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Measurement of agricultural efficiency and planning for sustainable development in drought prone area: A case study of Bagalkot district of Karnataka

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Abstract

The study of agricultural efficiency is one of the major concerns of agricultural geographers and agricultural economists. A study of the spatial variations in agricultural efficiency is indispensable for differentiating areas of poor performance from the other more productive area. In this paper an attempt is made to analyses the spatio-temporal variations in agricultural efficiency of Bagalkot district during 1995-96 and 2005-06. In the study region, three taluks (Hunagund, Bagalkot and Badami) was noticed as low efficiency regions in 1995-96, but in 2005-06 four taluks were noticed, they are Bagalkot, Badami, Hunagund and Bilagi. In the medium efficiency regions Bilagi and Mudhol taluks were recorded in 1995-96, but in 2005-06 only one taluk were noticed i.e., Mudhol. In high efficiency region only Jamkhandi taluk was recorded in both the study period.

On the basis of results, it can be concluded that the agricultural efficiency in Bagalkot district is an advancement, due to diversified nature of land-use pattern and cropping pattern of the Bagalkot district, has increased the production capacity and cropping intensity of the land. In the present scenario needs to strengthen the irrigation facilities, soil and moisture conservation, adoption of bio-technology, afforastation, changing in the cropping pattern, agronomic practices, livestock development, rural communications, development of medium, small and marginal farmers, agricultural laborers and setting up agro-based industries. The dry land development program, sustenance of animal husbandry, fisheries, horticulture, sericulture and small scale industries at village level should be setup through the various programmes for sustainable development of agriculture sector. Therefore, plans on permanent basis to promote agriculture development and restore the ecological balance in the region.

Introduction

The study of agricultural efficiency is one of the major concerns of agricultural geographers and agricultural economists. The level of agricultural efficiency, as a concept means the degree to which the economic, cultural, technical and organizational variables (i.e., man-made frame) are able to exploit the abiotic resources of the area for agricultural production (Singh, G.B. 1979). The spatial variations in physical output from the soils are the result partly of natural circumstances and partly of human manipulations of the land resources. Thus the regional differences in agricultural efficiency is the magnitude and interplay of a multitude of factors. Furthermore, the level of agricultural efficiency is a dynamic concept, as any modification in physical factors and improvement in non-physical bases of farming affect agricultural 'productkunde' per hectare.

A study of the spatial variations in agricultural efficiency is indispensable for differentiating areas of poor performance from the other more productive area. In India due to the increasing pressure of population on land. Land is becoming limited to permit any expansion of cultivated area. It is leading to the food problem. Today many countries are facing shortage of food. The suitable strategy seems to be to increase the production per unit area and per unit of time, to solve the food problem. For it, a measurement of the existing performance of agriculture becomes imperative before any remedial steps can be taken.

For a systematic and scientific land use planning a critical study of land use efficiency is a must. The interaction of both physical and human factors in an area at a given time determines, to a great extent, the efficiency of land use. Quantification of land use efficiency provides a precise and objective measure to examine the level of efficiency and it aims at devising a suitable, meaningful and practical technique by which agricultural efficiency can be expressed in quantitative terms. "It is a ratio between the achievement in terms of agricultural production and the actual potential of the land" (Ramanaiah, Y.V. and Reddy, N.B.K.-1984).

Study Area

Bagalkot district of Karnataka state is located in the northern region is well situated in the interior of the Deccan plateau (Fig.1). As the district belong to the semi-arid climatic region, it has large variation in the amount and distribution of rainfall and it has to face the droughts at least thrice in a decade. The district is consisting of six revenue taluks namely Badami, Bagalkot, Bilagi, Hunagund, Jamkhandi and Mudhol. The total numbers of villages are 623 and towns are 11. The district has population of 16,51,892 (2001 census) and it has 6,58,877 sq km of geographical area. Out of the total geographical area of the district 71.88 percent of area is used for the agriculture in 1990-91 but it has decreased to 65.98 percent in 2000-01. This is due to the rehabilitation and resettlement of 1 urban and 168 rural settlement, which have been affected by the Upper Krishna river multipurpose project. In the last two decades the scenario of land use pattern and the cropping pattern in the district were change drastically.

In 1990-91 out of the total agriculture area 72.20 percent of agriculture land was under different food crops, but in 2000-01 the different food crops cultivated area decreased to 61.90 percent. This may be attributed to the fact that the substance of agriculture shifted to commercial crops like sugar cane, cotton, oil seeds, etc. The cropping pattern of the district has changed towards commercialization due to increase in the irrigation potentiality, transport, communication, market facilities, etc. The cultivation of commercial crops has impact on socio-economic development of farmers compared to food crops growing farmers. In Bagalkot district 71 percent of population concentrated in rural area plays an important role in economic development of the district. The food crops, commercial crops and oil seeds are the important crops grown in this region. According to 2000-01 (Table:1) out of the total agriculture area (4,77,756 hectares; it includes net sown area and area cultivated more than once) 61.90 percent of land were used to grown the food crops, 22.75 percent of land were used

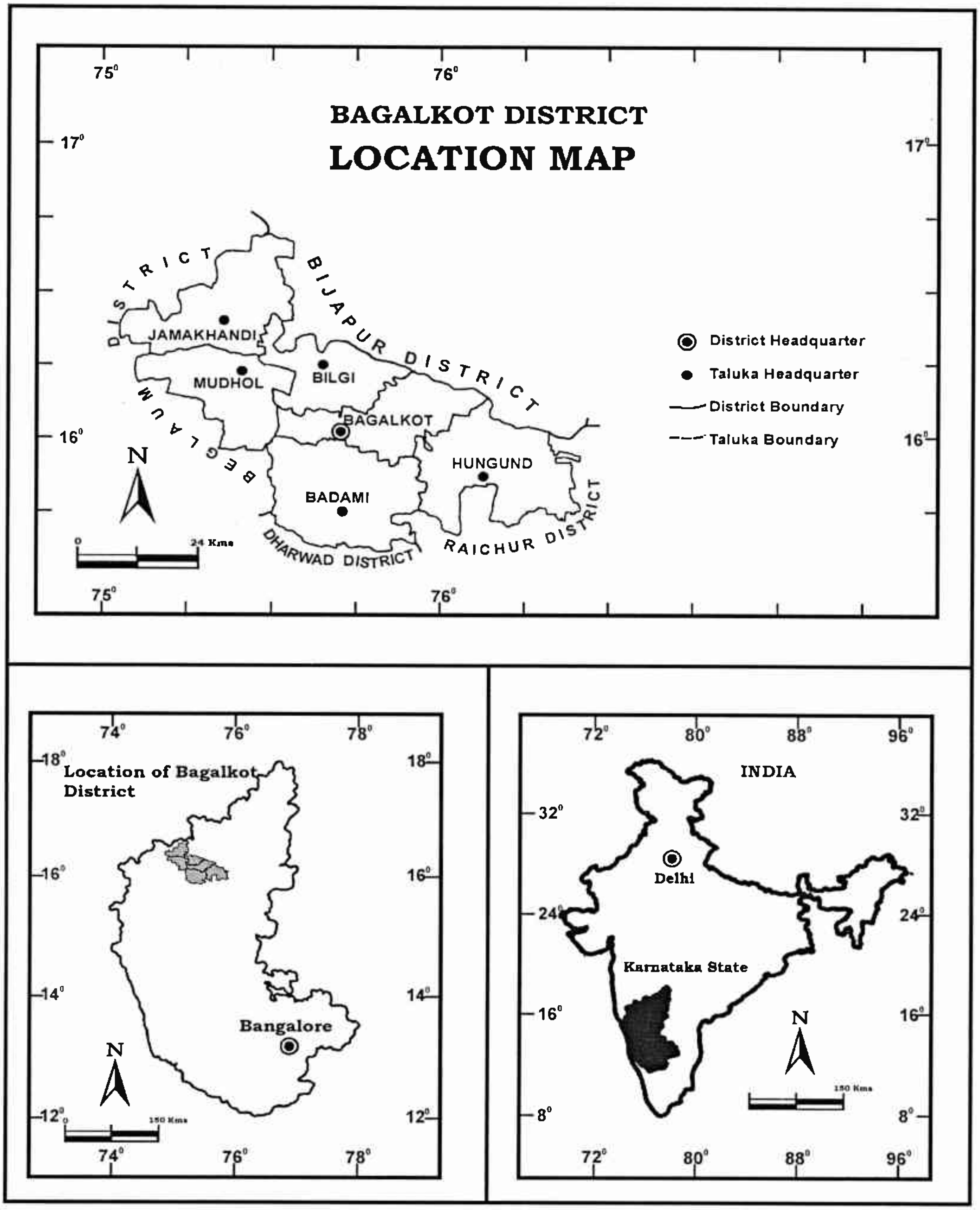

Fig. 1 Source: National Atlas of India

for oil seeds, 12.29 percent used for sugar cane, 01.18 percent of land used for other commercial crops (tobacco and cotton), 0.94 percent were used for vegetable crops, 0.71 percent used for fruits (grapes, pomegranate, sapota, papaya, etc.) and remaining 0.23 percent of land were used to grown the other minor crops.

Table 1: Agricultural Land Utilization Pattern of Bagalkot District: 2000-01.

Agricultural Land Utilization Pattern	Area (in hectares)	Percentages
Total Geographical Area	6,58,877	100.00
Total Agricultural Area i) net sown area ii) area more than once	**4,77,756** 4,34,749 43,007	**72.51** 65.98 06.53
Food Crops Area (Out of agricultural area)	2,95,731	61.90
Oil Seeds Growing Area	1,08,689	22.75
Sugarcane Crop Area	58,716	12.29
Other Commercial Crops Area	5,638	01.18
Vegetable Crops Area	4,491	0.94
Fruits Growing Area (grapes, pomegranate, sapota, papaya, etc.)	3,392	0.71
Other Minor Crops Area	1,099	0.23
Total Agricultural Area	**4,77,756**	**100.00**

Objectives

The main objectives of the present study are enunciated here under:

(i) to attempt the spatio-temporal variations in agricultural efficiency of Bagalkot District.

(ii) to examine the spatial variations in agricultural efficiency at taluk level.

(iii) to bring out the trend of temporal variations in the level of agricultural efficiency between 1995-96 and 2005-06.

(iv) to delineate the high efficiency areas and low efficiency areas.

(v) to suggest the suitable measures for sustainable development.

The general hypothesis that, there would be close relationship between regional disparities and agricultural efficiency regions (this hypothesis is proved).

Data Base

The secondary data have been collected from various published reports of Bagalkot District for the years of 1995-96 and 2005-06 to analyse the agricultural efficiency.

Methodology

Scholars from various disciplines have evolved various methods to measure agricultural efficiency and employed them at the macro, meso and micro levels. A measure for determining agricultural efficiency was evolved by Kendall (1939) who devised a system of "ranking co-efficient." To obtain the ranking co-efficient, first the enumeration units were ranked according to the acre yield for each of the selected crops, then the sum of the ranks occupied by the unit was divided by the number of crops to obtain the average rank of the unit. Stamp (1960) made an international comparison of agricultural efficiency of twenty countries by applying Kendall's method and obtained the ranking co-efficient based on the acre yields of nine selected crops. In India, Shafi (1960) used this method for determining agricultural efficiency of U.P., by considering per acre yields of eight food crops. Sapre and Deshpande (1964) have modified the procedure by taking a weighted average rank of Kendall. Gangully (1938) in his study of the Ganga's valley used nine leading crops and for each crop he calculated the yield index. Bhatia (1967) in his study used weighted average of the yield efficiency of all crops in a component areal unit, where the weights are proportionate to the share of cropland devoted to each crop which would give a measure of agricultural efficiency of the component, areal unit relative to the entire region.

Methodology Employed in the Study

In view of paucity of relevant data/ unsuitability of the method the formula of Bhatia, Enyedi and Shafi are not adopted in this paper.

In the forgoing analysis an attempt is made to study the trend of agricultural efficiency over a period of one decade from 1995-96 to 2005-06, by applying the recent and new techniques viz.: "Weighted and transformed standard scores" method adopted by R. Ram Mohan Rao and S. Simadri.

R. Ram Mohan Rao and S. Simadri (1984) taking a literal view of the term, observe that agricultural efficiency cannot be quantified by considering just a few indictors like yield, area and production of crops; instead, it is reflective of a wide spectrum of physical attributers and socio-economic factors. Sixteen indicators grouped into five classes viz. irrigation and rainfall, yields of principal crops, landuse characteristics, agricultural innovations and demographic aspects are considered and a method amalgamating these varied indicators on quantitative basis is evolved by employing the very useful technique of weighted and transformed standard scores.

In this study because of the non-availability of data only 9 indicators have been taken after considering their importance in determining the agricultural efficiency, viz. (i) area sown more than once as percentage of net area sown, (ii) net area sown as percentage of total geographical area, (iii) intensity of cropping, (iv) intensity of irrigation, (v) area irrigated more than once as percentage of net irrigated area, (vi) area under high yielding as percentage of net irrigated area, (vii) non-cultivable land as percentage of geographical area, (viii) canal irrigated land as percent of net irrigated land and (ix) cultivable waste land as percentage of geographical area have been taken for 1995-96 and 2005-06.

Criteria to Select the Efficiency Variables

The above selected indicators cannot be considered as having the same degree of importance in determining agricultural efficiency. There cannot be two opinions in selecting area sown more than once as one of the indicators of agricultural efficiency. It can safely be assumed that an area which is sown more than once a year is more efficient agriculturally. It can be said that land is put to intensive use if the area is sown more than once a year. Similarly net area sown as percentage of

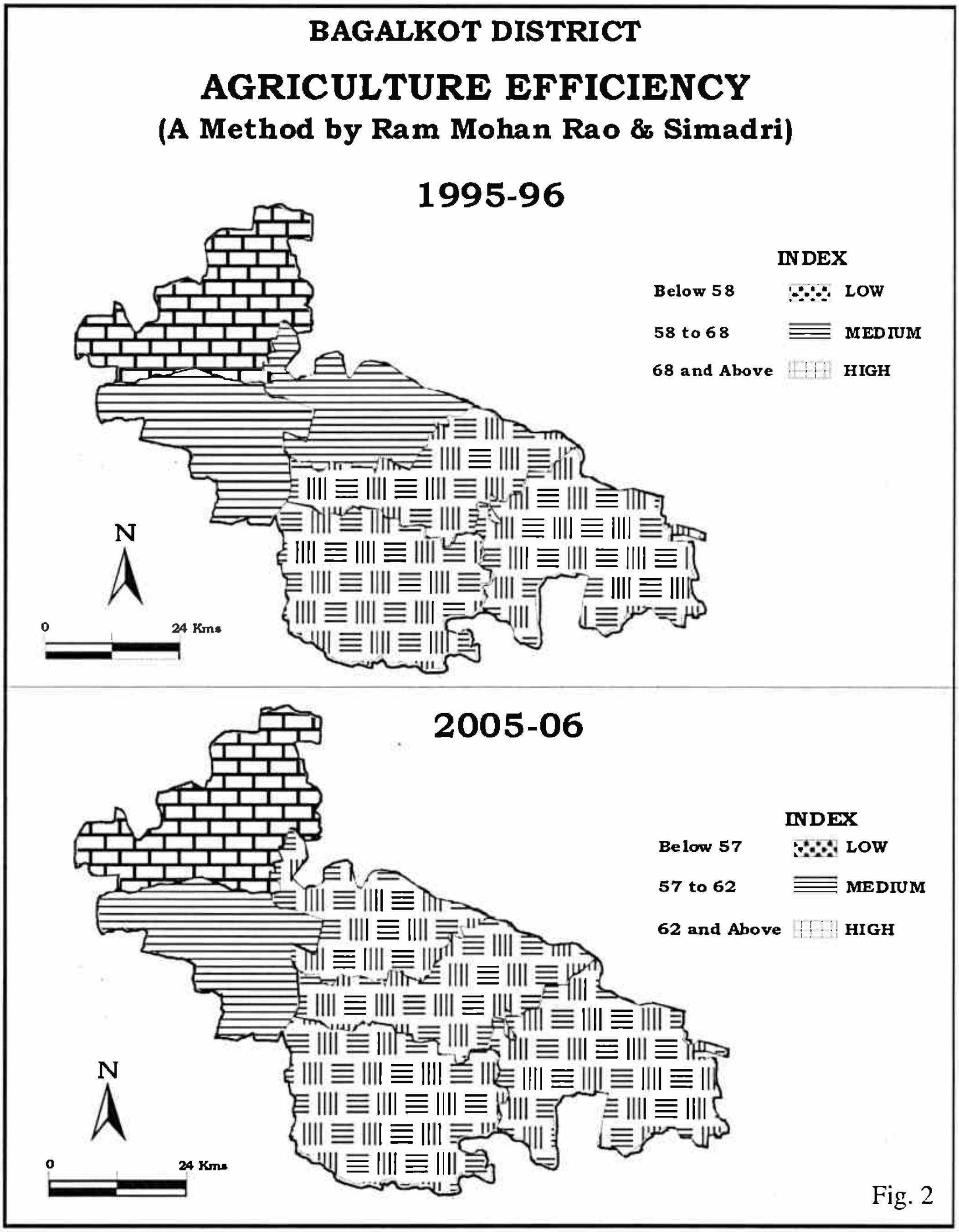

Fig. 2

the geographical area indicates the degree of use to which land area in a spatial unit is put to. Irrigation is one of the indispensable indicator of agricultural efficiency. Of all the sources of irrigation, canal irrigation is more dependable and leads to stable agricultural activity. Therefore, more weightage is given to canal irrigated area. The proportion of cultivable waste land and non-cultivable land to total geographical area are considered as indicators of agricultural efficiency. Greater the area of cultivable waste and non-cultivable land in a spatial unit lesser is the efficiency of agriculture and vice-versa.

The selected indicators after a careful examination of their importance as promoters of agricultural efficiency, a suitable method has to be evolved to measure the agriculture efficiency. After an evaluation of the various techniques mentioned in the previous page, it has been found that single method is comprehensive enough to give a total picture. Therefore the **weighted and transformed standard score method** is considered here as it is of more suitable than rest of the methods. The values of nine indicators greatly differ in their units from one to another. We have to convert the values in each of the nine indicators into comparable unit values in statistical terminology. This can best be done by computation of standard score. Since standard scores are equal units of measurement and since their size is the same from distribution to distribution, they become useful tool in the present study.

The Index of Agricultural Efficiency Formula

$$\text{I.A.E} = \frac{TZ_1(W_1)+TZ_2(W_2)+TZ_3(W_3)\ldots\ldots TZ_n(W_n)}{N}$$

where **I.A.E.** is the Index of agricultural efficiency for the taluk,

TZ_1 (W_1) is the Weighted standard score of indicators and

N is the Number of Indicators.

In this paper, an attempt is made to analyse the trend of agricultural efficiency by using R Ram Mohan Rao and Simadri method for two points of time i.e., 1995-96 and 2005-06. The standard deviation grouping technique is applied to categories the district in to low, medium and high efficiency regions as shown in the Figure No. 2. and Table No: 2 & 3.

Low Agricultural Efficiency Regions

The low category of agriculture (landuse) efficiency is found in Bagalkot, Badami, Hunagund and Bilagi taluks in 2005-06, but in 1995-96 three taluks were recorded i.e., Hunagund, Bagalkot and Badami. Among these, Hunagund and Badami taluks are located in less rainfall area, characterized by rugged topography. In view of rugged terrain and less area under cultivation, it is very difficult to make an effort in improving the situation of agriculture in these two taluks.

Medium Agricultural Efficiency Regions

This group comprises only one taluk i.e., Mudhol in 2005-06, but in 1995-96 Bilagi and Mudhol taluks were recorded. Among these Mudhol taluk has the lion's share of area under canal irrigation from Ghataprabha river project. Bilagi taluk has the efficient boar-well and partial canal irrigation system by the Ghataprabha river project. Which caters to the irrigation needs for at least one season and even in some areas for two times in a year. Yields of crops are high in isolated pockets as the formers try to apply greater amount of inputs in the irrigated area. This region is in a transition period and as such it may lead to high agricultural efficiency within next few years.

Table 2: Bagalkot District : Weighted Standard Scores of Agricultural Efficiency Variables :1995-96 and 2005-06 (A Method by R. Ram Mohan Rao and S. Simadri).

		1	2	3	4	5	6
Taluka	**Years**	Badami	Bagalkot	Bilagi	Hunagund	Jamkhandi	Mudhol
% Area Sown more than once	1995-96	53	56	43	36	52	69
	2005-06	60	68	54	60	43	61
NSA (%)	1995-96	56	53	68	75	58	40
	2005-06	48	60	39	70	61	65
Cropping Intensity	1995-96	64	66	52	46	62	79
	2005-06	70	44	64	70	52	70
Irrigation Intensity	1995-96	57	55	70	48	77	80
	2005-06	59	56	73	50	74	77
Area Irrigated %	1995-96	47	45	60	39	66	69
	2005-06	49	47	63	39	64	67
Area HYV	1995-96	53	73	55	38	45	48
	2005-06	19	40	17	33	17	12
Non Culti-vable land	1995-96	43	44	71	41	57	51
	2005-06	58	43	67	54	40	44
% Cereal Irrigated	1995-96	52	Nil	62	Nil	76	70
	2005-06	35	Nil	52	Nil	55	68
Cultivable Waste %	1995-96	90	62	77	61	208	71
	2005-06	90	62	77	61	208	71
Cum Std Score	1995-96	515	454	558	384	701	577
	2005-06	488	420	506	437	614	535
Avg std. Scores	1995-96	57	57	62	48	78	64
	2005-06	54	52	56	55	68	59

High Agricultural Efficiency Regions

Jamakhandi is the only one taluk coming under this region in both the study periods 1995-96 and 2005-06. Out of 73.14 percent of irrigated land in the taluk, 26.55 percent is irrigated by Ghataphrabha river project (i.e., Hidakal Dam). This factor has helped to faster the agricultural growth in the taluk. It has been noticed that out of 71 villages in the taluk 35 villages have benefited from Ghataphrabha irrigation project. This fact also indicates that the spread and effect of agricultural development is quite vast. In view of the above facts and impact of growth of industrial and urban nodality of Jamakhandi, this taluk is also characterises by greater proportion of area sown under sugarcane and more then once in a year and lesser proportion of area under category of cultivable waste. It is also the area where agricultural innovations area adopted, high yield varieties are used and multiple cropping systems are practiced.

Volume of Change in Agricultural Efficiency

It is significant to note that the agricultural efficiency in the district has distinctly improved during ten years of period from 1995-96 to 2005-06 at various levels. In fact Bilagi taluk has lost its efficiency from medium (1995-96) to low (2005-06). Because of wast irrigated area get submerged under the backwater of Upper Krishna Project i.e., Almatti reservoir. The status of remaining taluks is unchanged during the same period.

Planning for Sustainable Development

According to Indian Council for Agriculture Research (ICAR) there is possibilities of extension seem to be not very bright. No doubt the Jamkhandi, Badami and Bilagi taluks have large areas of cultivable waste land available for cultivation but the main difficulties are: seasonally some areas of these taluks are submerged by the back water of Alamatti Dam, barren land in some area, unhealthy climate, besides limitations/ inadequacy of irrigation facilities, infertile soil and undulating topography, etc. These areas can be made agriculturally fit by implement micro level planning for eradicating these problems.

In this regard some conditions have been suggested for improving productivity in agriculture. They are:

- Reasonably stable prices for agricultural products at remunerative level.
- Adequate marketing facilities.
- The development of resources, by the State Government, which are beyond the powers of the individual formers, such as, large scale irrigation, land reclamation or resettlement of project.
- Extension of landuse and intensification and utilization of land already in use through improved and scientific methods of cultivation.
- Diversification of farm production, i.e., besides cultivation of crops, dairy, poultry and fishing industries should be developed.
- Provision of education, research and extension and agro-economic services to spread the knowledge of improved methods of farming.

Table 3: Bagalkot District : Agricultural Efficiency in 1995-06 and 2005-06.
(A Method by R. Ram Mohan Rao and S. Simadri).

	1995-06		2005-06	
Development Class	**Range value**	**Name of the Taluks**	**Range value**	**Name of the Taluks**
Low Efficiency Region	Below 57	Hunagund, Bagalkot and Badami	Below 57	Bagalkot, Badami, Hunagund and Bilagi
Medium Efficiency Region	58 to 68	Bilagi and Mud-hol	58 to 62	Mudhol
High Efficiency Region	68 and above	Jamkhandi	62 and above	Jamkhandi

Conclusion

On the basis of field observation and data analysis by this researcher, it can be concluded that the agricultural efficiency in Bagalkot district is on advancement, due to the diversified nature of land-use pattern and cropping pattern of the Bagalkot district has increased the production capacity and cropping intensity of the land. In the present scenario needs to strengthen the irrigation facilities, soil and moisture conservation, adoption of bio-technology, afforastation, changing in the cropping pattern, agronomic practices, livestock development, rural communications, development of medium, small and marginal farmers and agricultural labourers and setting up agro-based industries. The dry land development program, sustenance of animal husbandry, fisheries, horticulture, sericulture and small scale industries at village level should be setup through the various programmes. The main objective of these programmes of agricultural development in the Bagalkot district is rotating around the drought situation. Therefore, plans on permanent basis to promote agriculture development and restore the ecological balance in the region.

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