

## Growth, Instability and Total Factor Productivity of Ragi (Finger Millet) in Karnataka

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### ABSTRACT

The study was undertaken to analyze the growth, instability and total factor productivity (TFP) of ragi in Karnataka. The required data was obtained from the Directorate of Economics and Statistics, Ministry of Agriculture, Karnataka from 1984-85 to 2013-14. Exponential growth model was used to compute growth rates, Thornqvist Theil index was used to calculate total factor productivity and Regression analysis was used to decompose the factors influencing TFP growth. The results revealed that, the structural break for production and productivity in 1993-94 and 1991-92 coincides with liberalization and the release of MR-1 variety. Hence, these break periods were taken as base to compute the growth rates. The results of growth rate indicated that, there was decrease in production of ragi in Karnataka and India and it was mainly due to decrease in area, though there was a significant growth in productivity during overall period (1984-85 to 2013-14) due to introduction of drought resistant and high yielding varieties. In Karnataka ragi production exhibited higher degree of instability in period II (1994-95 to 2013-14). The results of TFP indicated that, the average TFP index for 25 years was 1.30. Public research has significantly contributed to TFP growth in ragi. Hence there is a need for more technological breakthrough to enhance the production.

RAGI (*Eleusine coracana*) (Finger millet) is a widely cultivated crop of the tropical and subtropical regions of the world. In India, ragi is one of the important cereals which occupies the highest area under cultivation among the small millets. Ragi was cultivated over an area of 1.19 million hectares with a production of 1.98 million tonnes with an average productivity of 1661 kg per ha. Karnataka (56.21 %), Maharashtra (10.56 %), Tamil Nadu (9.94 %), Uttarakhand (9.40 %), Orissa (4.74 %) and Andhra Pradesh (3.69 %) are the major ragi growing states with respect to per cent share of area in India. Karnataka is the largest producer (59.52 %) of ragi in the country and main staple food consumed by majority of the population in South Karnataka (www.indiastat.com, 2013-14). In Karnataka, Tumakuru district accounts for larger area (22.7 %) and production (18.6 %) of ragi followed by Hassan and Ramanagara districts (www.eands.dacnet.nic.in).

Ragi is gaining importance in recent years due to its medicinal and nutritive value. The value addition brings more returns to the farmers and enhances nutritional status of their family members. Ragi is mainly consumed as mudde (dumpling), dosa, roti,

vermicelli and value added products like biscuits, malt and mixture in Southern states of India. However, there appear to be deceleration of area though several improved ragi varieties are evolved over time. In this context, the present study has been taken up to analyze the growth, instability and total factor productivity of ragi in Karnataka.

*Growth in area, production and productivity of ragi:* Growth in area, production and productivity of ragi was estimated by using the exponential function. Bai-Perron test (Bai and Perron, 2003) was used to find out the structural break in the area, production and productivity of ragi during 1984-85 to 2013-14. Structural break appears in the data when there is abrupt shift in the data there by helping us to know when there is a significant change in the data.

In case of area, production and productivity of ragi in India the study period (1984-85 to 2013-14) was divided into two sub periods based on the breaks, viz, area - I (1984-85 to 1993-94) and II (1994-95 to 2013-14) period this break coincided with liberalization; The liberalization might have contributed for the decrease in area under ragi due to shift in area from ragi to

maize. For production - period I (1984-85 to 2001-02) and period II (2002-03 to 2013-14) and for productivity period I (1984-85 to 1990-91) and period II (1991-92 to 2013-14) were considered in Karnataka.

These structural breaks coincide with the release of MR-1 variety (1990) which contributed for significant increase in yield and the economic liberalization and drought situation prevailed in the state as well as in the country.

*Growth rates for area, production and productivity of ragi in Karnataka and India ;* The compound growth rates (CGR) were calculated for Karnataka and India. The results revealed that, the growth rates of area for period I (1984-85 to 2005-06) and overall period (1984-85 to 2013-14) for Karnataka

were found to be significant and negative (1.20 and 1.81 % respectively) (Table I). For the overall period, area under ragi for Karnataka (-1.81 %) was declining at a slower rate compared to India (-2.59 %). With respect to production of ragi in Karnataka, there was a significant and positive growth during period I (1.64 %) and for India, during overall period the growth was found to be significant and negative (1.27 %).

The analysis revealed that, the growth in productivity of ragi during overall period for both Karnataka (1.60 %) as well as India (1.38 %) indicated a positive and significant growth. Though there was deceleration both in area and production there was significant growth in productivity during overall period due to introduction of drought resistant and high yielding varieties.

TABLE I

*Growth in area, production and productivity of ragi in Karnataka and India*

Year Karnataka	CGR (%) Area (000 ha)	Year India	CGR (%)
I (1984-85 to 2005-06)	-1.199***	I (1984-85 to 1993-94)	-2.695***
II (2006-07 to 2013-14)	-1.387	II (1994-95 to 2013-14)	-2.442***
Overall (1984-85 to 2013-14)	-1.811***	Overall (1984-85 to 2013-14)	-2.594***
Production (000 tonne)			
I (1984-85 to 1993-94)	1.642***	I (1984-85 to 2001-02)	-0.327
II (1994-95 to 2013-14)	1.058	II (2002-03 to 2013-14)	0.453
Overall period(1984-85 to 2013-14)	-0.238	Overall period (1984-85 to 2013-14)	-1.274***
Productivity (kg/ha)			
I (1984-85 to 1991-92)	0.236	I (1984-85 to 1990-91)	0.746
II (1992-93 to 2013-14)	0.930	II (1991-92 to 2013-14)	0.922**
Overall period(1984-85 to 2013-14)	1.602***	Overall period (1984-85 to 2013-14)	1.379***

Note: \*\*\*, \*\* indicates Significant at 1, 5 per cent, respectively

### District wise growth in area, production and productivity of ragi in Karnataka

For the ragi growing districts of Karnataka, the compound growth rates were worked out for 30 years (1984-85 to 2013-14) and the same was worked out for 15 years (1998-99 to 2013-14) for Chamarajanagar, Davanagere, Haveri and Gadag. For Ramanagara and Chikkaballapura districts growth rates were worked out for seven years (2007-08 to 2013-14) considering the formation of districts.

It is evident from the analysis that, there was decrease in area and production across all ragi growing districts of Karnataka (Fig 1). The results revealed that, among the major ragi growing districts of Karnataka the area and production showed negative trend, but with respect to production, Tumakuru and Ramanagara districts showed positive trend. There was significant and positive growth in productivity in Bengaluru Urban (2.56 %), Bengaluru Rural (1.96 %), Mysuru (1.93 %), Mandya (1.53 %), Kolar (1.49 %), Uttara Kannada (1.22 %) and Tumakuru (1.12 %). Although Tumakuru stands first in area and production, it stands seventh position with respect to productivity.

It is interesting to observe that the productivity has been showing positive trend in all the major ragi growing districts. The decrease in area can be attributed to shift in area from ragi to maize. The share of ragi has decreased from 17.77 per cent during 2000-01 to 13.66 per cent in 2013-14, whereas the share of maize has increased from 11.62 per cent during 2000-01 to 28.02 per cent in 2013-14.

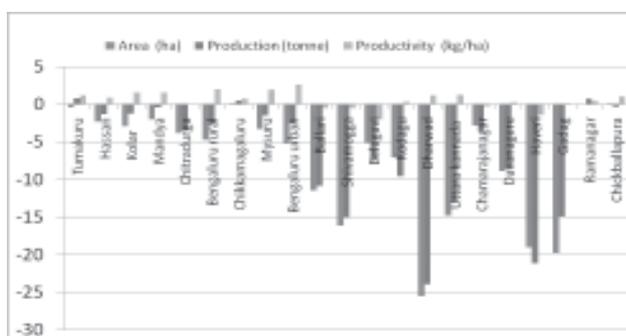


Fig 1.: District wise growth rate (%) in area, production and productivity of ragi in Karnataka during 1984-85 to 2013-14

*Instability in area, production and productivity:* Variations in area, production and productivity is a cause for concern, hence, it is important to know the extent of variability in area, production and productivity. The variability in area, production and productivity was analyzed using the following instability index.

$$\text{Instability Index} = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100 \times \sqrt{1-R^2}$$

Where,

$R^2$  = Coefficient of determination.

Ragi production exhibited higher degree of instability during period II (1994-95 to 2013-14) and overall period (1984-85 to 2013-14) at 45.99 per cent and 19.69 per cent, respectively in Karnataka (Table II). Similar trend was observed at all India level (17.71 % and 12.78 %). The high instability in the production of ragi may be attributed to increase in productivity. The instability in area during period I (6.0 % and 3.9 %) was less both in Karnataka and India and for the overall period. These findings are in confirmatory with the results of Divya (2011).

*Total factor productivity of ragi :* The total factor productivity (TFP) was computed using Thornqvist Theil index. The TFP was estimated taking into account two outputs and five inputs. From Fig 2 it was observed that, the TFP for ragi increased from 1.07 in 1991 to 1.39 in 2014. The TFP fell to 0.78 in 2000 and 0.99 in 2005 due to drought during that period. The highest TFP index was observed in 2003 (2.01). The average TFP index for 25 years was 1.30. The output index of ragi increased from 1.33 in 1991 to 1.40 in 2014. The highest output index was observed in 2008 (2.15). The average output index for 25 years was 1.47. In the case of input index, there were marginal fluctuations, decreasing from 1.25 in 1991 to 1.01 in 2014. The average input index of ragi was 1.15 for 25 years (Fig. 2). Similar findings have been reported by Kumar *et al.* (2008).

*Sources of total factor productivity growth in ragi :* To quantify the contributions of various factors to TFP growth, the variables considered were research

TABLE II

*Instability in area, production and productivity of ragi in Karnataka and India*

Karnataka	Instability index %	India	Instability index (%)
Area			
I (1984-85 to 2005-06)	6.00	I (1984-85 to 1993-94)	3.86
II (2006-07 to 2013-14)	11.81	II (1994-95 to 2013-14)	6.78
Overall (1984-85 to 2013-14)	8.44	Overall (1984-85 to 2013-14)	5.75
Production			
I (1984-85 to 1993-94)	11.98	I (1984-85 to 2001-02)	6.94
II (1994-95 to 2003-04)	45.99	II (2002-03 to 2013-14)	17.71
(1984-85 to 2013-14)	19.69	Overall period (1984-85 to 2013-14)	12.78
Productivity			
I (1984-85 to 1991-92)	9.81	I (1984-85 to 1990-91)	5.05
II (1992-93 to 2013-14)	15.51	II (1991-92 to 2013-14)	11.38
(1984-85 to 2013-14)	15.66	Overall period (1984-85 to 2013-14)	11.36

expenditure, rural literacy and kharif rainfall (Table III). The results indicate that public research (0.132) and rural literacy (0.682) significantly contributed to TFP growth in ragi. The rainfall is a crucial determinant of TFP in ragi. The estimated R square value was 0.60 indicating that 60 per cent of variation in TFP explained by the factors included in the model and F value was statistically significant (3.534) indicating a good fit of the model. Hence, the public research is key and significant source of TFP growth in staple food crop like ragi. These findings are in conformity with the results of Suresh and Chandrakanth (2015).

Ragi has outstanding properties as a subsistence food crop. Ragi is not a season bound crop and hence

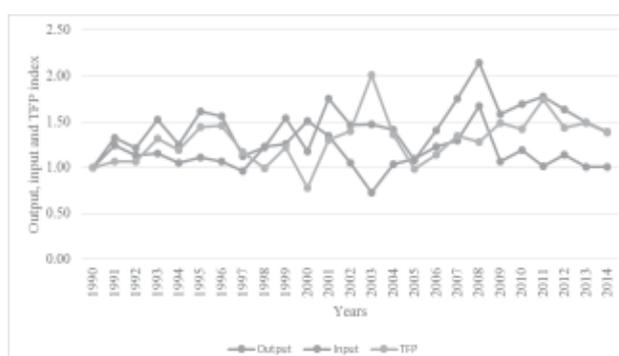


Fig 2.: Trend in total input, total output and TFP index of ragi in Karnataka

TABLE III

*Estimated parameters of TFP decomposition for ragi from 1990 to 2014*

Variables	Coefficients	Standard Error
Intercept	-5.874**	2.313
Research	0.132*	0.095
Rural literacy	0.682**	0.343
Kharif Rainfall	0.039	0.098
R <sup>2</sup>	0.60	
F-value		3.534**

Note:

\*\* and \* indicate significance at 5 and 10 per cent levels, respectively

it can be cultivated throughout the year. The growth and instability results shows that there is a scope to cultivate more ragi in Karnataka and India. After the implementation of Anna Bhagya Yojana in Karnataka State, there is increased demand for ragi. Hence, there is a need for more technological breakthrough to enhance the production. Therefore similar kind of programmes have to be implemented in other states

also to increase the demand for ragi as it is considered to be one of the highly nutritive crop. Sources of TFP growth revealed that, public research was significant source of TFP growth. Hence the Government should allocate substantial funds to public research mainly to enhance the productivity of ragi.

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(Received : May, 2016 Accepted : June, 2016)