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RESEARCH ARTICLE

Measurement of agricultural productivity and levels of development in the Malaprabha river basin, Karnataka, India

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Abstract

The present paper attempts to analyze the spatial patterns of agricultural productivity and assess regional disparities in the levels of agricultural development in the Malaprabha river basin, Karnataka state. The Malaprabha river basin is one of the natural regions, with agriculture being the lifeline activity of the inhabitants of the basin. However, surprisingly, the region experiences greater regional disparities in overall development in general and agricultural development in particular. Regional disparities in the river basin may be natural due to unequal distribution of natural resources or man-made in the sense of neglect of some regions and preferences for others for investment and infrastructural facilities, and to some extent, the developmental policies of the region. The present study has utilized the published sources of data and reports collected from the Directorate of Economics and Statistics, Govt. of Karnataka, the Directorate of Census Operations in Karnataka, Govt. of India, Bangalore, and other related statistical records at taluka level at two points in time, i.e., 1993–94 and 2013–14. Though the study area is a natural region, the taluka has been taken as the smallest unit of study. The findings suggest that significant disparities have extensively affected the various aspects of agricultural development in the talukas of the river basin. The areas with a low level of development should be given top priority so that they may come up at par with the developed areas and the concept of planning with social justice may be fulfilled.

Keywords: Productivity, Regional disparities, Lifeline, Composite indices, Agricultural development.

Introduction

Agricultural productivity is a quantitative term that provides an estimate of the power of agriculture to produce crops. It is not a synonym for soil fertility, which expresses the ability of soils to provide plant nutrients. The notion of productivity refers to the efficiency with which inputs are utilized in agricultural production (Shafi 1967). It measures the ratio of the index of agricultural outputs to that of total inputs in farm production and, therefore, provides an estimate of farm output per unit of input (Pandit 1965). Saxon (1965) is of the view that productivity is a physical relationship between output and the input that gives rise to that output. The measures of agricultural productivity that have been frequently adopted in different regional studies of agriculture are usually those of partial productivity (Shafi 1971), since only a single input or a group of inputs have been taken into account for the determination of farm productivity. Herring (1964) has categorized farm inputs into three main classes: land, labor, and capital. A composite measure where all these components of agriculture could be included is perhaps difficult to adopt for two reasons. Firstly, the data required for measuring productivity as a single input is more likely to be available than those required for evaluating overall productivity. Secondly, the aggregation of total inputs may tend to obscure the effects of changes in their composition.

Among the various inputs, land is the most permanently fixed and has assumed spatial importance in the regional studies of agriculture. It would not look peculiar that many of the measures of productivity are based on the land component of the farm inputs. In the absence of any measure for the cultivation of overall productivity, it must be appreciated that the choice of productivity measures would depend mainly on the purpose for which their estimation is desired. Land reforms and improvements in farm technology will be affected. The concept of labor productivity could be

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applied where knowledge of the income of the population engaged in agriculture is desired. The cost-benefit situation of farming may be better understood by considering the capital component of agricultural inputs. It may be noted, however, that capital investment structures are often so complicated that capital-based productivity is difficult to compute and interpret. The problem of the choice of measures of agricultural productivity was discussed at great length at the 23rd Annual Conference of Agricultural Economists, and it was generally agreed that the land factor may be recognized as the principal basis for the evaluation of agricultural productivity. Therefore, The yield rate may be considered a good measure of productivity, while other factors of production may be considered when making regional comparisons of farm production.

Development is a multidimensional phenomenon that brings qualitative changes and quantitative growth to society. It has been appropriately conceptualized as a process that improves the quality of life of the people (Siddiqui *et al*., 2010). To accelerate society's growth in a sustainable manner, it is necessary to ensure a balanced regional developmental process. Due to the uneven distribution of physical as well as human resources and socio-institutional, techno-economic, and infrastructural diversities, immense inter- and intra-regional disparities are found across the regions, which is a matter of great concern today for both developed and developing nations of the world. Regional disparities have become one of the most important, glaring, and growing problems not only in developing countries but also in the most advanced countries of the world (Sharma & Kumar, 1993).

Regional disparities are generally the outcome of numerous factors, such as variations in natural and physical endowments, differences in socioeconomic attitudinal parameters, infrastructural facilities, and, to some extent, the developmental policies of the state as well as the central government (Figure 1). This phenomenon is inherent and a natural outcome of the development process itself, wherein certain regions develop faster than others due to a number of factors. Time-to-time planning keeps the objective of wiping out the disparity persisting among different regions by adopting regional interests as well as available resource potentials. With independence, the whole face of the agriculture landscape in India began to change. The structural changes in agriculture include the technology of cultivation, the introduction of HYV seeds, the use of chemical fertilizers, the extension of irrigation, and a network of agricultural research through a series of five-year plans. Because of this, the centrally sponsored Command Area Development (CAD) Programme was launched in 1974–75, with the main objectives of improving the utilization of the created irrigation potential in selected major and medium irrigation projects of the nation for optimizing agricultural production from the irrigated land.

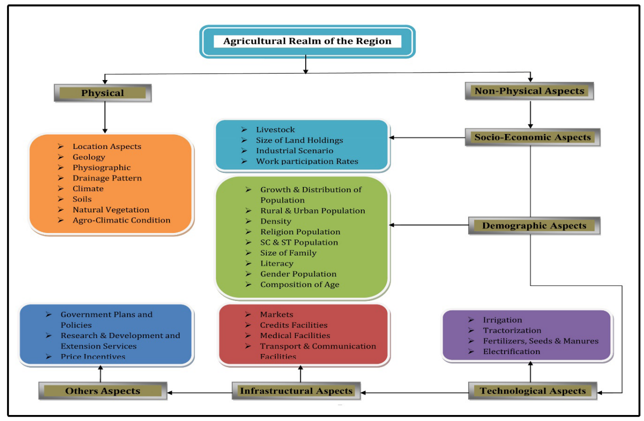

Figure 1: A model view of the aspects of development of the agricultural realm of the region

Therefore, the present paper attempts to analyze the spatial patterns of agricultural productivity and assess the spatial patterns of regional disparities in the levels of agricultural development in the talukas of the Malaprabha river basin in Karnataka state. The Malaprabha river basin is one of the natural regions, with agriculture being the lifeline activity of the inhabitants of the basin. However, surprisingly, the region experiences greater regional disparities in overall development in general and agricultural development in particular. Regional disparities in the study area may be natural due to unequal distribution of natural resources or man-made in the sense of neglect of some regions and preferences for others for investment and infrastructural facilities, and to some extent, the developmental policies of the region.

Study Area

Karnataka state's Malaprabha River Basin area is approximately triangular and located in the extreme western part of the Krishna basin. It lies between $15^0\ 05^I\ 02^{II}$ to $16^0\ 20^I\ 19^{II}$ N. latitudes and $74^0\ 05^I\ 43^{II}$ to $76^0\ 05^I\ 33^{II}$ E. longitudes, covering an area of 11549 sq. km, out of which 3880 sq. km are in Belgaum (33.59%), 1950 sq. km in Bagalakot (16.89%), 2739 sq. km in Dharwad (23.72%), 2657 sq. km in Gadag, 220 sq. km in Koppal, and 103 sq. Topographically, the Malaprabha basin area presents two important divisions, the Western Ghats and the typical eastern part of the Deccan/Karnataka plateau, with distinct characteristics. The plateau has two natural sub-divisions, the Semi-Malnad and the Northern Maidan, which include the state's northern upland, or the Deccan trap. An exhumed structure with superimposed drainage is also responsible for the sharp relief in the Kaladgi sandstones, in which Ghataprabha forms a waterfall near Gokak and Malaprabha forms a gorge near Saundatti (Spate and Learmonth, 1967).

The river Malaprabha is the most important right-bank tributary of the river Krishna. Benni Hall, Hire Hall, and others

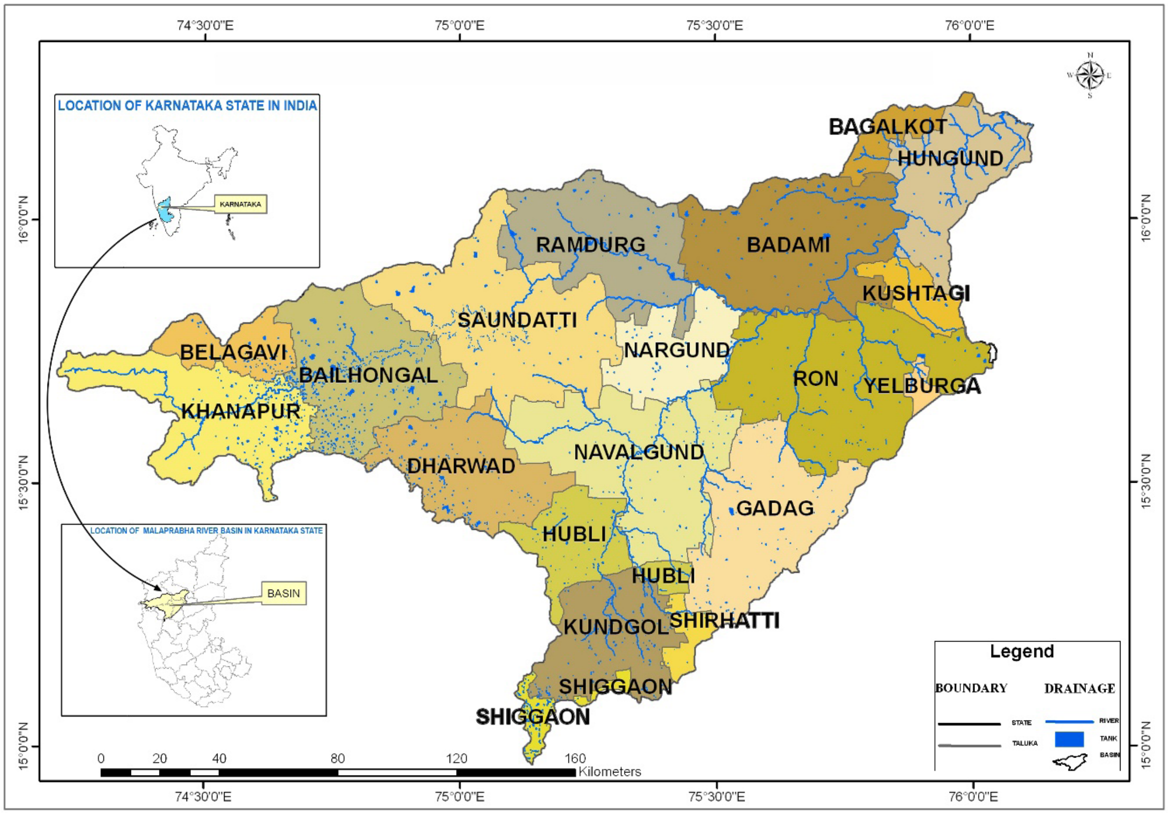

Figure 2: Location map of the Malaprabha river basin, Karnataka state, India

are the principal tributaries of the Malaprabha river [Figure 2]. The entire river basin experiences a semi-arid type of climate, spread in the hilly, northern dry, and northern transition zones of the agro-climatic zones of Karnataka state, and it is very warm during the summer, especially in April and May, with temperatures ranging between 35 and 400°C in the eastern part of the basin area. The annual normal rainfall of the Malaprabha basin area is over 759 mm spread over 50 days, and it receives monsoon rainfall as much as our nation, with slight variations. Deep black cotton soils are ubiquitous in the basin area. Jowar, besides other drought-resistant, inferior small millet crops, is traditionally the predominant crop. Geographically, deep black cotton soils, unpredictable monsoonal rainfall, droughts, and famines are part of the lives of people in the study region. The present study is a natural region that occupies 6.02% of the Karnataka state. As per the 2011 census, the population of the Malaprabha river basin is 3.38 million (5.53% of the state's total population), of which 77.66% are rural and 22.34% are urban. The dominance of rural populations makes the regional economy mainly agrarian. However, the basin's 68.37% of the workforce (61.75% of males and 79.55% of females) is still dependent on agriculture and its allied activities for their livelihood. The economic development and prosperity of the masses depend mainly on agriculture.

Objectives of the Study

The present study has been undertaken with the following specific objectives

- To examine the geographical patterns of agricultural productivity in the talukas of the Malaprabha river basin,
- To assess the levels of agricultural development for different time periods and mark inter-regional variations at two points in time, i.e., 1993–94 and 2013–14,
- To analyze the factors responsible for the inequalities in the levels of agriculture development among the talukas of the river basin,
- To suggest appropriate strategies to reduce regional inequalities for sustainable development.

Data Base and Methodology

The study is based on secondary sources of data, and information is collected from various sources. The area under different crops and their production are obtained from annual seasonal crop reports and plan statistics. Taluka-level yield per hectare for different crops is worked out by dividing the total production of a particular crop by the area under it. In order to minimize the anomalies arising out of fluctuations in area and output, the selected eleven crops (Paddy, Jowar, Maize, Wheat, Green Gram, Bengal Gram, Vegetables, Groundnut, Sunflower, Cotton, and

Sugarcane) have been studied for two points in time, i.e., 1993–94 and 2013–14, by applying the technique introduced by Jasbir Singh (1976) crop yield and concentration indices ranking coefficient method in the present study to assess the regional differences in the level of food production and to delimit the weaker areas from the point of agricultural productivity, the relative crop yield and concentration indices in ranking order and computed into the average ranking coefficient. It may be called the crop yield and concentration index ranking coefficient. The procedure is explained as follows:

$$CYI = \frac{Yae}{Yar}\ x\ 100 \ldots\ldots(I)$$

Where CYI = is the Crop Yield Index, Yae = is the average yield per hectare of crop 'a' in the component enumeration unit, and Yar = is the average yield of the crop 'a' in the entire region.

$$CCI = \frac{Pae}{Par}\ x\ 100 \ldots\ldots(II)$$

Where CCI = is the Crop Concentration Index, Pae = is the percentage strength of crop 'a' in the total cropped area in the component enumeration unit, andPar = is the percentage strength of crop 'a' in the total cropped area in the entire region.

$$CYI\ \&\ CI\ ranking\ co-efficient\ for\ crop\ 'a' = \frac{CYI\ ranking\ of\ crop\ 'a' + CC\ ranking\ of\ crop\ 'a'}{2}$$

After computing the agricultural productivity, to assess the levels of agricultural development in the Malaprabha river basin at the taluka level, a set of thirty indicators of the development of various sectors has been taken into account to determine the levels of development. These indicators fall into categories like agricultural components (12), demographic components (9), and infrastructure components (9), and the level of agricultural development has been evaluated by using the composite Z-score technique for three points in time, i.e., 1993–94 and 2013–14. The selection of a set of such variables is a very difficult task. The selected indicator approach appears to be of special relevance in the present analysis. To achieve the objectives mentioned above, the relevant method of quantitative analysis has been employed. For analysis, the z score' or Standard Score Additive Model has been used to arrive at the level of agricultural development for the talukas of the study area. This is a very simple calculation, but its results are the most appropriate. For the **'Z'** score, Smith (1979) has given a formula:

$$Zij = \frac{Xij - Xi}{\delta Xi}$$

[Where: Zij = Standardized value of the variable i in taluka j, Xij = Actual value of variable i in taluka j,Xi = Means value of variable i in all the talukas &δ Xi = Standard deviation of variables i in all talukas.]

In order to assess the overall level of agricultural development, the results of standard scores obtained for all indicators are added taluka-wise, and the average is taken out for these indicators (Table 1), which is known as the composite score (CS) for each taluka and algebraically expressed as:

$$CS = \frac{\Sigma\ Zij}{N}$$

[Where: C.S. = Composite Score, Σ Zij = 'z' score of all variables i in district j &N = No of variables.]

All data have been arranged in descending order and standardized to a zero mean for interpretation. The positive values show a high level of agricultural development, and the negative values indicate a low level of agricultural

Table 1: Selected indicators of the development from various components

1.	*Agricultural Components*
A_1	Total cropped area
A_2	Total arable land
A_3	Percentage of net sown area (NSA) to total geographical area
A_4	Area sown more than once (asmo)
A_5	Cropping intensity
A_6	Percentage of net irrigated area (NIA) to net sown area
A_7	Average size of agricultural land holdings
A_8	Percentage of area under pulse crops
A_9	Intensity of rainfall
A_{10}	Percentage of agricultural workers to total workers
A_{11}	Percentage of cultivators to total workers
A_{12}	Percentage of agricultural labor to total workers
2.	*Demographic components*
D_1	Percentage of the growth rate of the population
D_2	Density of population
D_3	Sex ratio
D_4	Level of urbanization
D_5	Literacy rate
D_6	Male literacy rate
D_7	Female literacy rate
D_8	Percentage of SC and ST populations to the total population
D_9	Percentage of non-agricultural workers to total workers
3	Infrastructural components
I_1	Consumption of fertilizers in kg per 1000 hectares of total cropped area
I_2	No. of tractor per 1000 hectors of total cropped area
I_3	Livestock population per lakh rural population
I_4	No. of pump sets per 1000 hectares of irrigated area
I_5	Total road length per 1000 hectares of geographical area
I_6	Number of post offices per lakh population
I_7	Number of telephone lines in use per lakh population
I_8	No. of cooperative societies per lakh population
I_9	Number of regulated markets

development. All the talukas are arranged into three categories: high, medium, and low developmental areas. Atlast, the results were presented with suitable figures and diagrams.

Results and Discussion

Regional Pattern of Agricultural Productivity

The area selected for the study, i.e., the Malaprabha river basin of Karnataka state, indicates an imbalance in agricultural productivity. Agriculture is the study region's lifeline or dominant primary activity, so it is essential to study important features of agriculture in the region. Agriculture in any area is closely related to productivity and topography. This chapter throws light on the taluka-wise crop productivity of the Malaprabha river basin. In this section, an attempt is made to study the yield of selected agricultural crops in the Malaprabha river basin. The period chosen for crop productivity analysis in the river basin is 1993–94 to 2013–2014.

Spatial Pattern of Agricultural Productivity (1993–94 to 2013–14)

Using Jasbir Singh's (1976) method, the crop yield and concentration indices are calculated for the selected eleven crops of the 13 talukas of the study region. In order to know the regional variation of productivity, the index values are calculated for two points in time, i.e., 1993–94 and 2013–14. The obtained indices are categorized into three groups, mainly high, medium, and low agricultural productivity regions in the study region. The same has been mapped with the help of the choropleth method to bring out spatio-temporal variations and regional disparities in crop production in the Malaprabha river basin. Tables 2, 3, and Figure 3 portray the distributional patterns of agricultural productivity in the Malaprabha river basin, and their regional differences can be explained with reference to diversions in physical socio-institutional, techno-economic, and infrastructural variables. In areas with better conditions, productivity is high, while in areas with constraints, it is low. The study reveals that the productivity index values ranged from 4.94 to 7.85 in 1993–94 and from 5.44 to 8.15 in 2013–14.

High Productivity Regions

Spatial variations in productivity are marked in the regions depending upon the nature of relief, slope, drainage, and soil, as well as the level of diffusion of agricultural innovations. In 1993–94, high (less than 6.00) agricultural productivity was noticed in six talukas: Dharwad, Ramadurga, Saundatti, Bailhongal, Badami, and Hubli. Only Dharwad and Gadag talukas of the basin were confined to this category in 2013–14. It is because of the development of irrigational facilities, an increase in the percentage of high-yield varieties of seeds, the distribution of fertilizers, and better socioeconomic facilities, particularly the extension of agricultural credits (Tables 2, 3 and Figure 3).

Medium Productivity Regions

During 1993–94, only one, i.e., Hunagund, fell into the category of medium (6.00 to 7.00) productivity regions of the river basin, whereas the number of talukas increased to seven, namely Hunagund, Ramadurga, Badami, Bailhongal, Ron, Khanapur, and Saundatti in 2013–14. This is mainly due to the lesser amount of rainfall received by these talukas, limited water supply through wells and tube wells, lesser amount of water supply through canals, soil fertility status, etc., which are the factors responsible for the medium productivity in the region (Tables 1, 2 and Figure 3).

Low Productivity Regions

In 1993–94, low (more than 7.00) productivity regions were observed in six talukas, namely Naragund, Navalgund, Ron, Gadag, Kundagol, and Khanapur, and the number of talukas decreased to four, namely Hubli, Kundagol, Navalgund, and Naragund, in 2013–14. This prevalence of low agricultural productivity was mainly due to environmental constraints (rainfall and topography), farmers' failure to use the recommended seeds, fertilizers, methods of cultivation, etc., (Tables 1, 2 and Figure 3).

The study reveals that low productivity was concentrated in those areas with higher hilly terrain or non-irrigated belts and a lack of modernization in agriculture. High productivity was found especially in irrigated belts. The profitability of agriculture has greatly increased due to the impact of canal irrigation, assured rainfall conditions, improved seeds, and fertile soils in the region (Figure 3).

Table 2: Crop productivity regions of Malaprabha river basin, Karnataka state during 1993-94 to 2013-14 (Jasbir Singh Method)

Talukas	*Ranking co-efficient indices of crop productivity*			
	1993-94		*2013-14*	
	Indices	*Rank*	*Indices*	*Rank*
Khanapur	7.85	1	6.85	6
Bailhongal	5.58	10	6.64	8
Saundatti	5.44	11	6.95	5
Ramadurga	5.34	12	6.05	10
Badami	5.70	9	6.06	9
Hunagund	6.86	7	6.03	11
Naragund	7.11	5.5	8.15	1
Ron	7.33	4	6.68	7
Gadag	7.52	3	5.97	12
Dharwad	4.94	13	5.44	13
Hubli	5.85	8	7.09	4
Navalgund	7.11	5.5	7.90	3
Kundagol	7.65	2	7.97	2

Source: derived after the calculation of RC of Indices by the researcher on the basis of the Taluka-wise selected crops for each period of study.

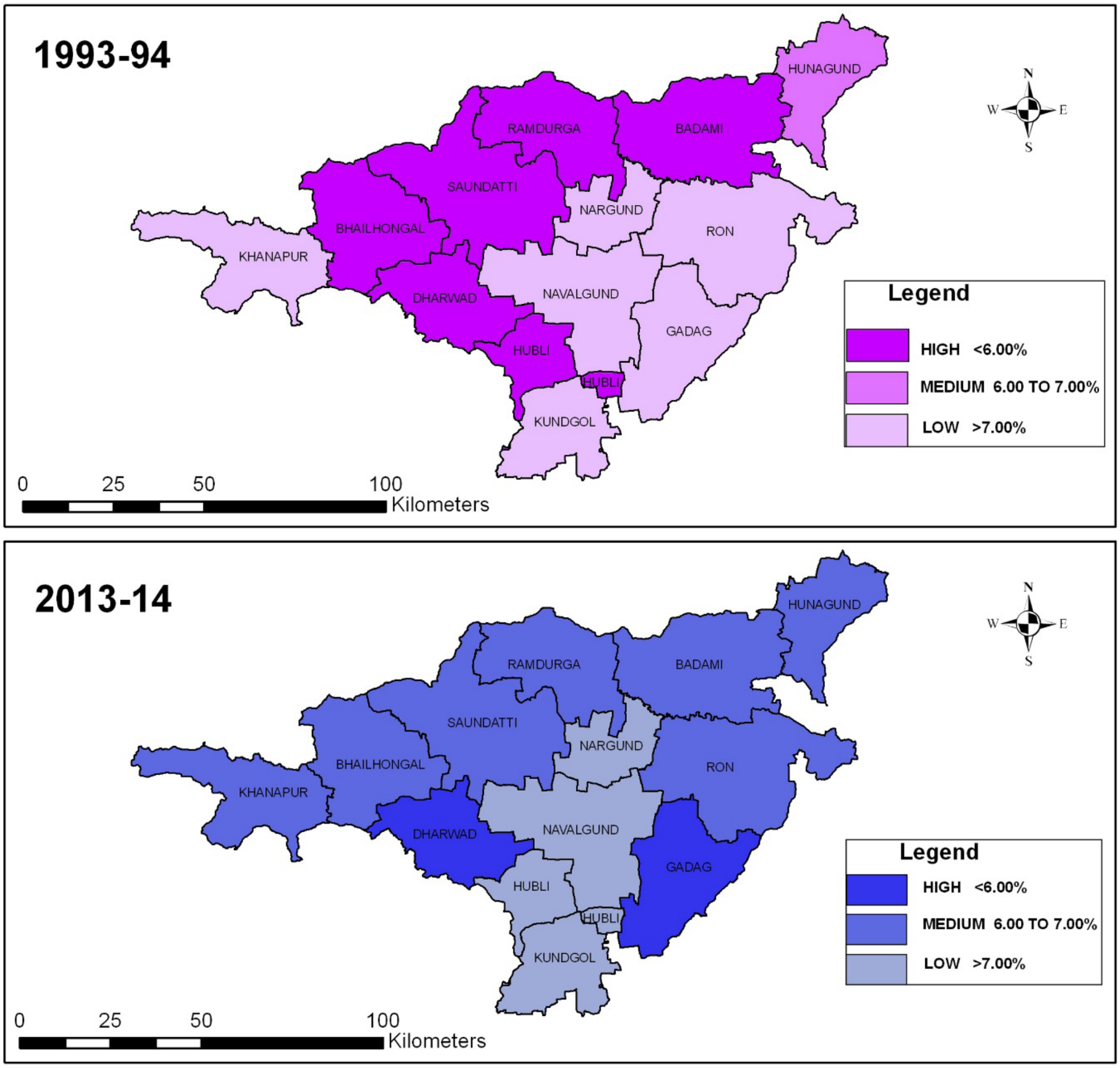

Figure 3: Crop productivity regions of the Malaprabha river basin, Karnataka state, India during 1993-94 to 2013-14 (By Jasbir Singh's Method)

Table 3: Disparities in the levels of agricultural productivity in the Malaprabha river basin from 1973-74 to 2013-14 (According to Jasbir Singh Method)

Category	*Range of ranking co-efficient indices*	*1993-94*			*2013-14*		
		No of talukas	*%of talukas area to total area*	*Name of the Talukas*	*No of talukas*	*% of talukas area to total area*	*Name of the talukas*
High	< 6.00	6	46.15	Dharwad Ramadurga Saundatti Bailhongal Badami Hubli	2	15.38	Dharwad Gadag
Medium	6.00 to 7.00	1	7.69	Hunagund	7	53.83	Hunagund Ramadurga Badami Bailhongal Ron Khanapur Saundatti
Low	> 7.00	6	46.15	Naragund Navalgund Ron Gadag Kundagol Khanapur	4	30.77	Hubli Kundagol Navalgund Naragund
		13	100.00		13	100.00	

Source: Classification derived after ranking of the talukas

Note: Lower the Ranking Co-efficientIndices higher will be the productivity and vice-versa.

Table 4: Developmental indices of Malaprabha river basin, Karnataka State, India during 1993-94 to 2013-14 (According to 'Z' Score Method)

Talukas	*Indices of Z Scores*			
	1993-94		*2013-14*	
	Indices	*Rank*	*Indices*	*Rank*
Khanapur	-0.3507	13	-0.3682	13
Bailhongal	-0.1794	12	-0.0743	9
Saundatti	-0.0877	9	0.0002	7
Ramadurga	-0.1694	11	-0.2287	12
Badami	0.0760	7	-0.1228	10
Hunagund	-0.0465	8	0.0296	6
Naragund	0.1796	2	0.1608	4
Ron	0.0765	6	0.1772	3
Gadag	0.1264	4	0.1856	2
Dharwad	-0.1308	10	-0.1584	11
Hubli	0.1512	3	0.0996	5
Navalgund	0.2684	1	0.3020	1
Kundagol	0.1085	5	-0.0024	8

Source: derived after the calculation of Z scores indices by researcher on the bases of the taluka wise selected indicators for each period of study

Levels of Agricultural Development

An important finding that emerges from Tables 3 and 4 is that agricultural development in the talukas of the Malaprabha river basin was not uniformly dimensional. This would be clear when we examine the taluka-wise Z score indices of agricultural development given in the Table 4 and depicted in Figure 4, which give a comparative picture of the levels of changes in agricultural development of all the talukas over two time periods, i.e., 1993–94 and 2013–14. The changes in the indices values have been examined to trace the direction of development. In addition, to have a clear insight into the problems of the backwardness of some talukas and their future prospects, a detailed analysis of the dimensions of development has been attempted. It is observed that irrigation has had a tremendous impact on agricultural development from different sources in the command areas of the Malaprabha river Project. Soil fertility, rainfall conditions, and socioeconomic facilities play an important role in the development of agriculture in the Malaprabha river basin.

Spatial Patterns of Level of Agricultural Development

In the present study, agricultural development has been considered as the function of 30 indicators, which have been grouped into three categories. The composite index of level of development is based on the aggregation of these three categories, as given in Table 5. Figure 4 shows the spatial distribution of regions with different levels of development. In 1993–94, the talukas under the high category (above a +0.15 score) formed a compact region in the central part of the basin (Table 5). The former region's relatively small size (23.08% of the basin) includes the Navalgund, Naragund, and Hubli talukas (Figure 4). The number of talukas has been further increased to four, such as Navalgund, Gadag, Ron, and Naragund, which fall under the category of high level of agriculture development in 2013–14 and encompass a compact region in the central, eastern, and south-eastern parts of the river basin (30.77% of the basin). The study reveals that these talukas have experienced high agricultural efficiency. This was mainly because of assured rainfall conditions, timely supply of irrigation by different sources, soil fertility, and methods of cultivation, socioeconomic conditions, and others (Tables 3, 5, and Figure 4).

Seven talukas of the river basin, namely Gadag, Kundagol, Ron, Badami, Hunagund, Saundatti, and Dharwad, fell under the moderate level of development (-0.15 to +0.45 score) in 1993–94 and formed a notable region around the periphery of the high level of development in the north western and south eastern parts of the basin (53.83% of the basin). However, all these talukas have a moderate value in the majority of the selected indicators. The Hubli, Hunagund, Saundatti, Kundagol, Bailhongal, and Badami talukas figured in the same category of development in 2013–14 and formed three distinct regions in the northwestern, northeastern, and southern parts of the basin (46.15% basin). This was mainly due to the talukas that have accessibility to water facilities; those talukas maintained their position, but due to

Table 5: Classifications of talukas on the levels of agricultural development in Malaprabha river basin during 1993-94 to 2013-14 (According to 'Z' Score Method)

Category	*Ranking co-efficient indices*	*1993-94*		*2013-14*	
		No of talukas & its area (in %)	*Name of the talukas*	*No of talukas & its area (in %)*	*Name of the talukas*
High	More than +0.15	3 (23.08)	Navalgund Naragund Hubli	4 (30.77)	Navalgund Gadag Ron Naragund
Medium	+0.15 to -0.15	7 (53.83)	Gadag Kundagol Ron Badami Hunagund Saundatti Dharwad	6 (46.15)	Hubli Hunagund Saundatti Kundagol Bailhongal Badami
Low	Less than -0.15	3 (23.08)	Ramadurga Bailhongal Khanapur	3 (23.08)	Dharwad Ramadurga Khanapur
		13 (100.00)		13 (100.00)	

Source: Classification derived after ranking of the talukas

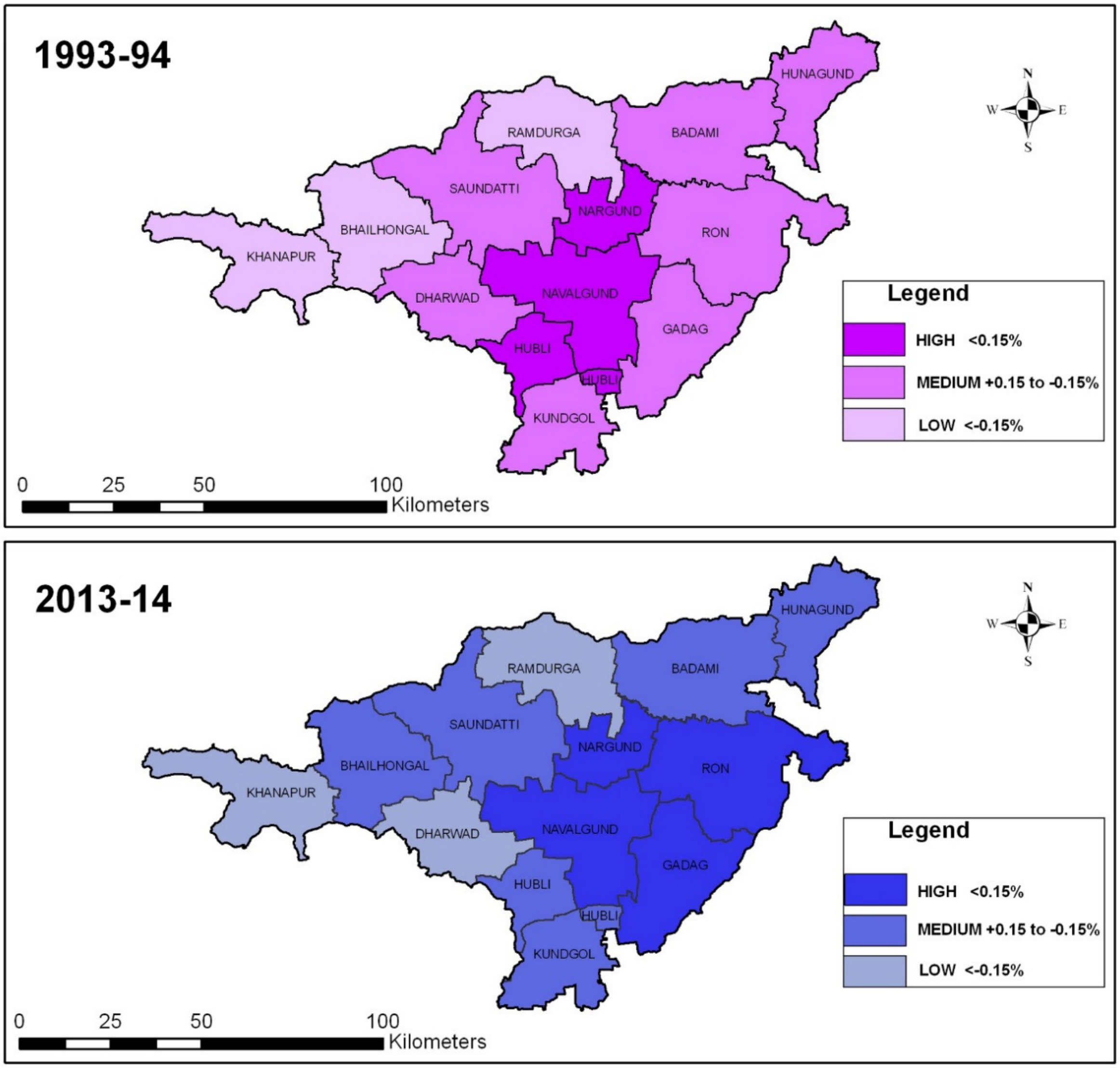

Figure 4: Levels of agricultural development regions of the Malaprabha river basin, Karnataka state, India during 1993-94 to 2013-14 (According to 'Z' Score Method)

variations in the amount of rainfall and rugged topography, some talukas have changed their position. These talukas will likely improve agricultural efficiency in the future (Tables 3, 5, and Figure 4).

The region of low level of agricultural development (below -0.15) covered about 23.08 percent of talukas, namely Ramadurga Bailhongal Khanapur of the basin in 1993–94, and they formed two different regions in the western and southern parts of the river basin. In 2013-14, three talukas, viz. Dharwad Ramadurga and Khanapur (23.08% of the basin), fell into this category of low agriculture development and formed three different regions in the western, southern, and southwestern parts of the basin. The low agricultural efficiency in these talukas is mainly responsible for the rugged topography, variation in the amount of rainfall, non-availability of assured water supply through canals, HYV seeds, absence of tank and well irrigation, etc. (Tables 3, 5, and Figure 4).

Conclusion

The spatial patterns of agricultural productivity and development levels clearly indicate that there is a wide range of variations among the talukas of the study area. High levels in the southwestern and north-central parts of the basin area characterise the geographical patterns of agricultural productivity. However, the composite mean z-score values of developmental indicators point out that the level of development is not homogeneous among the talukas in the Malaprabha river basin, and the overwhelming majority of the northeastern, western, and southern talukas are shown backward in the light of selected variables. The eastern and central plain talukas give the impression of being on the higher side of the scale of development. Sufficient land is available in the basin that could be brought under cultivation, and by increasing irrigation facilities, gross crop area can be increased considerably. A total of nine talukas have medium and low levels of regional development (69.23% of the basin); this is indeed a situation of great concern, and these should be given top priority so that they may come up at par with developed areas and the concept of planning with social justice may be fulfilled.

Therefore, it is the need of the hour to evolve such strategies that the horizontal disparities and vertical inequalities may be minimized in respect of agricultural growth and levels of socioeconomic development in the basin area. However, for sustainable agrarian development, the methods and techniques of agriculture should be adopted after considering the ecological constraints in a region.

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