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Agricultural Efficiency in Chhattisgarh

Anusuiya Baghel* and Sk. Nasib Ahamed, Raipur

Abstract

The paper analyzes the agricultural efficiency in 27 districts of Chhattisgarh to find out the physical, social and economic factors responsible for the regional patterns. Twenty crops having more than one percent of the total cropped area occupying more than 90 percent of the total cropped area were included in the study to measure the agricultural efficiency based on S.S Bhatia's yield index. The research is based on the agricultural statistics, 2015-16. Area and production of all the 20 crops in each district have been considered for measuring the agricultural efficiency in Chhattisgarh. The analysis has helped identification of diverse regions based on the efficiency index and provides a valuable basis for future intervention into the agricultural situation in the state.

Keywords: *Efficiency, index, weighted, ranking.*

Introduction

Geographers and agricultural economists have long been interested in determining the efficiency of agriculture in various parts of the world. In developing countries like India where agriculture is the mainstay of more than three-fourths of the population and where food security continues to be precarious, it is essential to re-examine the efficiency of agricultural practices. In this context, spatial variation in agricultural efficiency appears useful to identify areas that may be performing rather poorly in comparison with others (Bhatia, 1967). Agriculture is not just a food providing machine but the backbone of the livelihood of 60 percent of the people of India (Swaminathan, 2009).

The concept and measurement of agricultural efficiency is nothing new and has been used in agricultural studies since long. The analysis of agricultural efficiency is crucial in improving agricultural productivity and hence has attracted the attention of policy makers, researchers and development practitioners (Odhiambo and Nyangito, 2003). It is a scientific device to study the inherent fertility, productivity and capability of the land so that its misuse and underuse may be checked by planning for future use (Dutta, 2012). Geographers and agricultural economists have long been interested in determining the efficiency of agriculture in various part of the world. Kostrowicki (1964) drew attention to the fact that the terms efficiency and effectiveness apparently have no firmly established meaning. There are some who understand efficiency of agriculture synonymously with labour, capital or land productivity. Some consider it as the ratio of productivity to potential productivity or as net income from agricultural production per unit area, per labour unit or per unit of input

(Kostrowicki, 1964). In measuring efficiency of agriculture, a distinction however needs to be made across productivity of particular land uses; for example, the intensively cultivated fields on the one hand and extensively used rugged pastures on the other (Shafi, 1976).

Agricultural efficiency is certainly a more appropriate measure for delineating agricultural regions rather than merely measuring proportion of area under major crops. Crop combination represents the general pattern of an area while agricultural efficiency in addition takes into account the factor of yield. Efficiency refers to competence or capability. Agricultural efficiency depends upon the effect of a set of factors like physical (climate & soil), social and economic (size of landholdings & types of agriculture), and agricultural technology organization (crop rotation, irrigation & mechanization). Sinha (1968) computed agricultural efficiency using a simple technique of production area ratio and anaysing the variation with the help of standard deviation. The shifting emphasis from environmental factors to technological factors during 1964-65 through 1969-70 revealed the dynamics of agricultural transformation and points to the future course of the development (Subbiah and Ahmad, 1980).

Agricultural efficiency is measured based on a set of factors such as per unit area production, per unit labour production, production and investment ratio and profit from agriculture, per capita production of food grains etc. Due to the unavailability of data, most of the geographers and economists consider agricultural area and crop yield as a sufficient basis for measuring agricultural efficiency. Agricultural efficiency is measured using unit area production which is based on per acre production. Output expressed as grain equivalent appears to have been used for the first time by Buck (1956) in his study of the Chinese agriculture. Food and agricultural organization of the United Nations has used a scale-based weight system for constructing the international index numbers of agriculture production (Klayman, 1960).

The issue of agricultural efficiency has long attracted the attention from geographers. Ganguli (1938) took nine leading crops and calculated indices for measuring agricultural efficiency in Ganges valley. Kendall (1939) considered 10 main crops in 48 countries of England and ranked them according to their yield per acre. Kendall framed the average rank into rank coefficient. Stamp (1960) compared agricultural efficiency of 20 countries in the world considering 9 main crops and their rank coefficient. In India, Shafi (1960) first used the rank coefficient method for determining the efficiency in 48 districts in Uttar Pradesh considering per acre production of 9 food crops. Sengupta and Sdasyuk (1961) included the combination of crops and agricultural efficiency of crops which they considered useful in delineating agricultural regions of India. Sapre and Deshpande (1964) found rank coefficient method less useful and modified the method using weighted average instead of rank average. Tripathy (1970) measured the agricultural efficiency of 13 different crops in 38 *Parganas* (cluster of villages corresponding to a sub-division of a district) of Ganga-Gomti upper plain on the basis of per acre yield.

Bhatia in 1967 developed a method for measuring the agricultural efficiency to avoid many of the methodological shortcomings and measured the efficiency of a unit area corresponding to regional level. Yield ratio of all crops in all units was calculated for measuring of agricultural efficiency of a region with ratio of per acre yield in any unit area with per acre yield of crop in the entire region. Many other scholars have also contributed by developing different methods and techniques to measure agricultural efficiency in different regions (Ozkan, Ceylan and Kizilay 2009; Tchale, 2009; Suresh, 2015; Toma, Dobre, Dona and Cofas, 2015; Syp and Osuch, 2018; Kustysheva, Gayevaya, Petukhova and Buldakova 2018; Roy and Jana, 2019; Sbahi, Ziboon and Hassoon, 2019). However, Bhatia's method continues to be most widely used and also popular and the present study used Bhatia's method to measure agricultural efficiency in Chhattisgarh for its wider applicability.

Study area

Chhattisgarh is the 26th state of India came which was carved out of Madhya Pradesh state extending over 17° 46' to 24° 6'N latitudes and 80° 15' to 84° 24'E longitudes and covering an area of 1,35,194 km^2. The total population of Chhattisgarh is 2, 55, 45,198 as per 2011 Census with a relatively low density of 189 persons per km^2 (382 is country average). The poverty level in the state is relatively high as a very high proportion (43%) of its population consists of the socially and economically deprived communities belonging to scheduled tribes (30.6%) and scheduled caste (12.8%). The scheduled tribe population is largely concentrated in the northern and southern uplands of the state largely underdeveloped as far as agriculture is concerned due to inhospitable terrain conditions and traditional agricultural practices undertaken by the tribal communities. The Mahanadi basin and middle plain areas are characterized by Cuddapah rocks and are far more intensively cultivated. The geological formations have directly influenced the physiography and soil characteristics of the region favouring better agricultural output and yield.

The state is drained by river Mahanadi and its tributaries. Chhattisgarh plain is surrounded by high lands in all four sides. The region receives much needed rainfall from the south-west monsoon. Success or failure of farming is largely determined by the amount of rainfall in the rainy season. Lower part of the Mahanadi basin is characterized by black soil which is the most fertile soil in this region. Laterite soil found in northern as well as southern part of this region has low water holding capacity and hence renders much of the area unsuitable for intensive agriculture. The alluvial plains in the Mahanadi basin are most fertile and have encouraged intensive cultivation of rice. It is due to these soils that the region is known as the *'rice bowl'* of Chhattisgarh.

The agricultural efficiency in Chhatisgarh is largely determined by the nature of the terrain. In the central part of the state lies the gently sloping plain with an average height ranging from 270 to 300 metres. Almost the entire region has red-yellow soils and is covered by rice fields. The lateritic northern and southern upland and ridges favour millet cultivation.

Objectives

The main objectives before the research are a) to measure the spatial differences in agricultural efficiency of various districts in Chhattisgarh, and b) to determine the impact of demographic, social and economic factors in inter-district variation in agricultural efficiency.

Sources of data and methodology

The study is based on agricultural statistics of Chhattisgarh (2015-16). As many as 20 crops accounting for at least one percent of the total cropped area in each district have been selected for measuring the agricultural efficiency. Together these crops account for more than 90 percent of the total cropped area of the state. Bhatia's yield index method has been adopted for measuring the efficiency. Area and production related data for all these crops in 27 districts of the state have been considered for measuring the efficiency. Some crops like groundnut, *til* (sesame), sugarcane, *moong* (*Phaseolus aureus*), *masoor (lens culinaris*), *ragi* (*eleusine coracana*), *sawa* (*eleusine coracana*) are not significant to the cropping pattern in the state but are important in some districts where the area under these crops exceeds one percent.

The selected 20 crops occupy first five ranks in all the 27 districts of Chhattisgarh though their rank does vary in different districts. *Tur* is an exception which is not included within the 5^{th} rank in any district except in Balarampur district where 4.6 percent of the total cropped area is under this crop and holding the sixth rank. This crop however is widely cultivated in all the districts of Chhattisgarh. As many as 11 crops have more than one percent area each in Surguja, Balarampur and Surajpur districts. Kabirdham district has 10 such crops. On the other hand, only two crops have more than one percent area in Janjgir-Champa and Bijapur districts and three such crops have been found in Balodabazar district.

Bhatia (1967) measured the agricultural efficiency as per the following:

$$\mathrm{Ei} = \frac{\mathrm{Iya.ca+Iyb.cb+\cdots Iyn}}{\mathrm{ca+cb+\cdots cn}} \ldots\ldots\ldots \text{(i)}$$

Where Ei = Agricultural efficiency index; Iya.ca+Iyb.cb+……. Iyn = yield indexes of various crops and ca+cb+……..cn = Total area including index

$$\mathrm{Iya} = \frac{Yc}{Yr} * 100 \ldots\ldots\ldots\ldots\ldots \text{(ii)}$$

Where Iya = Yield index of crop a; yc = acre yield of crop a in the component areal unit and yr = acre yield of crop a in the entire region

After measuring the yield index Bhatia measured the weighted yield index for each district. Weighted yield index has been assigned to the percent area of all crops according to their yield index. Index number has been measured for getting the maximum or minimum yield index of any crop in a district in relation to state average. Weighted yield index of all the districts of the state has been calculated by yield index of any district for any crop with weightage of percent of the same crop in the same district. Thus:

Weighted Yield Index = Yield Index of any district of Crop a X% of crop a in the same district

$$\text{Index Number} = \frac{\text{Weighted Yield Index of any district of Crop } a}{\text{State average of Weighted Yield Index of Crop } a} * 100$$

Over 70 percent of the total cropped area of the state is under paddy which is why weighted yield index for only paddy is shown in the study.

Analysis by crops

In agricultural efficiency, weighted yield index depends on yield index and percent of the crop area. Hence agricultural efficiency is high if both yield index and percent of crop area are high in a district. Conversely the efficiency is low if both yield index and percent of crop area are low. The spatial patterns of twenty selected crops are discussed given below.

Rice

Weighted yield index of rice is higher than the state average in Chhattisgarh basin. In contrast, Bastar plateau is placed lower than the state average (Fig. 2). High yield index of rice is seen in areas of fertile soil, plain land and where irrigation facilities are available. The yield index of rice is too low in northern and southern plateau region due to the presence of rugged terrain, infertile soil and less irrigation facility (Fig. 1).

Wheat

The highest weighted yield index (294.1%) of wheat is found in Balarampur district. This crop is not cultivated in tribal dominated areas of Bastar plateau. Index number of more than 200 percent is confined in Deogarh upland. Extremely low index (less than 25%) is found in tribal dominated Bastar plateau. Deogarh upland leads in wheat cultivation and more than 5 percent of total cropped area of Deogarh upland is devoted to the cultivation of this crop.

Gram

The weighted yield index (748.9%) of gram is the highest in Bemetara district and the crop is not at all cultivated in tribal districts of the southern upland. The index is more

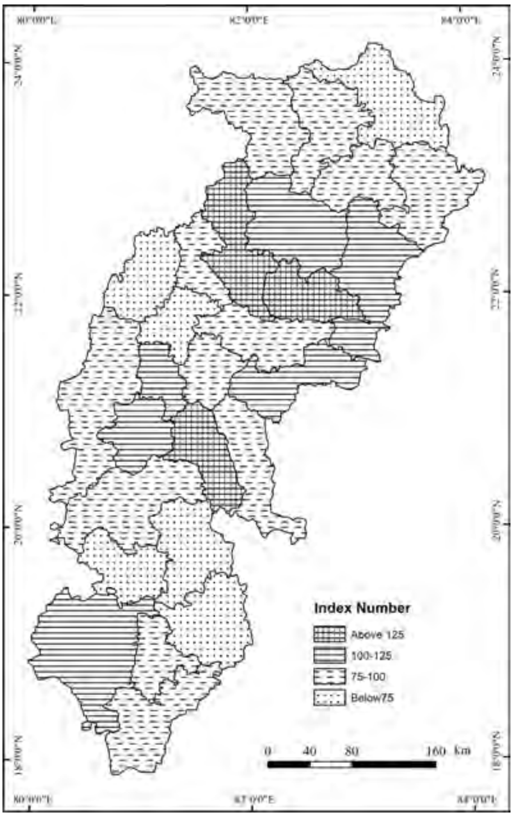

Fig. 1 Chhattisgarh: Area under rice, 2015-16

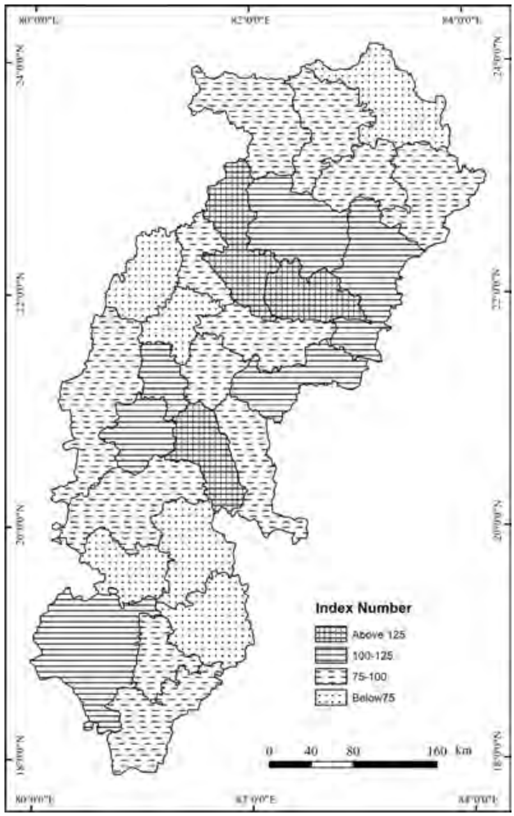

Fig. 2 Chhattisgarh: Weighted yield index of rice (index number), 2015-16

than 200 percent in semi-arid rain shadow areas of the western part of the Maikal range and characterized by *Kanhar* (black) soil carried by the rivers flowing from the range. Significant wheat area is devoted to this crop of above 25 percent in the Mikal range of the western part of the state. The yield index of rice in this area is low but the fertile soil and humidity holding capacity of the soil increases the yield index of gram.

Teora (Chikling wetch)

Spatial pattern of weighted yield index of *teora* is largely similar to rice and gram in Chhattisgarh. Weighted yield index is found above the state's average in the Mahanadi basin and Mikal range. *Teora* crops account for a high share of the total cropped area in Mungeli (30.3%) and Balod district (19.8%). The Bastar plateau is completely devoid of *teora* cultivation.

Maize

The highest weighted yield index of maize is found in upland area of Bastar plateau. In this region, wighted yield index of maize is above 200 percent of the state's average. Cultivation of this crop is much less in the Chhattisgarh plain.

Kodo *(Paspalum scrobiculatum)*

Much like maize, the weighted yield index of *kodo* is high in Bastar plateau. The index is found in Bastar plateau above 200 percent of the state's average. The per cent of *kodo* crop in Bastar plateau is above 20 percent to the total cropped area.

Urad *(Vigna mungo)*

The pattern of weighted yield index of *urad* resembles that of maize and *kodo*. The highest weighted yield index of above 200 percent has been found in Bastar plateau and Jaspur-samri pat region. The highest proportion (5.8%) of *urad* crop is found in Raigarh district.

Soybean

Soybean is limited to only a few districts in Chhattisgarh. Its weighted yield index is above 300 percent in Maikal range of Chhattisgarh state. Remarkably, 14.2 percent of the total cropped area under soybean is found in kabirdham district of Mikal range.

Sugarcane

Like Soybean, the weighted yield index is more than 100 percent compared to state's average in Surguja upland and western Maikal range. Sugarcane cultivated in more than 2 percent of the total cropped area is found in Maikal range and northern Surguja upland.

Tur *(Cojanus cajan)*

Tur is widely cultivated in all the districts of Chhattisgarh next only to rice. The weighted yield index of more than 200 percent has been found in Surguja upland. The crop is mostly cultivated in northern part of Chhattisgarh particularly in Balarampur district accounting for above 4 percent of the cropped area.

Kulthi *(Macrotyloma uniflorum)*

Like maize, *urad* and *kodo*, the weighted yield index of *Kulthi* has been found in Bastar plateau and Surguja upland. The Bastar plateau has weighted yield index of *kulthi* is more than 200 percent compared to regional average. About 5.6 percent of the total cropped area is under *Kulthi* in Narayanpur district.

Ramtil *(Guizotia abyssinica)*

Ramtil is cultivated only in tribal dominated Surguja upland and Bastar Plateau and is completely absent in the plains. The weighted yield index of *ramtil* has been found to be more than 300 percent in Bastar and Surguja uplands. Above 5 percent of the total cropped area comes under *ramtil* crop in Bastar and Surguja uplands.

Mustard

Mustard is extensively cultivated in Chhattisgarh. The weighted yield index is more than 200 percent in Deogarh upland. Above 3 percent area of the cropped area is devoted to this crop in Deogarh upland of Surguja high land.

Groundnut

The weighted yield index of groundnut, more than the state average is found in northern upland which includes the districts of Surguja (407.8), Surajpur (111.4) and Balarampur (111.4). The yield index of groundnut is more than the state average only in Mahasamund district. Percentage area under groundnut is the highest in Surguja (1.9%) and Mahasamund district (1.8 %).

Masoor *(Lens culinaris)*

The weighted yield index of *masoor* is the maximum in Bemetara district (454.1%). This index is more than the state average in Bemetara, Kabirdham, Mungeli, Rajnandgaon and Surguja (270.8%), Balarampur (115.7%), Surajpur (107.0%) of Surguja upland. However around one percent of the cropped area is under this crop in Bemetara (1.1%) and Kabirdham (1.0%) districts.

Til *(Sesame)*

The weighted yield index of *til* is more than the state average in Raipur upland, Raigarh plateau and Surguja upland. High weighted yield index has also been found in tribal dominated areas of southern Chhattisgarh. The highest percent of cropped area under this crop is reported from Sukma and Korba districts (1.7%).

Linseed

The weighted yield index of linseed is more than the state average in the northern part much resembling the pattern of mustard. Weighted yield index is above 150 percent in Durg-Raipur and Deogarh upland while the Chhattisgarh plain reported an index lower than the state average.

Moong *(Vigna radiata)*

The weighted yield index of moong has been confined to rugged terrain areas of Raipur upland. The highest percent of moong area is 2 percent in Gariyabandh district.

Ragi *(Eleusine coracana)*

The weighted yield index of more than 200 percent is found in Bastar upland. The *ragi* crop is not cultivated in Surguja upland. Kondagaon district has 1.8 percent area under this crop which is the highest.

Sowa *(Anethum graveolens)*

The maximum weighted yield index of *sowa* is found in tribal dominated of Bastar Plateau. The index is higher than the state average in Deogarh upland. Dantewada district (2.8%) ranks first in *sowa* cultivation.

Paddy cultivation dominates in all the districts of Chhattisgarh, considered as a low risk crop production which is why agricultural efficiency in Chhattisgarh has been largely influenced by area and yield index of paddy.

Spatial pattern

There is a great deal of variation in the index of agricultural efficiency across the districts of Chhattisgarh ranging from a high of 160 in Janjgir-Champa district to a low of 73.6

in Gariyaband district. Based on the extent of variation, the state has been classified into four agricultural efficiency regions (Fig. 3): regions of high (more than 100), medium (90-100), low (80-90) and very low (Below 80) agricultural efficiency.

High agricultural efficiency

High agricultural efficiency is found in 8 districts of Chhattisgarh included under Seonath basin and characterized by high agricultural yield due to available plain land and low forest cover. Structured by the rocks of Cuddapah series, the region has abundance of black soil deposited by the rivers originating from the Maikal range. Paddy is the most extensively cultivated crop in this basin followed by *teora* while soybean and sugarcane too are largely cultivated in this region. Cultivation of gram and wheat is also undertaken to some extent. Janjgir-Champa district in this region has the highest efficiency with a yield index of rice being 164.4 percent. The yield index and percent of rice are both high in Janjgir-Champa district. Dhamtari district holds the second position in terms of agricultural efficiency and the level of agricultural development in this district is also high. Use of chemical fertilizer, high yield seeds, pesticides, tractor, irrigation facilities, net sown area, percent of area under *rabi* crops, double cropped area, plant conservation, and mechanization as well as irrigation too are more in Chhattisgarh basin. More than 50 percent of the net sown area is irrigated in Chhattisgarh basin. The weighted yield index of gram has been found above 100 percent in western Mikal rang and Durg-Raipur upland. The weighted yield index of *teora* is above the state average in Bilaspur plain and Pendra-lormi plateau.

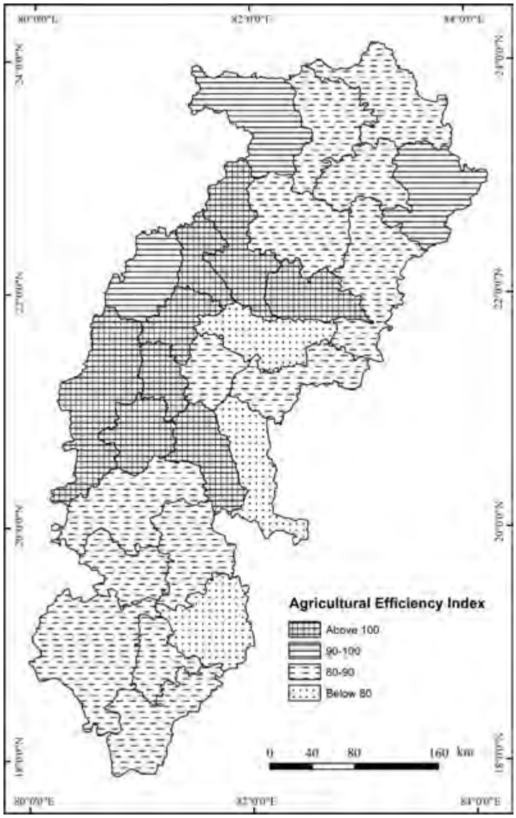

Fig. 3: Chhattisgarh: Agriculture efficiency, 2015-16

Medium agricultural efficiency

Three districts namely Koriya (95), Jashpur (96.6) and Kabirdham (96.9) with agricultural efficiency index varying between 90 and 100 are included under medium agricultural efficiency region. Medium agriculture efficiency regions are Maikal range and Raigarh upland of Chhattisgarh state. This region is characterized by rugged terrain and dense forest cover. Gram, soybean and sugarcane are the main crops in the Mikal range.

The Mikal range of Chhattisgarh state has weighted yield index of gram is more than 500 percent of the state's average. The

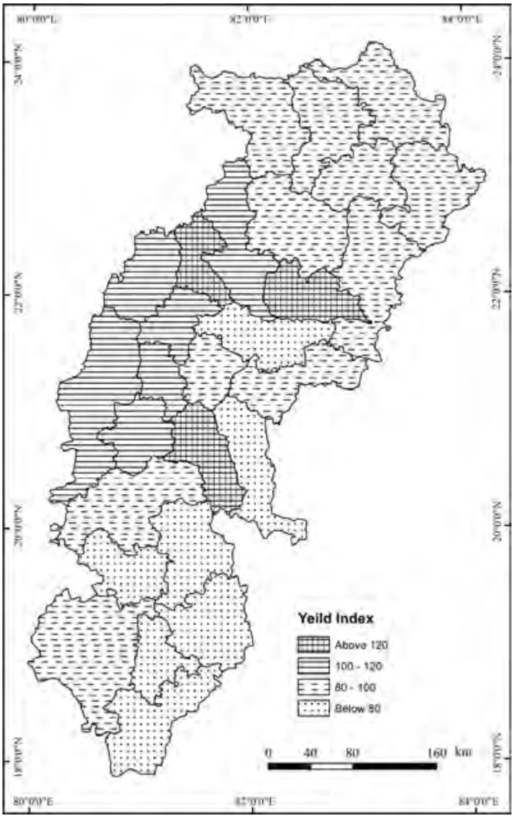

Fig. 4 Chhattisgarh: Yield index of rice, 2015-16

yield index of gram is lower than the state average in Mikal range but area under gram in Maikal range has the largest in the state. The yield index and area under soybean are both highest in the Maikal range. The weighted yield index of wheat and maize is above 200 percent and weighted yield index of *tur* is above 300 percent in Deogarh upland. Similarly, the Raigarh upland has weighted yield index of *urad* above 300 percent and the weighted yield index of Ramtil is above 600 percent.

Low agricultural efficiency

Low agricultural efficiency is far more extensive, spread over 13 districts of Chhattisgarh – 5 in the northern part, six in Bastar plateau (except Bastar district) in southern part and two in Chhattisgarh basin. These areas are generally characterized by little or no irrigation and include Surguja upland which is characterized by multi-crop cultivation. Bastar plateau however lacks crop diversification producing only a single crop, mainly paddy. Double cropping and cultivation during *rabi* season are extremely rare. The unfavourable terrain conditions restrict net sown area to less than 50 percent of the total reporting area which largely contributes to lower efficiency.

The weighted yield index of paddy is more than 100 percent only in five districts of Bijapur, Raipur, Kanker, Korba and Raigarh (Fig. 4). This index for rice is only 57.8 percent in Balarampur district. The weighted yield index of wheat is however more than 200 percent in Surguja upland. For maize, *tur, urad, ramtil,* mustard, *kulthi* and linseed the index is over 200 percent. The weighted yield index of groundnut is 185 percent in Surajpur district. This index is less than 50 percent for gram, *teora* and mustard.

In Chhattisgarh, the yield index of paddy is less than 85 percent has been found in these thirteen districts. The yield index of wheat is low in all these districts. Area under wheat is 3 percent in Deogarh upland of Surguja highland. The yield index of *kodo* is high in the rugged terrain of northern and southern parts. The yield index of *ragi* is high in the districts of northern and southern regions but low agricultural efficiency has been measured in these regions due to less acreage under *ragi*. Similarly, the yield index of *sawa* is high but the acreage is low in Bastar plateau.

The very low yield index of paddy has been found in rugged terrain of the state where

Table 1: Correlation between agriculture efficiency and its determinants

Determinants	r value
Net sown area	+ 0.540
Double cropped area	+ 0.628
Rabi area	+ 0.512
Use of agricultural equipment	+ 0.480
Use of fertilizer	+ 0.483

the yield indexes of millets are relatively high. Thus, the highest paddy area has been found in this region but this region comes under low agricultural efficiency region due to the low yield index.

Very low agricultural efficiency

Very low agriculture efficiency has been found in Raipur upland and eastern part of Bastar plateau with a high proportion of scheduled caste and scheduled tribe population inhabiting these regions. Only three districts namely Bastar, Balodabazar, and Gariyaband had very low agricultural efficiency. The paddy area is above 80 percent in Raipur upland. The weighted yield index of paddy is found below the state average. Weighted yield index of both wheat and *teora* are relatively high as has been found in Raipur upland. The weighted yield indexes of all the crops as well as paddy is low in this upland. The yield indexes of maize, *kodo*, *ragi*, *kulthi* and *urad* are medium in eastern part of Bastar Plateau. The eastern part of Bastar plateau has high yield index for *ramtil*. But the agricultural efficiency is low in the eastern part of Bastar plateau due to the low yield index of paddy. The least concentration of agricultural facilities has been found in eastern part of Bastar plateau due to rugged terrain and dense forest cover. Low yield index of paddy has been noticed in the southern part of Raipur upland due to rugged terrain and infertile soil. The north-eastern part of Raipur upland comes under plain area but the yield index of paddy is too low due to unavailability of irrigation facility and presence of laterite soil.

Significant positive association has been found between agriculture efficiency with net sown area, irrigation, double cropped area, area under *rabi* crops, use of agricultural equipment, and use of fertilizer. Availability of agricultural equipment and use of fertilizer help to increase in crop production.

Conclusion

In Chhattisgarh, paddy is the main crop in northern and southern parts of the state but per unit production of paddy is low due to rugged terrain in these areas. Rabi crops are rarely cultivated in these areas due to unavailability of irrigation. The scheduled tribe population is mostly concentrated in the northern and southern uplands of the state largely underdeveloped as far as agriculture is concerned due to inhospitable terrain conditions and traditional agricultural practices undertaken by the tribal communities. The yield index of paddy largely determines the agricultural efficiency in the state because the area under this crop is overwhelming. Geographical factors like relief, soil and rainfall continue to strongly influence variation in agricultural efficiency.

Agriculture is still less developed in Chhattisgarh and there is much scope to increase efficiency by extending irrigation facilities and encouraging use of fertilizer, modern agricultural implements and improved seeds at low cost particularly in low agricultural efficiency areas and areas that are largely inhabited by the tribal population. The latter needs particular attention as these areas are not suitable to the main crop cultivated but support many alternative crops of high economic value.

References

Bhatia, S. S. (1967). New Measure of Agricultural Efficiency in Uttar Pradesh, India, *Eco. Geog. 43*(3), 224-260.

Buck, J. L. (1956). *Land Utilization in China, Reproduced by the Council of Economic and Cultural Affairs*, New York.

Dutta, S. (2012). Assessment of Agriculture Efficiency and Productivity: A Study of Hugly District, West Bengal, India, *International Journal of Current Research, 4*(11), 190-195.

Ganguli, B. N. (1938). *Trends of Agriculture and Population in the Ganges Valley*, Methuen & Co. Ltd. London.

Government of Chhattisgarh (2016). *Agricultural Statistics 2015-16*, Land Record Office, Raipur.

Kendall, M. G. (1939). The Geographical Distribution of Crop Productivity in England, *Journal of the Royal Statistical Society, 102*(1), 21-62.

Klayman, M. L. (1960). International Index Numbers of Food and Agricultural Production, *FAO, Monthly Bulletin of Agricultural and Statistics, 9*(3), 290-330.

Kostrowicki, J. (1964). Geographical Typology of Agriculture- Principles and Methods, *Geograpia Polonica, 1*,111-146.

Kustysheva, I. N., Gayevaya, E. V., Petukhova, V. S. & Buldakova, O. A. (2018). Efficiency of Land Use for Agriculture, *Revista ESPACIOS, 39* (26), 1-12.

Odhiambo, W. & Nyangito, H. (2003). Measuring and Analysing Agricultural Productivirty in Kenya: A Review of Approaches, *Kenya Institute for Public Policy Research and Analysis*, 26, 1-64.

Ozkan, B., Ceylan, R.F. & Kizilay, H. (2009). A Review of Literature on Productive Efficiency in Agricultural Production, *Journal of Applied Science Research, 5* (7), 796-801.

Roy, S. S. & Jana, N. C. (2019). Agricultural Productivity and Efficiency in Purulia District, West Bengal, *International Journal of Reviews and Research in Social Sciences, 7*(2), 283-292.

Sapre, S. G. & Deshpande, V. D. (1964). Inter District Variations in Agricultural Efficiency in Maharashtra State, *Indian Journal of Agricultural Economics, 19*(1), 222-242.

Sbahi, M. K., Ziboon, A. R. T. & Hassoon, K. I. (2019). Evaluation of the Efficiency of Agricultural Production in the Pivotal Farms Utilizing Remote Sensing Techniques, *Journal of Engineering and Sustainable Development, 23*(4), 86-99.

Sen Gupta, P. and Galina Sdasyuk (1961). Economic Regionalization of India, Problems and Prospects, *Census of India*, 1, 109-116.

Shafi, M. (1960). Measurement of Agriculture Efficiency of Uttar Pradesh, *Eco. Geog., 36*(4), 296-305.

Shafi, M. (1976). Approaches to the Measurement of Agricultural Efficiency-Study in Agricultural Typology in Mishra, V. C., N. P. Ayyer and Pramila Kumar (Eds.), *Essays in Applied Geography*, Manager, University Printing Press, Sagar.

Sinha, B. N. (1968). Agricultural Efficiency in

India, *Geographer, 15*, 101-127.

Stamp, L. D. (1960). *Our Developing World*, Faber and Faber, London.

Subbiah, S. & Ahmad A. (1980). Determinants of Agricultural Productivity in Tamil Nadu, *Trans. Institute Indian Geographers, 2*, 19-31.

Suresh, A. (2015). Efficiency of Agricultural Production in India: An Analysis Using Non-Parametric Approach, *Indian Journal of Agricultural Economics, 70*(4), 471-486.

Swaminathan, M. S. (2009). Drugged Management for Rural Livelihood Security, *The Hindu*, 17th August.

Syp, A. & Osuch, D. (2018). Assessment of Farm Efficiency and Productivity: A Data Analysis Envelopment Approach, *Research for Rural Development, 2*, 146-153.

Tchale, H. (2009). The Efficiency of Smallholder Agriculture in Malawi, *AFJARE, World Bank*, Lilongwe, Malawi, 23(2) 101-121.

Toma, E., Dobre, C., Dona, I. & Cofas, E. (2015). DEA Applicability in Assessment of Agriculture Efficiency on Areas with Similar Geographically Patterns, *Agriculture and Agricultural Science Procedia, 6*, 704-711.

Tripathy, R. R. (1970). *Changing Patten of Agricultural Land Use of Upper Ganga Gomati Doab*, Agra University, Agra.

Anusuiya Baghel*,
Professor,
School of Studies in Geography,
Pt. Ravishankar Shukla University, Raipur

Sk. Nasib Ahamed,
Research Scholar
School of Studies in Geography,
Pt. Ravishankar Shukla University, Raipur

*Author for Correspondence
E-mail: anusuiya_baghel@yahoo.com