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Determinants of agricultural productivity in Karnataka

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Abstract
bnOur tests naturally depend on the input and output relationship existing in the agricultural sector of the state. An analysis of the input and output relationship was made with the help of statistical techniques in order to determine the relationship amongst a number of factors which may cause spatial variations in productivity. In an effort to discover variations in productivity, a series of nine independent input variables were selected. The average values of all the nine variables from 1993-94 to 2007-08 are calculated for each of the twenty-seven districts of the state that have been considered.

Keywords: Agricultural productivity, Production Function, Variables, Regression Equations, factors.

Introduction

Agricultural productivity is a multidimensional concept, which includes technological advancement, effective management of available resources and organizational set-up for the agricultural production. These factors in turn affect the relative production in any region.

In order to assess the productivity variations in each of the twenty-seven (including newly created) districts of the state, the best two methods (out of seven) for the evaluation of productivity have been applied, considering all the major food crops grown in the state, namely, Rice, Ragi, Jowar, Bajra, Maize, Wheat, Other Cereals, Tur, Gram, Other Pulses, Groundnut, Sugarcane and Cotton since the beginning of 1993-94 in the state up to 2007-08. As said above, the following two approaches have been adopted for evaluating productivity, viz;

a) Agricultural Productivity Based on Output per hectare of Cropped Land (Price Weighted).
b) Agricultural productivity Based on Output per Agricultural Worker (Price Weighted).

In this section, an attempt has been made to test our following hypotheses; viz:

1) Hypothesis-H_1: "Regional Imbalances in Agricultural Productivity are due to Spatial Variations in the Availability of Important Agricultural Inputs".
2) Hypothesis-H_2: "Diverting of Human Labour Pressure from Agriculture Sector to some Non-agriculture Sectors will increase the Productivity of Agricultural Sector".

Nature of the Variables

The variables considered for the statistical analyses Variable 1 stands for agricultural productivity in terms of output (productivity index per hectare), variables 2 to 4 indicate the resource inputs relating to irrigation through canal, tube-well, and other sources. The 5 variable relates to the proportion of area planted under high-yielding varieties of seeds. Sixth variable indicates consumption of chemical fertilizers (NPK). The 7th variable relates to information regarding number of persons engaged in agriculture.

The 8th variable relates to animal power, i.e., population of bullocks (over 3 years of age). The total number of bullocks engaged in agricultural operations was divided by the total cropped area of the respective district in order to assess the number of animal power per 1000 hectares. The 9th variable relates to the availability of mechanically driven machine, i.e., number of tractors in terms of horse-power units in operation (assuming that 1 tractor is equal to 30 horse-power units). The 10th variable relates to the advancement of agricultural credit (short and medium term in aggregate) by the two major sources of agricultural finance at the district to the farmers namely, primary Agricultural Credit Societies and Cooperative Banks.

Choice of a production function

Agricultural Production function relationships can be examined by specifying a particular production (output per hectare) to traditional inputs such as labour, animal power and water and to modern inputs such as fertilizers, high yielding varieties of seeds, pesticides, etc., Among the various types of production functions, the Cobb-Douglas, type of function enjoys wide application. It is a linear logarithm, and can be written in the following general form:

$$\mathrm{Y_1 = A\, X_1^b\, X_2^c\, X_3^d\ \ldots\ldots.X_n^y}$$

Taking logarithm of the above equation the same equation takes the form of a linear equation, and can be written as:

$$\log Y_1 = \log\ A + b \log\ X_1 + c +\ d \log\ X_3 \ldots\ldots\ldots + y \log\ X_n$$

In Jaunpur district of Uttar Pradesh, Hopper (1965) identified land, animal power and irrigation as three important inputs influencing the output of Barley, Wheat and peas. Gram being a dry crop, irrigation was not identified as an important input. In his cross-sectional study of Ferozepur and Amritsar districts of Punjab, Krishna (1966) found that land and labour were significant inputs, although his estimated land and labour elasticities for 1954-55, 1955-56, and 1956-57 reveal wide variations. But the dry land, irrigated land and rainfall were statistically measurable inputs. Besides these Chennareddy (1962). Rao (1965), Singh (1975), and Srivastava and Nagadevara (1972) find a similar variability.

Factor Analysis

For establishing cause and effect type relationship between the output and input, it was essential to identify the relevant indicators with the help of certain statistical technique. The factor analysis was adopted because it avoids a certain number of problems inherent in the conventional studies and reduces further the computational efforts required in trials of different combinations for identifying the most significant relationship amongst the various feasible combinations. In contrast to regression analysis, factor analysis also deals directly with correlative dependents by arranging variables into independent linear combinations and permits any indicator to be treated as a dependent variable of a small set of common components. This procedure encourages an expansion of the variable set.

Determinants of productivity in very high and high productivity regions

The rotated factor matrix of the variables selected has been, which indicates that a 'Package of Variables' have significant inter-cohesion in the high productivity region. The first factor Fl accounts for 61.84 percent variance in the total variables set. The input variables on the matrix showing high positive coefficient loadings on the first factor are: irrigation by Canal (0.95), area planted under HYV (0.81) and tractor power (0.55). The second factor indicates only the irrigation by tube-well with a loading of 0.66 in the variables set. The third factor with a variance of 11.44 percent also indicates a positive single loading of 0.53 on the fertilizer consumption in the high productivity region.

Determinants of productivity in medium productivity region

The rotated factor matrix of the variables set is for the medium productivity region. The first factor on the matrix does not yield any significant loading. However, second, third and fourth factors indicate a positive loadings in irrigation by canal (0.78) in second factor with a variance of 29.16 percent; area planted under HYV (0.59), fertilizer consumption (0.55) and agricultural credit (0.76) in third factor; and fourth factor has yielded a positive loading of 0.77 for tractor power with a variance of 11.25 percent in the variables set. Besides these factors, a significant number of variables do not exhibit a precise picture of relation with the agricultural productivity in this region.

Determinants of productivity in low productivity region

In the low productivity region, factor one (F_1) has yielded only one coefficient or loading of 0.62 on irrigation by canal with a variance of 52.16 percent in the total variables set. The second factor (F_2) is characterized with preponderance of negative loading on other variables except the positive loading of 0.76 again for canal irrigation. In the third factor too a single variable (tractor power) accounts for a coefficient of 0.88 in the total variables set with a variance of 13.34 percent.

Determinants of productivity in Karnataka

The analysis performed taking into consideration the whole of the districts considered in Karnataka as one single unit has yielded rather a different picture of variables. indicates a significant inter cohesion on first factor (F_1) fertilizer consumption and importance of tractor power in the state with a value of loadings 0.88 and 0.74 respectively which together accounts for 44.12 percent variance in the total variables set. Second factor (F_2) has yielded no significant interpretation for the analysis. However F_3 explains the significant loading 0.76 for the variable agricultural credit.

The significance of the rest of the variables does not emerge owing to a great variation of the district – wise statistics in the state. Thus, the rationale for analyzing the cause and effect type relationship of variables in different groups (productivity regions) lies in the fact that different regions have different package of variables, which may have a direct bearing on the productivity, therefore, they were tested in different combinations. Hence, from the above analysis, the Hypothesis–*H_1: "Regional Imbalances in agricultural productivity are due to spatial variations in the availability of important agricultural inputs" is established.*

Regression Equations

Under different regions of productivity the combination of variables included for developing and analyzing the Cobb-Douglas production function, the values of the each input (variable) was converted into logarithms to accommodate the 'n' variables. Multiple regression of Y_1 on different combinations of the resource inputs have been computed in logarithm values of the variables which lead to the development of Cobb-Douglas type of function.

One advantage of this type of function is that this relates to know productivity region which has been studied separately. The coefficient of the respective function gives the elasticities of productivity in respect to each variable assuming that it holds good for other regions also and reasonably good relationships is established as:

$Y_1 = 553924$	X_2	X_4	X_6	X_7
	0.01653	0.02277	0.17747	-099682

The above equation shows that keeping other variables constant if 1 percent change in irrigation by canal is incorporated, it will bring a change of 0.016 percent in the low productivity region. Again a change of 1 percent irrigation by other sources will bring a change of 0.022 percent in the same region whereas, the sensitivity of the 6^{th} variable shows that 1 percent change in the fertilizer consumption per hectare will bring a change of 0.177 percent in the productivity output.
The last significant variable 7^{th} variable has negative regression coefficient showing that 1 percent change in the labour deployment per 1000 hectares will bring a negative change of 0.99 percent in the net value of the productivity.

This supports our Hypothesis: H_2.
The productivity equation indicates that the most sensitive variable from the input side is the deployment of human labour per 1000 hectare, of about 1 percent change in productivity can easily be anticipated by diverting the agricultural labour pressure from the agriculture sector to some other sectors. The second most sensitive variable which gives 0.177 percent change in the productivity is the fertilizer consumption, other sources of irrigation anticipated 0.022 percent change and irrigation by canal occupy next respective place in order of preference by giving 0.016 percent sensitivity.
Keeping other input factors constant, 1 percent change in respective input variable would result the followings:
a) 1 percent change in irrigation (percentage) by canal would bring a positive change of +0.01653 percent in productivity index (Agricultural Output).
b) 1 percent change in irrigation (percentage) by other sources would bring a positive change of +0.02277 percent in productivity index.
c) 1 percent change in fertilizer consumption per 1000 hectares would bring a positive change of +0.01747 per cent in productivity index; and
d) 1 percent change in agricultural workers per 1000 hectares would bring a negative change of -0.99682 percent in productivity index.

The remedial steps indicated in the present study call for diversion of agricultural labour to some other industrial professions by creating useful job opportunities in the lower productivity zones. Hence, our second Hypothesis-*H_2: "Diverting of Human Labour Pressure from Agriculture Sector to some Non-agriculture Sectors will Increase the Agricultural Productivity" i*s established
Increase of fertilizer inputs, increase in irrigated area through such means as are suitable to the respective geographical conditions and irrigated area through canals calls for development of a dynamic decision model in the region concerned. Such a model should be incorporated for studying the regional sensitivities of the respective input factors.

Conclusion
From the above, it is clear that regional variation is existing in Karnataka in respect of agricultural development. Regional imbalance in agricultural productivity caused the undevelopment of agriculture in Karnataka state Regional imbalances in agricultural productivity are due to special variations in the availability of important agricultural inputs. Provision of agricultural input along with the development of basic infrastructure will help to develop agriculture. Further diverting of human labour pressure from agriculture sectors to some non–agricultural sector will increase the productivity of agricultural sector and contributes positively towards the agricultural development in the state.

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