>
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<td>X_1</td>
<td>0.851</td>
<td>0.144</td>
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<tr>
<td>X_2</td>
<td>0.095</td>
<td>0.774</td>
<td>0.348</td>
<td>0.291</td>
<td>0.399</td>
</tr>
<tr>
<td>X_3</td>
<td>0.842</td>
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<td>-0.118</td>
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<tr>
<td>X_4</td>
<td>0.414</td>
<td>0.021</td>
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<td>X_5</td>
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<td>0.071</td>
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<td>X_6</td>
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<td>-0.772</td>
<td>0.316</td>
<td>0.364</td>
<td>0.231</td>
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<tr>
<td>X_7</td>
<td>0.652</td>
<td>0.415</td>
<td>-0.12</td>
<td>0.476</td>
<td>-0.241</td>
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</tbody>
</table>

Thus, the principal components d_1, d_2, d_3, d_4 and d_5 are given as follows:

\[ d_1 = (0.851)Z_1 + (0.095)Z_2 + \ldots \ldots + (0.652)Z_7 \]
\[ d_2 = (0.144)Z_1 + (0.774)Z_2 + \ldots \ldots + (0.415)Z_7 \]
\[ d_3 = (-0.123)Z_1 + (0.348)Z_2 + \ldots \ldots + (-0.12)Z_7 \]
\[ d_4 = (-0.16)Z_1 + (0.291)Z_2 + \ldots \ldots + (0.476)Z_7 \]
\[ d_5 = (-0.232)Z_1 + (0.399)Z_2 + \ldots \ldots + (-0.241)Z_7 \]

\[ X_i - \mu_i \]

where \( Z_i \) = \ldots ..., where \( \mu_i \) is the mean of \( X_i \)'s and \( \sigma_i \) is the standard deviation of \( X_i \)'s

The principal component values for 30 districts of Odisha are presented in Table 5.
Table 5: Principal Component Value for the Districts of Odisha

<table>
<thead>
<tr>
<th>Sl.No</th>
<th>DISTRICT</th>
<th>d₁</th>
<th>d₂</th>
<th>d₃</th>
<th>d₄</th>
<th>d₅</th>
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<td>2.6759</td>
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<td>0.7215</td>
<td>1.2177</td>
<td>0.5421</td>
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<td>13</td>
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<td>1.2590</td>
<td>0.2450</td>
<td>-0.7156</td>
<td>1.1243</td>
<td>0.7213</td>
</tr>
<tr>
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<td>-0.3517</td>
<td>-0.4404</td>
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<td>15</td>
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<td>0.8817</td>
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<td>0.2052</td>
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<td>-0.2926</td>
<td>-0.1201</td>
<td>-0.3606</td>
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<td>17</td>
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<td>-2.8690</td>
<td>0.8103</td>
<td>-0.1756</td>
<td>0.9509</td>
<td>0.4390</td>
<td>-0.1689</td>
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<td>19</td>
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<tr>
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<td>MAYURHANJ</td>
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<td>-0.0146</td>
<td>-1.3268</td>
<td>-0.4398</td>
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<tr>
<td>21</td>
<td>PHULBANI</td>
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<td>-0.1908</td>
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<td>-0.6710</td>
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<td>BOUDH</td>
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<td>0.2368</td>
<td>0.8656</td>
<td>-0.1617</td>
<td>0.0570</td>
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<td>23</td>
<td>PURI</td>
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<td>-0.2456</td>
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<tr>
<td>24</td>
<td>KHURDHAY</td>
<td>1.1251</td>
<td>0.5209</td>
<td>0.6403</td>
<td>0.5370</td>
<td>0.1766</td>
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<td>25</td>
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<td>-1.7618</td>
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<td>-0.1837</td>
<td>-0.0526</td>
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<tr>
<td>26</td>
<td>SAMBALPUR</td>
<td>-0.1685</td>
<td>-1.2302</td>
<td>-0.9514</td>
<td>-0.9115</td>
<td>0.5203</td>
<td>-0.5483</td>
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<td>27</td>
<td>BARGARH</td>
<td>3.6367</td>
<td>1.2065</td>
<td>-1.0000</td>
<td>-0.3979</td>
<td>-0.5337</td>
<td>0.5823</td>
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<tr>
<td>28</td>
<td>DEOGARH</td>
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<td>-2.0307</td>
<td>-0.4672</td>
<td>0.5668</td>
<td>0.2567</td>
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<td>29</td>
<td>JHARSUGUDA</td>
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<td>-2.6933</td>
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<td>-0.7472</td>
<td>-1.7213</td>
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<tr>
<td>30</td>
<td>SUNDARGARH</td>
<td>-2.0923</td>
<td>0.9665</td>
<td>-0.4661</td>
<td>-1.9706</td>
<td>0.6946</td>
<td>-0.5736</td>
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</tbody>
</table>

As \(d_1\), \(d_2\), \(d_3\), \(d_4\), and \(d_5\) are uncorrelated and are shown to be normally distributed by Kolmogorov-Smirnov test (Table 6) we use \(\bar{d} = 1/5 \sum d_i\) which is also normally distributed to classify the districts of Odisha (Table 7).
Table 6: Test of Normality (One-Sample Kolmogorov-Smirnov Test)

<table>
<thead>
<tr>
<th></th>
<th>d₁</th>
<th>d₂</th>
<th>d₃</th>
<th>d₄</th>
<th>d₅</th>
<th>( \bar{d} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of observation</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Normal Parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>2.5903</td>
<td>1.5241</td>
<td>0.9823</td>
<td>0.8779</td>
<td>0.5347</td>
<td>0.6650</td>
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<tr>
<td>Kolmogorov-Smirnov Z</td>
<td>0.690</td>
<td>0.457</td>
<td>0.633</td>
<td>0.865</td>
<td>0.487</td>
<td>0.501</td>
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<tr>
<td>Asymptotic Significance (2-tailed)</td>
<td>0.728</td>
<td>0.985</td>
<td>0.817</td>
<td>0.443</td>
<td>0.972</td>
<td>0.963</td>
</tr>
</tbody>
</table>

The classification of districts of Odisha on the basis of “\( d \)” calculated from all the 7 indicators considered in this study is shown in Table 7.

The percentiles of normal distribution are used to classify the districts. The values of \( \bar{d} \) have been categorized by the following:

1. Less than \( (\bar{d}-0.6745\times\delta) \): \([\text{Less than } -0.4485]\) = Backward
2. \((\bar{d}-0.6745\times\delta)\) to \(\bar{d}\): \([-0.4485\text{ to } 0]\) = Underdeveloped
3. \(\bar{d}\) to \((\bar{d}+0.6745\times\delta)\): \([0\text{ to } 0.4485]\) = Developing
4. Above \((\bar{d}+0.6745\times\delta)\): \([\text{above } 0.4485]\) = Developed

Further, districts have been divided into four level of development depending upon the values of the principal components, calculated from 7 indicators considered in the study.

Table 7: Classification of Districts

<table>
<thead>
<tr>
<th>BACKWARD</th>
<th>UNDERDEVELOPED</th>
<th>DEVELOPING</th>
<th>DEVELOPED</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANUGUL</td>
<td>DHENKANAL</td>
<td>BALESORE</td>
<td>KENDRAPARA</td>
</tr>
<tr>
<td>NUAPADA</td>
<td>GAJAPATI</td>
<td>BOLANGIR</td>
<td>SONEPUR</td>
</tr>
<tr>
<td>RAYGADA</td>
<td>KORAPUT</td>
<td>CUTTACK</td>
<td>JAGATSINHPUR</td>
</tr>
<tr>
<td>PHULBANI</td>
<td>MAYURNHANJ</td>
<td>KEONJHAR</td>
<td>JAPUR</td>
</tr>
<tr>
<td>DEOGARH</td>
<td>PURI</td>
<td>BOUDH</td>
<td>BHADRAK</td>
</tr>
<tr>
<td>SUNDARGARH</td>
<td>NAYAGARH</td>
<td>NABARANGPUR</td>
<td>GANJAM</td>
</tr>
<tr>
<td>JHARSUGUDA</td>
<td>SAMBALPUR</td>
<td>MALKANGIRI</td>
<td>KALAHANDI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KHURDHA</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BARGARH</td>
</tr>
</tbody>
</table>
Results and Discussions

An analysis of classification of districts according to level of agricultural development of the State has been made in Table 7. This analysis shows an overview of how many districts need to be considered to formulate the revised policy and programmes strategies to improve those indicators which contribute to low level development. It is thus observed that 7 out of 30 districts of Odisha have come under the category of backward districts, 8 districts underdeveloped, 6 districts developing and 9 districts in developed categories, showing thereby that large regional disparities exist in levels of agricultural development in the State. Agricultural development is the highest in Kendrapara district and the lowest in Jharsuguda district. The result suggests that proper steps be taken by the Government of Odisha to reduce the disparities level in a phased manner by prioritizing the districts for each critical indicator under study.

References

3.1 Disparities in agricultural development. Before addressing key research questions, we assess the level of agricultural development across districts in Odisha by constructing a composite index of agricultural development (ADI) based on the following indicators: (i) % share of cultivable land in total land. Some of the studies have reported that instability is a consequence of growth. Odisha PACS Study Report - Free download as PDF File (.pdf), Text File (.txt) or view presentation slides online. Odisha PACS Study Report. A Study on Capacity Building needs. assessment in Odisha State. Sadhikaratha foundation plot no 11 & 12, HIG, Manikonda, hyderabad - 500089. Tanesha nagar. Acknowledgments. Sadhikaratha Foundation gratefully acknowledges the support and assistance of the individuals who shared their experiences and assisted in the development of this study. In particular we thank Mr Tushar K Panda, Managing Director, Orissa State Cooperative Bank (OSCB) for his immense support for successful completion of the study. Using Principal Component Analysis technique and constructing district-wise agricultural development indices, this paper analyses the spatio-temporal variations in agricultural development in Odisha, India for 3 years over the period 2001-02 to 2011-12, identifies the underlying factors, examines inter-relationships and draws policy implications for improving the agricultural situation. AGRICULTURAL DEVELOPMENT IN ODISHA: ARE THE DISPARITIES GROWING?, International Journal of Food and Agricultural Economics, 2015, pp. 129-144, Volume 3 Tripathi and Prasad: Agricultural Development in India since Independence. Agricultural development in India since independence: a study on progress, performance, and determinants. agriculture. These confirm that Indian economy was a backward and agricultural based economy at the time of Independence. The first phase of agricultural policy witnessed tremendous agrarian reforms, institutional changes, development of major irrigation projects and strengthens of cooperative credit institution. Agricultural development is not pre-determined but it is a continuous process of improvement of crop and livestock production. It implies the availability to the maximum number of people in adequate measures the existence of agricultural and technological infrastructural facilities for enhancing the agricultural produce. Development in the farm sector requires a balanced human resource development in most of the countries. The technology absorption in agriculture which is a principal sector of economy of most of the Asian countries could be considered as a primary objective of any developmenta...