



Assessment of efficient cropping zone for Rice and Bajara in Akole Tahsil

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Abstract:

A physiographic and climatic condition determined different efficient cropping zones. The quantity and quality of crop yield can be affected by water stress, heat stress or frost or by pests and diseases. As climate conditions change, efficient cropping zones for the cultivation of specific crops may shift. It is important to understand such changes to farmers, planners, policy makers and land managers for developing adaptation strategies. The objective of the study was to detect village wise crop efficiency in Akole Tahsil in Ahmednagar District. Relative Spread Index (RSI) and Relative Yield Index (RYI) were computed for determination of village wise efficient cropping zone. The present study is based on the village wise data regarding the cropping patterns procured for last twelve years from the Government Offices. This study examined, using records from 2001 to 2012, changes in yield, the area under cultivation, and production efficiency of Rice and Bajara. The map of the village wise efficient cropping zone for Rice and Bajara has been prepared using the different criterion of efficient cropping zone with help of this GIS (Geographical Information system) software. About 16% villages show efficient cropping zone for Rice, but the same villages failed inefficient cropping zone for Bajara.

Keywords: *Efficient Cropping Zone, Geographical Information System, Rice, Bajara*

1 Introduction

Agricultural efficiency depends on natural resources i.e. soil, water, nutrients, minerals, etc. for growth and productivity of crops (Zolekar and Bhagat, 2015). Agricultural efficiency is affected by changes in temperature, precipitation, soil, distribution of infestation pests, insects, diseases or weeds. These elements determine the overall agro-ecological setting for nourishment and crop efficiency. Indian agronomy fate depends on the monsoon (Prasanna, 2014). Rainfall occurring over India during summer monsoon season significantly affects the cropping patterns and agricultural production of the country by providing water for

the two main crop growing seasons, *Kharif* (Summer) and *Rabi* (Winter). Variations in the monsoon rainfall made different efficient and inefficient cropping zones (Krishna Kumar et al. 2004; Prasanna. 2014). Due to the heavy rainfall land in hilly zones are facing different problems like soil erosion, losses of fertile soil, water logging, groundwater depletion, increases in surface runoff, productivity losses, etc. (Barah, 2010, Zolekar and Bhagat, 2014, Deshmukh and Aher, 2016). Consequently, these lands are converted into fallow and barren land and resulted in degraded and highly inefficient cropping zone. Nevertheless, crop efficiency is further narrowed down under influence of several

other forces related to infrastructure facilities, socio-economic factors, technological developments, etc. Several researchers in the field of agriculture have detected efficient cropping zone using Relative Spread Index (RSI) and Relative Yield Index (RYI) (Subrahmaniyan et al. 2005; Kokilavani and Geethalakshmi, 2013; Otung and Akpaet, 2016). Therefore, in the present study, RSI and RYI indices have been computed for all villages for identification of efficient cropping zone.

2 Materials and Methods

2.1 Study Area

Akole Tahsil is located at western part of Ahmednagar District, in the state of Maharashtra (India) (Figure 1). It is well surrounded with the mountains of Sahyadris. Its latitudinal extent is between 19° 15' 14" North to 19° 44' 59" North and longitudinal extent is from 73° 37' 00" East to 74° 07' 24" East. Altitude varies from 1646m to 620m with major peaks i.e. Kalasubai (highest peak in Maharashtra height 1646 m), HarichandraGarh (1424), AjubaDongar (1375m), and KomdaDongar (1030m). The ridge from RatanGarh towards east is water divide between River Mula and Pravara. The Bhandardara dam is constructed on the River Pravara and Ambit dam on the River Mula. Total Villages are 191 with four Revenue Circles i.e. Rajur, Akole, Samsherpur and Kotul. Total Geographical area of Tahsil is 1,505.08 km². Out of them agriculture land is 987.12 km². The climate of the Tahsil is hot and dry. It is except during the south-west monsoon season. The rainfall varies from 470 mm at eastern border to 4937 mm at the western boundary and average rainfall is 508.9mm per year. However, the study area consists of two zones namely the Transition Zone (receiving 500-1200 mm rainfall) and Hilly Zone (receiving 1200-5000 mm rainfall). Except for the study area, the

entire Ahmednagar district falls under drought-prone area.

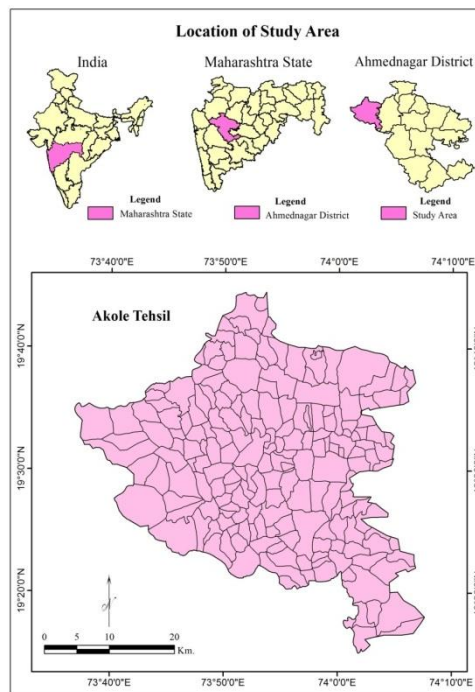


Figure 1. Study area (Akole Tahsil) in Ahmednagar District (M.S.) India

2.2 Methodology

The present study is based on the village wise data regarding the area, yield, production and total cultivable area procured for last twelve years (2000 to 2012) from the Government Offices for 191 villages. These data were used to compute RSI and RYI as suggested by Kanwar (1972) (Formula 1, 2) to identify categories of efficient cropping zones (Table 1). The efficient cropping zone (Table 1) has been taken into account for understanding the areal strength and dominant area of major crops in the study region. Based on the criteria for efficient cropping zone (Table 1), the efficient cropping zone among the different agro-climatic zones and the potential villages for Rice and Bajara crop within each zone were identified. Arc GIS is vector based GIS software useful for compilation, analyses, storage and presentation of spatial analysis. All data required for the

study has been loaded, processed and analysed using Arc Map 10. The map of the village wise efficient cropping zone for Rice and

Bajara(Figure 2) has been prepared using different criterion of efficient cropping zone (Table 1) with help of this GIS software.

$$RSI = \frac{\text{Area of particular crop expressed as \% of total cultivable area in the Village}}{\text{Area of crop expressed as \% to the total cultivable area in theTahsil}} \times 100 \text{ ha NSA} \quad (1)$$

$$RYI = \frac{\text{Mean Yield of a particular crop in a Village (Kg/ha)}}{\text{Mean Yield of the crop in the State (Kg/ha)}} \times 100 \text{ ha NSA} \quad (2)$$

3ResultsandDiscussion

3.1 Efficient Cropping Zone for Rice

In Maharashtra, Rice is the second important crop to people, growing over an area of 14.99 lakh ha with 2.01 t/ha. Rice is a traditional rainfed *Kharif* food crop in the study region, especially in Western site. The average productivity of the study region (1.3 t/ha) is less compared to Maharashtra State. Rainwater resource is a major source of water for *Kharif* crops i.e. Rice in the western part of the Akole Tahsil. The eastern part of the study area is rain shadow areas. The heavy rainfall is observed at the western part of the study region. It means that rainfall is gradually decreases toward rain shadow areas. Therefore, about 16% villages namely, Ambevangun, Ambit, Balthan, Bari, Kumshet, Ladgaon, Pedhewadi, etc. are observed to be the efficient cropping zone for Rice, but the same villages failed inefficient

cropping zone for Bajara (Figure 2). Identification of efficient cropping zones: Data from Table 2 indicates that only two villages i.e. Khirvire and Waranghushi were found to be the most MECZ for rice. Even though about 43% villages shows the highest area under Rice the RYI was low this might be due to the high price of fertilizer, high price of agricultural input, high rent charges of the agricultural machinery, lack of consultancy facilities, lack of finance, etc. Therefore, most of the population in the study region is living below poverty line. Approximately 55% villages fell under Highly-Inefficient cropping zone for Rice and 60% for Bajara where both RSI and RYI values were below 100 per cent. 16 villages come under ECZ, 106 villages under HICZ and two villages under MECZ for Rice.

Table 1. Criterion for Efficient cropping zone

RSI	RYI	Cropping Zone
>100 (High)	>100 (High)	Most Efficient Cropping Zone (MECZ)
>100 (High)	< 100 (Low)	Efficient Cropping Zone (ECZ)
< 100 (Low)	>100 (High)	Not Efficient Cropping Zone (NECZ)
< 100 (Low)	< 100 (Low)	Highly Inefficient Cropping Zone (HICZ)

Table 2. Village wise Efficient Cropping Zone for Rice and Bajara in Akole Tahsil

Village	Rice			Bajara			Village	Rice			Bajara		
	RSI	RYI	Zone	RSI	RYI	Zone		RSI	RYI	Zone	RSI	RYI	Zone
Abitkhind	H	L	ECZ	L	L	HICZ	Gardani	L	L	HICZ	H	H	MECZ
Agar	L	L	HICZ	L	L	HICZ	Garwadi	H	L	ECZ	L	L	HICZ
Agastinagar	L	L	HICZ	H	H	MECZ	Ghatghar	H	L	ECZ	L	L	HICZ
Akole	L	L	HICZ	H	H	MECZ	Ghodsarvadi	L	L	HICZ	H	H	MECZ
Ambad	L	L	HICZ	H	H	MECZ	Ghoti	H	L	ECZ	L	L	HICZ
Ambevangun	H	L	ECZ	L	L	HICZ	Godhewadi	H	L	ECZ	L	L	HICZ
Ambhol	H	L	ECZ	L	L	HICZ	Gondushi	H	L	ECZ	L	L	HICZ
Ambikanagar	L	L	HICZ	H	H	MECZ	Guhire	H	L	ECZ	L	L	HICZ
Ambit	H	L	ECZ	L	L	HICZ	Hivargaon	L	L	HICZ	H	H	MECZ
Aurangpur	L	L	HICZ	L	L	HICZ	Induri	L	L	HICZ	L	L	HICZ
Babhulwandi	H	L	ECZ	L	H	NECZ	Isarthav	H	L	ECZ	L	L	HICZ
Badagi	H	L	ECZ	L	L	HICZ	Jachakwadi	L	L	HICZ	H	L	ECZ
Bahirwadi	L	L	HICZ	H	L	ECZ	Jahagirdarwadi	H	L	ECZ	L	L	HICZ
Balthan	H	L	ECZ	L	L	HICZ	Jambhale	L	L	HICZ	L	L	HICZ
Baravvadi	H	L	ECZ	L	L	HICZ	Jamgaon	L	L	HICZ	L	L	HICZ
Bari	H	L	ECZ	L	L	HICZ	Jayanawadi	H	L	ECZ	L	L	HICZ
Belapur	L	L	HICZ	L	H	NECZ	Kahadi	H	L	ECZ	L	L	HICZ
Bhandardara	H	L	ECZ	L	L	HICZ	Kalambh	L	L	HICZ	L	H	NECZ
Bhojdaravadi	L	L	HICZ	L	L	HICZ	Kalas Bk	L	L	HICZ	H	H	MECZ
Bholewadi	L	L	HICZ	L	L	HICZ	Kalas Kh	L	L	HICZ	H	H	MECZ
Bitaka	L	L	HICZ	L	L	HICZ	kalewadi	L	L	HICZ	H	L	ECZ
Bori	L	L	HICZ	H	L	ECZ	Karandi	L	L	HICZ	L	L	HICZ
Bramhanwada	L	L	HICZ	L	H	NECZ	Katalapur	H	L	ECZ	L	L	HICZ
Chaitanyapur	L	L	HICZ	L	L	HICZ	kauthewadi	H	L	ECZ	L	L	HICZ
Chand Suraj	L	L	HICZ	H	L	ECZ	Keli Kotul	H	L	ECZ	L	L	HICZ
Chandgirwadi	H	L	ECZ	L	L	HICZ	Keli Otur	H	L	ECZ	L	L	HICZ
Chas	L	L	HICZ	H	H	MECZ	Keli Rumhanwadi	L	L	HICZ	H	H	MECZ
Chinchavane	L	L	HICZ	L	H	NECZ	Khadaki bk	L	L	HICZ	L	L	HICZ
Chinchodi	H	L	ECZ	L	L	HICZ	Khadaki Kh	H	L	ECZ	L	L	HICZ
Chitalvedhe	L	L	HICZ	H	H	MECZ	Khanapur	L	L	HICZ	H	H	MECZ
Dagadwadi	H	L	ECZ	H	H	MECZ	Khetewadi	L	L	HICZ	L	L	HICZ
Deogaon	H	L	ECZ	L	L	HICZ	Khirvire	H	H	MECZ	L	L	HICZ
Deothan	L	L	HICZ	H	H	MECZ	Khuntewadi	L	L	HICZ	L	L	HICZ
Dhagewadi	L	L	HICZ	H	H	MECZ	Kodani	H	L	ECZ	L	L	HICZ
Dhamangaon Awari	L	L	HICZ	H	H	MECZ	Kohane	H	L	ECZ	L	L	HICZ
Dhamangaon pat	L	L	HICZ	L	H	NECZ	Kokanwadi	H	L	ECZ	L	L	HICZ
Dhamanvan	H	L	ECZ	L	L	HICZ	Koltembhe	H	L	ECZ	L	L	HICZ

Village	Rice		Zone	Bajara		Zone	Village	Rice		Zone	Bajara		Zone
	RSI	RYI		RSI	RYI			RSI	RYI				
Dhokari	L	L	HICZ	H	L	ECZ	Kombhalne	L	L	HICZ	L	H	NECZ
Dhumalwadi	L	L	HICZ	H	H	MECZ	Kothale	H	L	ECZ	L	L	HICZ
Dighambar	L	L	HICZ	L	L	HICZ	Kotul	L	L	HICZ	L	H	NECZ
Dongargaon	L	L	HICZ	H	H	MECZ	Kulungan	H	L	ECZ	L	L	HICZ
Dongarwadi	H	L	ECZ	H	L	ECZ	Kumbhephal	L	L	HICZ	H	H	MECZ
Ekdare	H	L	ECZ	L	L	HICZ	Kumshet	H	L	ECZ	L	L	HICZ
Ganore	L	L	HICZ	H	H	MECZ	Ladgaon	H	L	ECZ	L	L	HICZ
Lahit Bk	L	L	HICZ	H	H	MECZ	Pisewadi	L	L	HICZ	H	L	ECZ
Lahit Kh	L	L	HICZ	H	H	MECZ	Poprewadi	L	L	HICZ	L	L	HICZ
Lavhali Kotul	H	L	ECZ	L	L	HICZ	Purushwadi	L	L	HICZ	L	L	HICZ
Lavhali Otur	H	L	ECZ	L	L	HICZ	Rajur	L	L	HICZ	L	L	HICZ
Lingadeo	L	L	HICZ	H	H	MECZ	Ranad Bk	H	L	ECZ	L	L	HICZ
Mahadev wadi	H	L	ECZ	L	L	HICZ	ranad Kh	H	L	ECZ	L	L	HICZ
Malgaon	H	L	ECZ	L	L	HICZ	Ratanwadi	H	L	ECZ	L	L	HICZ
Manhere	H	L	ECZ	L	L	HICZ	Rede	L	L	HICZ	H	L	ECZ
Manikozar	L	L	HICZ	L	L	HICZ	Rumbhodi	L	L	HICZ	L	H	NECZ
Manoharpur	L	L	HICZ	H	H	MECZ	Sakirwadi	H	L	ECZ	L	L	HICZ
Manyale	L	L	HICZ	L	H	NECZ	Samrad	H	L	ECZ	L	L	HICZ
Maveshi	H	L	ECZ	L	L	HICZ	Samsherpur	L	L	HICZ	H	H	MECZ
Mehenduri	L	L	HICZ	L	L	HICZ	Sangvi	L	L	HICZ	H	H	MECZ
Mahaladevi	L	L	HICZ	H	L	ECZ	Sarovarwadi	H	L	ECZ	L	L	HICZ
Mhalungi	L	L	HICZ	L	L	HICZ	Satewadi	L	L	HICZ	L	L	HICZ
Mogras	L	L	HICZ	L	H	NECZ	Savargaon Pat	L	L	HICZ	L	L	HICZ
Morwadi	L	L	HICZ	L	L	HICZ	Savarkute	H	L	ECZ	L	L	HICZ
Murshet	H	L	ECZ	L	L	HICZ	Shail vihir	H	L	ECZ	L	L	HICZ
Muthalne	L	L	HICZ	H	H	MECZ	Shairankhel	L	L	HICZ	L	H	NECZ
Mutkhel	L	L	HICZ	L	L	HICZ	Shelad	H	L	ECZ	L	H	NECZ
Nachanthav	L	L	HICZ	L	L	HICZ	Shendi	H	L	ECZ	L	L	HICZ
Nagwadi	L	L	HICZ	H	H	MECZ	Shenit Bk	H	L	ECZ	L	L	HICZ
Nawalewadi	L	L	HICZ	H	L	ECZ	Shenit Kh	H	L	ECZ	L	L	HICZ
Nilwande	L	L	HICZ	H	L	ECZ	Sherevadi	L	L	HICZ	H	L	ECZ
Nimbral	L	L	HICZ	H	L	ECZ	Shidwad	L	L	HICZ	H	H	MECZ
Nirgudwadi	L	L	HICZ	H	L	ECZ	Shiganwadi	H	L	ECZ	L	L	HICZ
Pabhulwandi	H	L	ECZ	L	L	HICZ	Shilwandi	H	L	ECZ	L	L	HICZ
Pachnai	L	L	HICZ	L	L	HICZ	Shinde	H	L	ECZ	L	L	HICZ
Pachpatawadi	H	L	ECZ	L	L	HICZ	Shirpunje Bk	H	L	ECZ	L	L	HICZ
Padalne	L	L	HICZ	H	H	MECZ	Shirpunje Kh.	H	L	ECZ	L	L	HICZ
Padoshi	H	L	ECZ	L	L	HICZ	Shiswad	H	L	ECZ	L	L	HICZ

Village	Rice		Zone	Bajara		Zone	Village	Rice		Zone	Bajara		Zone
	RSI	RYI		RSI	RYI			RSI	RYI				
Paithan	H	L	ECZ	L	L	HICZ	Shivajinagar	H	L	ECZ	L	L	HICZ
Palsunde	L	L	ECZ	L	L	HICZ	Somalwadi	H	L	ECZ	L	L	HICZ
Pangari	L	L	HICZ	H	H	MECZ	Sugaon Kh	L	L	HICZ	H	H	MECZ
Panjare	H	L	ECZ	L	L	HICZ	Sugaon Bk.	L	L	HICZ	L	L	HICZ
Parakhatpur	L	L	HICZ	H	L	ECZ	Sultanpur	L	L	HICZ	H	H	MECZ
Pedhevadi	H	L	ECZ	L	L	HICZ	Takahari	L	L	HICZ	H	H	MECZ
Pendhshet	H	L	ECZ	L	L	HICZ	Takali	L	L	HICZ	H	H	MECZ
Phopsandi	L	L	HICZ	L	L	HICZ	Tale	H	L	ECZ	L	L	HICZ
Pimpaldarawadi	H	L	ECZ	L	L	HICZ	Tambhol	L	L	HICZ	H	H	MECZ
Pimpaldari	L	L	HICZ	H	H	MECZ	Terunghun	H	L	ECZ	L	L	HICZ
Pimpalgaon Khand	L	L	HICZ	H	H	MECZ	Thakarwadi	L	L	HICZ	H	H	MECZ
Pimpalgaon Nakvinda	H	L	ECZ	H	H	MECZ	Tirdhe	H	L	ECZ	L	L	HICZ
Pimpalgaon Nipani	L	L	HICZ	H	H	MECZ	Titavi	L	L	HICZ	L	L	HICZ
Pimpari	L	L	HICZ	L	L	HICZ	Uddavane	H	L	ECZ	L	L	HICZ
Pimparkane	H	L	ECZ	L	H	NECZ	Umbarewadi	L	L	HICZ	L	L	HICZ
Unchakhadak Bk	L	L	HICZ	L	L	HICZ	Waghapur	L	L	HICZ	H	H	MECZ
Unchkhadak Kh	L	L	HICZ	H	H	MECZ	Waghdari	H	L	HICZ	L	L	HICZ
Vashere	L	L	HICZ	H	H	MECZ	Waki	H	L	HICZ	L	L	HICZ
Vihir	H	L	ECZ	L	L	HICZ	Walunjshet	H	L	HICZ	L	L	HICZ
Virgaon	L	L	HICZ	H	H	MECZ	Waranghushi	H	H	MECZ	L	L	HICZ
Vithe	L	L	HICZ	L	L	HICZ							

3.2 Efficient Cropping Zone for Bajara

About 16% of NSA is under *Kharif* Bajara. It requires moderate soil moisture in growing period and less in the mature stage. Most of the area of MECZ and ECZ under Bajara is observed in the villages i.e. Dhagewadi, Dhamangaon, Sugaon, Tahakari, Takali, Shidwa, Pimpalgaon, Nakvinda, Pimpalgaon Khand, etc. with gentle slopes, deep soils, rain shadow area, etc. (Table 2; Figure 2). Even though 8% villages show the highest area under Bajara, the RYI was low this might be due to inefficient use of water resources. About 60% villages fail under highly-inefficient and 7 % villages shows NECZ for Bajara due to heavy rainfall zone.

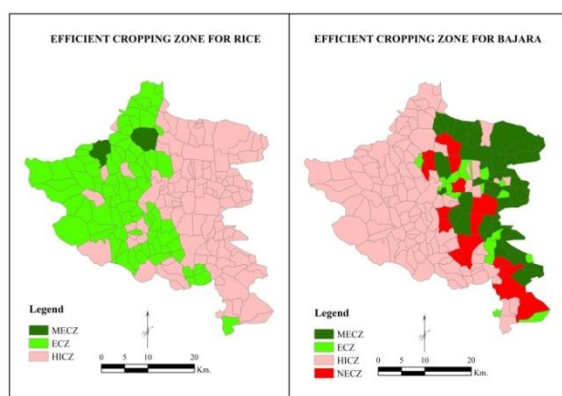


Figure 2. Efficient Cropping Zone for Rice and Bajara in Akole Tahsil

4. Conclusion and Future Scope

The crop yield index for Rice and Bajara shows a strong relationship with monsoon rainfall intensity. *Kharif* is the main crop growing season in study region. Foodgrain yield during *Kharif* season is directly affected by rainfall variation. Rice is dominant crop in *Kharif* season observed in western site and Bajara is staple food in some of the villages in Eastern part of the region. Steep slopes, coarse soils, less fertility, heavy soil erosion, heavy irregular rainfall, poor human power,

inadequate financial supply, etc. observed problems of agriculture in the region. Efficient cropping zone for Rice are found in heavy rainfall zone but the same area fails for Bajara. The productivity of all crops in the region is observed less than developed areas.

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