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Analysis of Growth in Area, Production and Yield of Rainfed Paddy in Shivamogga District of Karnataka

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Abstract

Rice is the most important staple food of the country and consumed by about 65 per cent of the population. The present analysis was undertaken to estimate the growth and instability patterns of area, production and productivity of rainfed paddy for the period spanning from 2011 to 2020, factors affecting in non-adoption of rainfed paddy and production as well as marketing constraints faced by paddy growers in Shivamogga district of Karnataka during 2020-2021. Methodology used as Compound Annual Growth Rate (CAGR), Cuddy Della Vella Index and garret's ranking. Findings showed negative, non-significant compound growth rates for rainfed paddy area (1.64) and production (0.95). However, productivity exhibited positive growth (non-significant). Medium stability for area (32.20), production (28.80) and higher stability for productivity (7.33) characterized rainfed paddy, influenced by farmer shifts to crops like arecanut and maize. Chief obstacles to rainfed paddy adoption were late monsoon onset (62.25%), followed by early withdrawal, weed infestation, water control, yield concerns and traditional farmer mindsets. The major production and marketing constraint faced by farmers were identified by using Garrett's ranking methodology on bases of severity. The key production challenges were insect and pest damage (80.00%), low yield (67.00%), labour scarcity and erratic weather (41.86%). Hindrances encompassed delayed inputs, cultivation costs, credit shortages, and marketing issues: price fluctuation (79.00%), high commissions (66.00%), storage inadequacy (50.00%), market unawareness, transportation costs and subpar quality. So to boost awareness and income for rainfed paddy growers, the government should promote traditional practices *via* financial aid, subsidies and credit support for rainfed paddy farmers. Addressing market challenges, including fluctuating prices and storage insufficiencies, is crucial for sustained progress in rainfed paddy cultivation.

Keywords : Compound annual growth rate, Cuddy della vella index, Instability index, Rainfed paddy, Garrett's ranking

Paddy, the extensively cultivated and vital food crop worldwide, holds significant importance as the staple food for over 60 per cent of the global population (Singh and Singh, 2020). Rice, predominantly grown and consumed in the Asian region, particularly thrives in India, which boasts the largest paddy cultivation area globally. Although China leads in rice production, India follows closely as the second-largest producer and has also emerged as a significant consumer of rice. The cultivation of paddy in India dates back to ancient times. According to experts like De Candolle and Watt, South India is believed to be the birthplace of cultivated paddy, while Vavilov suggests that India and Burma should be recognized as the primary centers of origin for cultivated paddy.

In 2021, China led global paddy production, making up nearly 30 per cent of the total output, as per FAO data. India closely trailed with a 24 per cent share,

while Bangladesh contributed 7 per cent. Indonesia, Vietnam and Thailand produced seven per cent, five per cent and four per cent, respectively. India, in the same year, accomplished a yearly paddy production potential of 117.47 million tonnes.

Paddy holds a position of prominence in India as the primary crop, serving as the staple food for people residing in the eastern and southern regions of the country. In the 2020-2021 period, India achieved a record high in rice production, reaching 116.42 million tonnes. This marked an increase of 3.66 million tonnes compared to the previous year and an impressive surplus of 8.62 million tonnes compared to the average production over the previous five years, which stood at 107.80 million tonnes. Among the states in India, Karnataka stands out as a major contributor to rice cultivation. During the 2017-18 period, Karnataka cultivated rice on an expansive area of 1.32 million hectares, resulting in an annual production of 3.5 million tonnes. (FAO, 2021)

Importance of Study

Rice is one of major crops grown and consumed in rainfed areas and rainfed cultivation accounts for about 25 per cent of rice production (Kumar, 2019). Due to its dependence on climate rainfed rice cultivation is less vulnerable to changes in temperature and rainfall. Rainfed paddy cultivation requires less cost of production compared to irrigated paddy cultivation, so even poor farmer can take up rainfed cultivation and also it has been reported that cultivation of paddy with continues irrigation destroy the soil structure. The present study focuses on analysis of area production and productivity rainfed paddy and production and marketing constraints faced by rainfed paddy growers. As Shivamogga district comes under Southern Transition Agro-climate Zone in Karnataka which receive average annual rainfall 1813 mm. In this area farmers prefer to take up rainfed paddy cultivation because as this area receives more rain fall and also paddy crop requires more water for cultivation so to encourage farmers in order to save local cultivars and to increase area under rainfed cultivation as area under rainfed cultivation decreasing year after year that is from last 10 years area under paddy declined from 15 lakh ha to 12 lakh ha. Rice is high water demanding crop and today's world sustainability and intergenerational equity is given huge importance both nationally and internationally, merely by cultivating irrigated rice using borewell or canal irrigation is not at all sufficient in today's world, we have to look at other options, if we continue to do so, water the most scarce resource on earth will be exhausted, myopic use and extraction of water is not the answer and thus, the study was conducted with the following objectives :

Objective

1. To analyze the growth in area, production and productivity of rainfed paddy in Shivamogga district.
2. To analyze the production and marketing constraints of rainfed paddy.
3. To evaluate reasons for non-adoption of rainfed paddy in study area.

METHODOLOGY

Study Area : The study was conducted in Shivamogga district OF Karnataka, where a purposive selection method was utilized to choose two villages from each of the Shikaripura and Soraba taluks because as in Shivamogga district, paddy farmers grow paddy in both irrigated and rainfed method. Subsequently, 15 farmers were purposively selected from each village, specifically Chikkajambur, Hirejambur, Andige, and Ulavi, resulting in a total sample size of 60 rainfed paddy growers.

Primary Data : Data regarding reasons for non- adoption of rainfed paddy (late onset of monsoon, early withdrawal of monsoon, heavy weed infestation, lack of water control, yield concern and conventional mind set of farmers), production constraints (damages due to insects and pests, low yield, labour shortage, aberrant weather conditions, lack of timely availability of inputs and high cost of cultivation and lack of availability of credit) and marketing constraints (price fluctuation, high commission charges, lack of scientific storage structure, lack of awareness about

market information, market news and inadequate and high cost of transportation and poor quality) of rainfed paddy collected using a pre-tested schedule by personal interview method during the 2020-2021 from study area.

Secondary Data : The information regarding the area, production, and yield of rainfed paddy was sourced from the Annual Report publications of the Department of Agriculture, Shivamogga, for the year 2020-2021.

Sample Size : Purposive sampling method used to select only rainfed paddy farmers from taluks within the district, namely Shikaripura and Soraba in that two villages were selected from each taluk, resulting in a total of four surveyed villages. The villages included in the survey were Chikkajambur, Hirejambur, Andige and Ulavi. Within each village, 15 farmers were chosen as respondents for the survey which make total of 60 respondents from study area.

Analytical Tools and Techniques

Compound Annual Growth Rate : Compound annual growth rates were estimated to study the percentage increase or decrease in the selected parameter. The following exponential type of function was used (Anjaneyalu, 2015).

$$Y = ab^te$$

Where, Y = Dependent variable for which growth was estimated *i.e.,* area (ha), production (tonnes) and productivity (tonne/ha).

a = Intercept or constant

b = Regression/trend coefficient

t = Periods in years (1, 2, 3…n)

e = Error terms

Instability Analyses : Instability in area, production, productivity of rainfed paddy as examined by using two different measures of instability such as Coefficient of Variation and Cuddy-Della Valle Index (Gairhe *et al.*, 2019).

Coefficient of Variation : Although Coefficient of Variation (C.V) is the simplest measure of instability, it over-estimates the level of instability in time series data which are characterized by long-term trends. CV can be calculated as follows:

(C.V) = (Standard Deviation /Mean)* 100

Instability Index : Cuddy-Della Valle Index The instability in area, production and productivity of rainfed paddy was examined by using the Cuddy-Della Valle Index. The Cuddy-Della Valle Index corrects the coefficient of variation in long term trend. (Cuddy and Della, 1978).

The Cuddy Della Valle Index de-trends shows the exact direction of the instability. Therefore, it is a better measure to capture instability in agricultural production. A low value of this index indicates low instability in area, production, productivity and vice-versa. (Kumar *et al*., 2002).

The Cuddy-Della Valle Index corrects the CV as:

Cuddy - Della Valle Instability Index (per cent) = $CV\sqrt{(1-R^2)}$

Where,

C.V. was the Coefficient of Variation in per cent and R2 was the coefficient of determination from a time trend regression adjusted for its degrees of freedom.

The ranges of CDVI are given as follows :

- Low instability = 0 to 15
- Medium instability = 15 to 30
- High instability = 30 and above

Garrett's Ranking Technique : Garrett's ranking technique was used to find out the most significant factor which influences the respondents. To analyze the problems faced by farmers in production and marketing of rainfed paddy, Garrett's ranking technique was used. According to this, respondents

have been asked to assign the rank for all factors and the outcome of such ranking has been converted into score value with the help of the following formula:

$$\text{Per cent position} = \frac{100\,(R_{ij} - 0.5)}{N_j}$$

Where R_{ij} = Rank given for i^{th} item by j^{th} individual

N_j = Number of items ranked by j^{th} individual

The per cent position of each rank was converted in to scores by referring to Garrett table. Then for each factor, the scores of individual respondents were summed up and divided by the total number of respondents for whom scores were gathered. The mean scores for all the factors were ranked following the decision criteria that higher the value, more important is the constraint or most important reason for the beneficiaries. (Garrett and Woodworth, 1969)

Results and Discussion

Area, Production and Productivity of Rainfed Paddy in Shivamogga District of Karnataka

An exponential function was utilized to project the growth in area, production and productivity of rainfed paddy in Shivamogga district over a span of 10 years, from 2011 to 2021. The compound growth rates for area and production were calculated as negative with values of 1.64 and 0.95, respectively, and were found to be non-significant. However, productivity exhibited a positive growth rate of 0.7, also deemed non-significant according to Table 1. The mean, standard deviation and coefficient of variation for area (mean:36,743.20, SD:10,040.518, CV:27.326, production (mean:583.15, SD:159.33, CV:27.323) and productivity (mean:15.86, SD:1.116, CV:7.035) are presented in Table 1 (Soujanya *et al*., 2023).

Based on the findings presented in Table 2, it can be inferred that the area under cultivation exhibited

Table 1

Growth rate area of rainfed paddy in rainfed paddy in Shivamogga district of Karnataka

Years	Area (ha)	Production ('000q)	Productivity (q/ha)
2011-12	36586	606.60	16.58
2012-13	35458	548.18	15.46
2013-14	33870	486.37	14.36
2014-15	35793	592.02	16.54
2015-16	64166	986.87	15.38
2016-17	28486	395.67	13.89
2017-18	37272	642.20	17.23
2018-19	30036	472.77	15.74
2019-20	32106	524.61	16.34
2020-2021	33659	576.24	17.12
Mean	36743.20	583.15	15.86
Standard Deviation	10040.518	159.33	1.116
Coefficient of Variation	27.326	27.323	7.035
CAGR (per cent)	-1.64	-0.95	0.70
P value	0.525803 NS	0.835367 NS	0.172062 NS

Note : NS = Non-significant

Source : Annual report, Department of Agriculture, Shivamogga, 2020-2021

TABLE 2
Instability index of area, production and productivity of rainfed paddy in Shivamogga district from 2011-2021

Particulars	Instability index
Area	32.2
Production	28.80
Productivity	7.33

high instability (32.2), while production showed a moderate level of instability (28.80) and productivity demonstrated a high degree of stability (7.33). (Prakash and Venkataramana, 2023).

Fig. 1 and 2 depict the trend in area and production of rainfed paddy from 2011-12 to 2020-21, revealing a downward trajectory over the years. This decline can be attributed to farmers shifting their focus from rainfed paddy cultivation to other competing crops such as maize and arecanut. However, there was a notable surge in both area and production during the 2015-2016 period, attributed to favourable rainfall conditions. A similar investigation conducted by Rather (2014) examined the trends in area, production and productivity of paddy cultivation in Jammu and Kashmir.

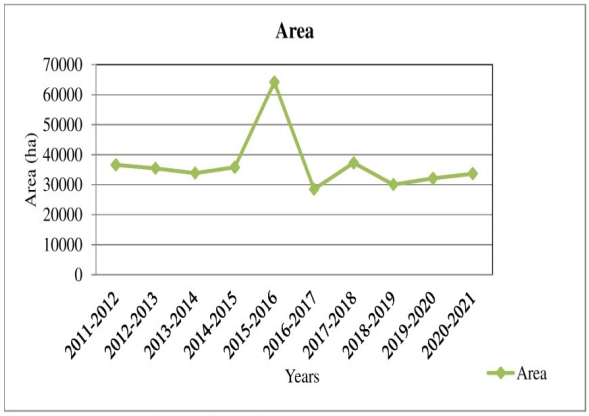

Fig. 1 : Area under rainfed paddy in Shivamogga district

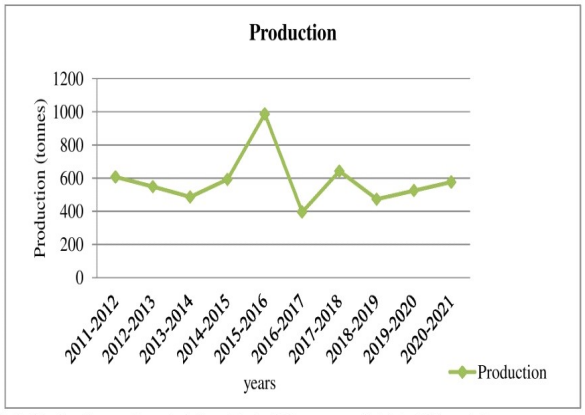

Fig. 2 : Production of rainfed paddy in Shivamogga district

Fig. 3, presents the fluctuating trend in productivity of rainfed paddy spanning from 2011-112 to 2020-21. This variability can be attributed to farmers adopting high-yielding varieties along with recommended agricultural practices, including the use of green manure crops. (Ganjeer *et al*., 2018).

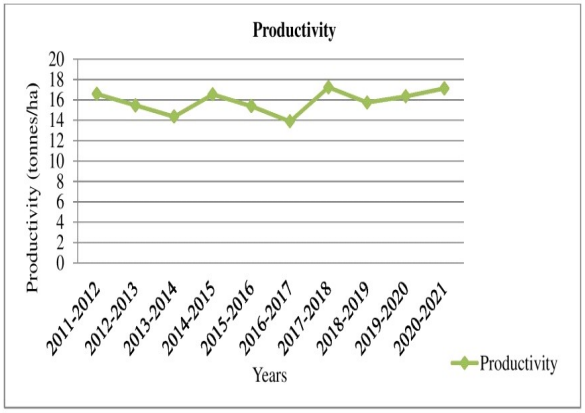

Fig. 3 : Productivity of rainfed paddy in Shivamogga district

Reasons for Non-Adoption of Rainfed Paddy in Study Area

The reasons for non-adoption of rainfed paddy cultivation by sample farmers is recorded in Fig. 4 Late onset of monsoon, early withdrawal of monsoon, heavy weed infestation, lack of water control, yield concern and conventional mind set of farmers was major reasons for non-adoption of rainfed paddy in lowland area of Shivamogga district despite being an area highly suitable for rainfed paddy cultivation. Among these reasons, the most prominent factor is the late onset of the monsoon season (62.25), followed by early withdrawal of the monsoon (50.64), heavy weed infestation (46.23), lack of water control (35.47), yield concerns (25.96) and the conventional mindset of farmers (20.74).

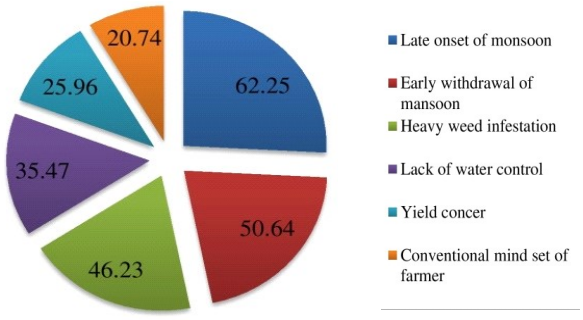

Fig. 4 : Factor influencing in non-adoption of rainfed paddy in study area

Constraints Faced by Sample Respondents in Production and Marketing of Rainfed Paddy in Shivamogga District

The constraints experienced by farmers in cultivation of rainfed paddy are detailed in the Table 3. The major production constraint faced by farmers was insects and pests damage (80.00%) fallowed by low yield (67.00%), labour shortage (60.00%), aberrant weather conditions (41.86%). However problems like lack of timely availability of inputs (20.70%), high cost of cultivation (12.08%), lack of availability of credit (9.80%) and lack of access to capital were reported by respondents. (Ouma and De, 2011)

In addition to, production constraints, marketing constrain elicited in the Table 4. Price fluctuation (79.00%), high commission charges (66.00%), lack of scientific storage structure (50.00%), lack of awareness about market information and market news (45.33%), inadequate and high cost of transportation (28.50%) and poor qualities (26.66%) were ranked I, II, III, IV, V and VI, respectively, as marketing constraints in rainfed paddy cultivation. Farmers also face challenges such as a lack of training and extension programmes to help them improve their farming practices, as well as lack of demonstration plots in the village from which they acquire profit. (Kumar *et al*., 2015)

Growth rate of area and production of rainfed paddy was negative and less stable and productivity has shown a positive growth rate and stability. The major factor that effect on non-adoption of rain fed paddy was late onset of monsoon in study area. The major production and marketing constrains were based on severity were damages due to insects and pests and price fluctuation, respectively. This indicates that farmers in the Shivamogga district have been able to enhance their paddy yield through improved farming techniques, technological advancements or other interventions, compensating for the decrease in cultivated land and overall production along with have to enhance the marketing facilities for paddy.

The analysis reveals stagnation in rainfed paddy cultivation in Shivamogga district, influenced by various production and marketing constraints. Policy recommendations should focus on promoting traditional practices, enhancing infrastructure, and stabilizing markets to sustain and improve rainfed paddy cultivation.

Policy Recommendation : Government interventions should prioritize financial support (Subsidies & Schemes), infrastructure development and market stabilization measures to address production and

TABLE 3

Production constraints faced by respondents in cultivation of rainfed paddy

Particulars	Garret score	Garret Rank
Damages due to Insects and pests	80.00	I
Low yield	67.00	II
Labour shortage	60.00	III
Aberrant weather conditions	41.86	IV
Lack of timely availability of inputs	20.70	V
High cost of cultivation	12.08	VI
Lack of availability of credit	9.80	VII

TABLE 4

Marketing constraints faced by respondents in cultivation rainfed paddy

Particulars	Garret score	Garret Rank
Price fluctuation	79.00	I
High commission charges	66.00	II
Lack of scientific storage structure	50.00	III
Lack of awareness about market information and market news	45.33	IV
Inadequate and high cost of transportation	28.50	V
Poor quality	26.66	VI

marketing challenges, ensuring sustained growth and income for rainfed paddy farmers in Shivamogga district.

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