Finger Millet-Smallholders Livelihood and Urban Consumers Health-food

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Feature

Finger Millet, the Smallholders' Livelihood and Urban Consumers' Health-food in India: An Economic Analysis[1]

B. GANESH KUMAR, N. SIVARAMANE, AND CH. SRINIVASA RAO

This study has been conducted with the aim of finding reasons why the farmers continue cultivation of finger millet and also the possible future of this important crop for its increasing consuming pattern. The study is based on both primary and secondary data which were collected from the farmers in the state of Karnataka, Tamil Nadu, Maharashtra and Andhra Pradesh and pertained to the year 2015-16.For estimating the elasticity of price and income on ragi consumption, the Almost Ideal Demand System (AIDS) model with two stages is attempted in the study. It was also observed that in all the study states, the farmers were found cultivating this crop mostly under rainfed conditions, except in Karnataka where it was being cultivated under irrigated conditions significantly. The study has found that finger millet is being replaced by other competing fine cereals and commercial crops. The profitability of ragi is being affected due to its low productivity, absence of an organized seed supply chain, high labour requirement and lack of markets. On the other hand, the study has observed a perceptible demand of ragi among the urban population because of its nutritive value. The Government of Karnataka has included finger millet in its social programmes and study has suggested that other states should also make its reach to the smallholders.

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Introduction

Millets are considered to be one of the oldest foods known to mankind. Millets are hardy crops that grow well under rainfed conditions and in less fertile soils (Michaelraj and Shanmugam, 2013). Millets, grown in resource-poor regions under arid and semi-arid conditions serve the purpose of sustainable food supply to the smallholders, as they adapt well to harsh environment, especially drought conditions (Dicko *et al.,* 2005). The growth requirements are very limited as millets not only withstand several abiotic factors like unpredictable climate; limited and inconsistent precipitation and nutrient-depleted soils, but also they are somewhat less-suffered from many biological agricultural constraints (Sharma and Ortiz, 2000; Maqbool *et al.,* 2001). Small millets as a group, includes several grain crops namely finger millet (*ragi*), kodo millet (*varagu*), and little millet (*panivaragu*). Though they are accorded a relatively lower importance among feed crops by the Indian farmers, they are quite important from the point of food security at household level in certain regions of the country, especially tribal belts, as they can be grown even in poor soil and climatic conditions. Besides, their cultivation period is short and they can be very well fitted into multiple cropping systems both under the irrigated, as well as the dry farming conditions. Additionally, they provide nutritious fodder to the livestock kept by the farmers that give them additional income from the farm household regularly. The grain being hardy and dry, could be stored for long, and hence could be considered as "famine reserves". Millets are highly nutritious, non-glutinous and not acid forming foods. Hence, they are soothing and easy to digest. They are considered the least allergenic and the most digestible grains available. Compared to rice, especially polished rice, millets release lesser percentage of glucose, and over a longer period of time. This lowers the risk of diabetes.

One of the important minor millets is finger millet (*Eleusine coracana*), an annual herbaceous plant widely grown as a cereal crop in the arid and semiarid areas in Africa and Asia. It is a tetraploid and self-pollinating species, probably evolved from its wild relative *Eleusine Africana* (National Research Council, 1996). Finger millet is native to the Ethiopian and the Ugandan highlands (D'Andrea *et al.,* 1999). Interesting crop characteristics of finger millet are the ability to withstand cultivation at altitudes of 2000 metres above sea level, its favourable micronutrient content (high iron and methionine content in particular), its high drought tolerance and the very long storage time.

In India, finger millet (locally called by various names including *ragi*, *kezhvaragu*, *ragulu*, *nachani*, *mandua* etc) is mostly grown and consumed in Karnataka, Andhra Pradesh, Tamil Nadu, Odisha, Maharashtra, Garhwal and Kumaon (Uttarakhand), Rajasthan, Dang District (Gujarat) and Goa. Karnataka contributes about 53 per cent of total production of finger millet in the country, followed by Tamil Nadu (15 per cent), Uttarakhand (10 per cent) and Andhra Pradesh (7.5 per cent) during 2013–14. Finger millet is a rich source of Ca (300–350 mg/100g), P (283 mg/100g) and Fe (3.9 mg/100g) (Gopalan *et al.,* 2000). It is also rich in vitamins viz. thiamine, riboflavin, folic acid and niacin (Vidyavati *et al.,* 2004). Ragi flour is made into flatbreads, including thin, leavened *dosa* and thicker, unleavened *roti*. Ragi grain is malted and the grains are ground. This ground flour is consumed mixed with milk, boiled water or yoghurt. In India, ragi recipes are hundreds in number and even common food such as *dosa*, *idly* and *laddu* are made out of ragi. In Southern parts of India, paediatricians recommend finger-millet-based food for infants of six months and above because of its high nutritional content, especially iron and calcium. Homemade ragi malt is a popular infant food and very good for health.

In spite of all the health benefits and the hardy nature of this millet, the area under finger millet is continuously declining in India and so is the production. This downward trend was distinctly visible from the 80's when India ushered in green revolution promoting principally rice and wheat, which was due to the policy support towards these fine cereals and their high productivity. Besides, this crop suffered further in terms of area under cultivation from the mid-90's due to diversion of lands, especially in the semi-arid tracts, towards cotton and maize, which was due to a technological breakthrough. Production of wheat, paddy and maize continues to dictate the terms in semi-arid regions of India compared with millets in general, finger millet in particular (Shukla *et al.,* 2015). The economics of its cultivation has also not helped its cause for sustenance. On the positive side, this millet is increasingly being consumed as part of diet among urban population in India, owing to its superior nutritive values.

It is in this background, that a study has been conducted on this crop to know the reasons why the farmers still continue cultivating this millet and also the possible future for this very important food crop for the ever-increasing, consuming, urban population in our country and elsewhere.

Methodology

The study used both primary and secondary data on finger millet.

(i) Selection of study area

The study used primary data on finger millet cultivation from the farmers of the principal ragi-growing states of Karnataka, Tamil Nadu, Maharashtra and Andhra Pradesh. About 400 farmers (200 each from irrigated and rainfed cultivation) from Karnataka and 200 farmers each from the other three states were interviewed to collect data on production practices, varieties grown and economics of finger millet cultivation through personal interview using pre-tested interview schedules during 2015–16. The households were chosen from the districts based on their production and productivity in all the states considered in the study.

(ii) Finger millet - consumption data

The household level data on consumption of ragi available from 50th (1993–94), 55th (1999–2000), 61st (2004–05) and 68th (2011–12) rounds of the National Sample Surveys Organisation (NSSO) were used for this analysis. The NSS consumer expenditure survey is conducted every year. However, a large sample consumption survey is conducted once in 5 years collecting information at a more disaggregate level covering all the states and union territories (UT), all economic classes and rural and urban sectors. States where consumption of ragi was less than 0.1 kg of monthly per capita, and Union Territories were not shown in the result.

(iii) Analytical tools

a. Production practices and economics of finger millet cultivation, and consumption of finger millet

Tabular and percentage analyses were used to document the production practices and estimate the economics of finger millet cultivation in the study area, and the consumption trend of finger millet among rural and urban population in India.

b. Estimation of demand elasticity and demand forecast for finger millet

For estimating the elasticity of price and income on ragi consumption, the Almost Ideal Demand System (AIDS) model (Deaton and Muellbauer, 1980) with two stages are attempted in the study. In the first stage, food expenditure as a function of food prices and total expenditure in double log form was used. In the second stage, Seemingly Unrelated Regression (SUR) model was used by considering the expenditure on food items, viz. rice, wheat, ragi, other cereals and millets and other food items as a function of their prices, and the monthly per capita expenditure, age and household size. The ragi consumption was estimated using the above mentioned demand model for all India. The consumption data from various rounds of NSSO survey, particularly Rounds 50, 55, 61 and 68 were used for estimation of elasticities of all the food items.

The demand projections of ragi for rural and urban India are obtained by using the following formula for the three time periods considered:

$$Q_{2020} = Q_{2011}(1+r)^{9} \quad \text{.....(1)}$$

$$Q_{2025} = Q_{2011}(1+r)^{14} \quad \text{.....(2)}$$

$$Q_{2030} = Q_{2011}(1+r)^{19} \quad \text{.....(3)}$$

Where,

Q_{2011} is the monthly quantity of ragi consumed in 2011–12 by the concerned group of population (rural/urban);

Q_{2020} is the projected quantity of ragi demanded for the group (rural/urban) for the year 2020;

Q_{2025} is the projected quantity of ragi demanded for the group (rural/urban) for the year 2025;

Q_{2030} is the projected quantity of ragi demanded for the group (rural/urban) for the year 2030; and

'r' is the sum of p^{o} and c^{o}

Where,

p^{o} is the population growth rate / annum

c^{o} is growth rate of per capita ragi consumption / annum

Results and Discussion

(i) Land Holding and Cropping Pattern followed by Ragi Growers in the Study Area

The land holding and cropping pattern followed by the sample farmers in the study states is presented in Table 1.

The average landholding of the ragi growers was found to be ranging from 1.21 ha to 2.69 ha in the study area, with Karnataka farmers cultivating this crop in larger area, compared to their counterparts in other states. It was also observed that in all the study states, the farmers were found cultivating this crop mostly under rainfed conditions except in Karnataka, where it was being cultivated under irrigated conditions significantly. More specifically in Tamil Nadu, about 98 per cent of the landholdings was rainfed and only 2 per cent of the land had irrigated ragi, indicating very less priority of the crop in the irrigated lands.

With respect to cropping pattern in the study states, it was observed that the ragi farmers of Karnataka followed by those from Tamil Nadu and Andhra Pradesh were growing more diversified crops than their counterparts in Maharashtra, indicating different resource endowment patterns existing among the study states. Gross cropped area was found to be the maximum in Tamil Nadu, followed by Andhra Pradesh, Maharashtra and Karnataka among the ragi farmers, while area under ragi was the maximum in Tamil Nadu followed by Karnataka, Andhra Pradesh and Maharashtra.

(ii) Resource Use Pattern in Ragi Production by the Farmers in the Study Area

The resource-use pattern followed by the growers in ragi production in the study is furnished in Table 2.

The study revealed that the seed rate practiced by the ragi growers in the study area varied from 5.8 kg/ha to about 30.7 kg/ha. The farmers in Tamil Nadu were found using 30.7 kg seeds per ha, followed those in Andhra Pradesh (14.4 kg/ha), Karnataka (10.8 kg/ha) and Maharashtra (5.79 kg/ha). These variations were due to the method of sowing by the ragi growers, who followed the direct sowing method in Tamil Nadu, while about an equal number of farmers follow both direct seeding and transplanting in Andhra Pradesh and Karnataka. Conversely, all the farmers of Maharashtra practice transplanting method of sowing, thus require less seed for sowing.

Table 1. Land holding and cropping pattern followed by ragi growers in the study states

Particulars	Karnataka			Tamil Nadu			Maharashtra			Andhra Pradesh		
Land holding (ha)	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total
	1.48 (55%)	1.21 (45%)	2.69	0.03 (2%)	1.21 (98%)	1.24	0.46 (25%)	1.41 (75%)	1.87 1.87	0.28 (23%)	0.93 (77%)	1.21
Crops grown	Irrigated	Rainfed		Irrigated	Rainfed		Irrigated	Rainfed		Irrigated	Rainfed	
	Ragi, Red gram, Maize, Ground nut, Paddy, Beans, Potato, Horse gram, Vegetables, Flowers, Grapes, Mango, *Eucalyptus*, Areca nut, Coconut, Banana, Mulberry	Ragi, Red gram, Ground nut, Horse gram, Mango		Ragi, Beans, Potato, Maize, Tomato, Horse gram, Peas, *Eucalyptus*, Green gram, Lablab, Sugarcane	Ragi, Sorghum, Horse gram, Green gram, Little millet		Ragi, Paddy Sugarcane, Ground nut	Ragi, Ground nut		Ragi, Beans, Sorghum, Patato, Maize, Tomato, Horse gram, Peas, Green gram, Little millet, Lablab, Sugarcane	Ragi, Sorghum, Horse gram, Green gram, Little millet	
Ragi varieties grown	GPU-28, Indaf-5, Indaf-9, Indaf-7, Local			GPU-28, ML-365, CO-14, MR-1, PYR-1			VL-149, PES- 400, RAU-8,HR-374, DAPOLI-1, GPU-26, PR-202, B-11			RATNAGIRI, GODAVARI, BHARATHI		
Gross cropped area	430			557			445			473		
Area under ragi cultivation	237			419			97			208		
(ha)												
Share (%)	55			75			22			44		

Source: Primary survey, 2016

Table 2. Resource use pattern in ragi production by the farmers in the study area

Inputs	States			
	Karnataka	Tamil Nadu	Maharashtra	Andhra Pradesh
Seed (kg/ha)	10.8	30.7	5.8	14.4
FYM (kg/ha)	1040	1488	4513	3671
Fertilizer (kg/ha)	387	320	275	37
Human labour (man-days/ha)	93	74	169	106
Bullock labour (man-days/ha)	5.50	1.32	5.21	6.38
Machine labour (man-days/ha)	1.60	1.74	0.67	0.38

Source: Primary survey, 2016

The use of farmyard manure (FYM) by the ragi growers was observed to be more in Maharashtra (4513 kg/ha) and Andhra Pradesh (3671kg/ha) than in Tamil Nadu (1488kg/ha) and Karnataka (1040 kg/ha). Conversely, the application of fertilizers by them was found to be maximum in Karnataka and Tamil Nadu (387 kg/ha and 320 kg/ha respectively), when compared to Maharashtra (275 kg/ha) and Andhra Pradesh (37 kg/ha). Hence, in general, it is observed that this crop is cultivated under inorganic conditions in Karnataka and Tamil Nadu, while it is cultivated relatively organic in Andhra Pradesh and Maharashtra.

With respect to labour use pattern, it was found that human labour use in ragi cultivation was found more (169 man-days/ha) in Maharashtra, as compared to Andhra Pradesh (106 man-days/ha), Karnataka (93 man-days/ha) and Tamil Nadu (74 man-days/ha). Bullock labour use was higher in Andhra Pradesh (6.38 man-days/ha) followed by Karnataka (5.50 man-days/ha), Maharashtra (5.21 man-days/ha) and Tamil Nadu (1.32 man-days). Conversely, machine labour was used more in Tamil Nadu and Karnataka (1.74 man-days/ha and 1.60 man-days/ha respectively), than the other two states (0.67 man-days/ha in Maharashtra and 0.38 man-days/ha in Andhra Pradesh, respectively). This observation of more human and animal labour in Maharashtra and Andhra Pradesh were due to the transplanting and tilling operations. It is also evident that a great deal of mechanization was happening in Tamil Nadu and Karnataka, especially in the operations of tilling of land and threshing of harvested crops, as is shown by more use of machine labour by the growers.

(iii) Cost and Returns of Ragi Cultivation

The cost of cultivation was calculated based on the Commission on Agricultural Costs and Prices (CACP) concepts[2], and the details on costs and returns are furnished in Tables 3 and 4. It could be observed from Table 3 that Cost A1, which comprise all the out-of-pocket cost items were found to be the highest in Karnataka (INR.

Table 3. Cost of cultivation of ragi production in the study area

(INR./ha)

Item/Cost	States				
	Karnataka		Tamil Nadu	Maharashtra	Andhra Pradesh
	Irrigated	Rainfed	Rainfed	Rainfed	Rainfed
Cost A1	51617	42692	27729	25735	13111
Seed	495	495	615	102	79
FYM	6700	6200	1847	2535	2472
Fertilizers	5040	4700	4121	4082	541
Plant protection chemicals	0	0	0	272	0
Human labour	23350	16250	10331	11618	6298
Bullock labour	4400	4320	1049	3817	1305
Machine labour	9728	9260	8743	2259	1932
Interest on working capital			1023	1050	484
Cost A2	51617	42692	28968	25735	13111
Cost B	56617	47692	29378	27261	14320
Cost C	62057	51885	36253	43772	25269

Source: Primary survey, 2016

51,617 per ha under irrigated condition and INR. 42,692 per ha under rainfed condition, respectively), followed by Tamil Nadu (INR. 27,729 per ha), Maharashtra (INR. 25,735 per ha) and Andhra Pradesh (INR. 13,111 per ha). The major item of expenditure here is the cost of labour (69–73 per cent of Cost A1), as it is evidenced from the fact that this crop is a highly labour-intensive one on account of tedious land preparation, removal of weeds, protection from birds, manual harvesting and post-harvest operations (FAO, 1996). The other major expenses among the Cost A1 components are those on fertilizers, except in case of Karnataka where the farmers were found spending more on purchase of farmyard manure.

The leasing of land by the ragi growers was found only in Tamil Nadu. Hence, Cost A2 remained the same for all the other states. Similar trend was observed in case of Cost B, where it was found highest in Karnataka (INR. 56,617 per ha under irrigated condition and INR. 47,692 per ha under rainfed condition, respectively), followed by Tamil Nadu (INR. 29,378 per ha), Maharashtra (INR. 27,261 per ha) and Andhra Pradesh (INR. 14,320 per ha).

Similarly, Cost C was found to be the highest in Karnataka (INR. 62,057 per ha under irrigated condition and INR. 51,885 per ha under rainfed condition, respectively), followed by Maharashtra (INR. 43,772 per ha), Tamil Nadu (INR. 36,253 per ha) and Andhra Pradesh (INR. 25,269 per ha). This is because Karnataka and Maharashtra farmers were engaging more human labour in transplanting seedlings, weeding, summer ploughing and winnowing than other states. On the other side, the wage rates were relatively less for human labour in Andhra Pradesh, implying less cost on family labour.

The returns from ragi cultivation were worked out and the different forms of income for the farm households are listed in Table 4. It showed that the farmers of Karnataka were found getting more returns than their counterparts in other states. After accounting all the cost components, the farmers in Maharashtra and Tamil Nadu were incurring loss in the cultivation of ragi. Finally, the cost of production per kg of ragi was worked out to be the highest in Karnataka (INR. 25.56 under rainfed condition), followed by Maharashtra (INR. 18.12), while it was INR. 16.62 in Karnataka (under irrigated condition), INR. 12.48 in Tamil Nadu and INR. 4.75 in Andhra Pradesh. It was calculated by taking into account only the Cost A1.

It is found from the table that ragi cultivation was found to be a loss making agricultural activity in Maharashtra, while it was profitable in the other three states. However, if we impute the value of family labour, it makes loss to the farmers in Tamil Nadu, indicating

Table 4. Returns from ragi production in the study area

(INR./ha)

Item/Returns	States				
	Karnataka		Tamil Nadu	Maharashtra	Andhra Pradesh
	Irrigated	Rainfed	Rainfed	Rainfed	Rainfed
Yield (kg/ha)	3105	1670	2279	1329	2582
Gross returns	102410	58985	35530	22348	38785
Profit over Cost A1 (Farm business income)	50793	16293	7801	-3387	25674
Profit over Cost A2	50793	16293	6562	-3387	25674
Profit over Cost B (Family labour income)	45793	11293	6152	-4913	24465
Profit over Cost C (Net income)	40353	7100	-723	-21424	13516
Cost of Production (INR./kg)	16.62	25.56	12.17	19.36	5.08
Net profit (INR./kg)	13.00	4.25	-0.32	-16.12	5.23

Source: Primary survey, 2016

that the family labour is spent on this farming ignoring better opportunity cost elsewhere. In other words, the ragi growers of Tamil Nadu don't appear to make a gainful employment in their farm. However, they might be continuing ragi cultivation for their consumption purpose.

(iv) Consumption of ragi over time

Table 5 shows that the consumption of ragi has declined sharply among rural population over the years from 1,811,000 tonnes in 1993–94 to 750,000 tonnes in 2011–12. A state-wise perusal reveals that this sharp decline was happening in Karnataka and Andhra Pradesh. However, Karnataka still accounts for 67.91 per cent of total consumption followed by Andhra Pradesh (12.26 percent) and Tamil Nadu (7.62 per cent) during 2011–12. Whereas, it was 52.10 per cent in Karnataka during 1993–94 followed by Tamil Nadu (15.11 per cent) and Andhra Pradesh (10.96 per cent).

The consumption of ragi among urban population revealed that it was found continuously increasing from 235,000 tonnes in 1993–94 to 272,000 tonnes in 2011–12 (Table 6). However, the state level consumption data shows that the state of Karnataka alone accounts for a major

Table 5. Consumption of ragi in rural areas of India over time

(000'tonnes/year)

State	Year			
	1993-94	**1999-2000**	**2004-05**	**2011-12**
Karnataka	943 (52.10)	728 (54.51)	761 (65.21)	509 (67.91)
Andhra Pradesh	198 (10.96)	120 (8.95)	106 (9.11)	92 (12.26)
Tamil Nadu	274 (15.11)	176 (13.17)	149 (12.78)	57 (7.62)
Maharashtra	122 (6.74)	134 (10.02)	62 (5.33)	35 (4.73)
Uttarakhand	NA	NA	22 (1.85)	12 (1.54)
All India	1811 (100.00)	1336 (100.00)	1167 (100.00)	750 (100.00)

Figures in parentheses indicate percentages to all India figures
Source: Various rounds of NSSO

Table 6. Consumption of ragi in urban areas of India over time

(000'tonnes/year)

State	Year			
	1993-94	**1999-2000**	**2004-05**	**2011-12**
Karnataka	194 (82.37)	216 (86.40)	226 (84.33)	222 (81.70)
Tamil Nadu	16 (6.82)	16 (6.60)	18 (6.77)	20 (7.26)
Andhra Pradesh	17 (15.11)	8 (3.20)	14 (5.31)	17 (6.27)
Maharashtra	0 (0.00)	0 (0.00)	0 (0.00)	2 (0.00)
Uttarakhand	NA	NA	0(0.00) (0.00)	0 (0.00)
All India	235 (100.00)	250 (100.00)	268 (100.00)	272 (100.00)

Figures in parentheses indicate percentages to all India figures
Source: Various rounds of NSSO

share during the period of analysis, ranging from 81.70 per cent in 2011–12 to 86.40 per cent in 1999–2000. This was followed by Tamil Nadu, which has a percentage share ranging from 6.60 per cent in 1999–2000 to 7.26 per cent in 2011–12 and Andhra Pradesh, which has a percentage share ranging from 3.20 per cent in 1999–2000 to 7.31 per cent in 1993–94. Other states like Maharashtra and Uttarakhand had a small share of consumption of ragi among the all India level consumption.

The average monthly per capita consumption of ragi over a period of time is presented in Table 7. The results revealed that the average monthly per capita consumption of ragi at all India level was 0.075 kg in rural areas and 0.060 kg in urban areas during 2011–12, while it was 0.240 kg and 0.090 kg respectively during 1993–94. State-level analysis on consumption of ragi reveals that Karnataka was the major state in terms of ragi consumption in rural areas (1.130 kg/capita/month) during 2011–12 followed by Uttarakhand (0.137 kg/capita/month) and Andhra Pradesh (0.136 kg/capita/month); while in 1993–94, the same was 2.530 kg in Karnataka followed by Tamil Nadu (0.620 kg) and Andhra Pradesh (0.340 kg). Similarly in case of consumption of ragi in urban areas, the average monthly per capita consumption in Karnataka was 0.754 kg, followed by Andhra Pradesh (0.050 kg) and Tamil Nadu (0.047 kg) in 2011–12; while in 1993–94, it was 1.160 kg in Karnataka followed by Andhra Pradesh (0.080 kg) and Tamil Nadu (0.070 kg).

(v) Consumption of ragi across income groups

The consumption pattern of ragi over various income decile groups of population for both rural and urban population of the major states, as well as all India are presented in Figures I and II. Decile denotes dividing the population into ten groups with equal number of persons.

It could be seen from Figure 1 that for rural population of India, the consumption of ragi was increasing from lower decile to upper decile in the earlier survey rounds. But in the recent years, it was increasing until a certain upper decile group, after which the consumption was found reducing. The same pattern was observed in urban population of India over all time periods (Figure 2). This might be due to the reason that people eat outside home at higher levels of income.

Table 7. Average monthly per capita consumption of ragi India over time

(kg/capita/30 days)

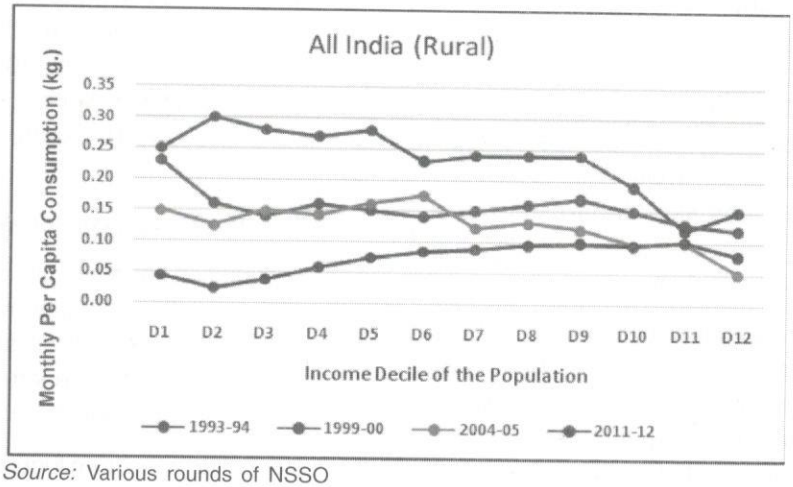
State	Rural				Urban			
	1993-94	1999-2000	2004-05	2011-12	1993-94	1999-2000	2004-05	2011-12
Andhra Pradesh	0.340	0.180	0.160	0.136	0.080	0.040	0.057	0.050
Karnataka	2.530	1.740	1.818	1.130	1.160	1.050	1.084	0.784
Maharashtra	0.210	0.200	0.093	0.048	0.000	0.000	0.000	0.003
Tamil Nadu	0.620	0.420	0.356	0.128	0.070	0.050	0.055	0.047
Uttarakhand	0.030	0.000	0.285	0.137	0.000	0.000	0.003	0.001
All India	**0.240**	**0.150**	**0.131**	**0.075**	**0.090**	**0.070**	**0.076**	**0.060**

Source: Various rounds of NSSO

(vi) Demand Projection for Ragi Production in India

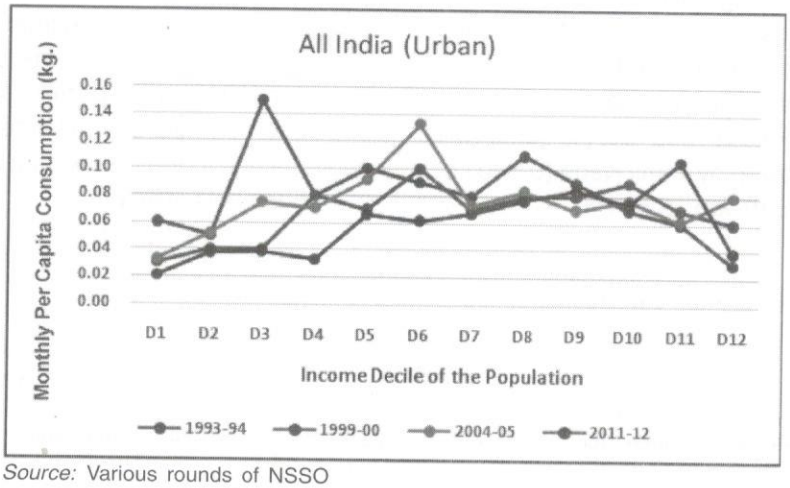
Expenditure estimates of total food items for all India (Total population)

The elasticities of demand for all India are given in Tables 8 and 9. Table 8 shows expenditure elasticity of food. Since it is evident that true per capita monthly income data is not captured during the surveys properly due to various reasons, monthly per capita expenditure (MPCE) was used as a proxy for the variable in the model. At the all India level, the expenditure elasticity indicates that, on an average, one percent increase in income leads to about 0.67 percent increase in expenditure on food. As expected, the household size is found to significantly and negatively affect the per capita food consumption. The negative signs for dummy coefficients show that, over years, the proportion of



Source: Various rounds of NSSO

Figure 1. Consumption of ragi in India (Rural) across groups



Source: Various rounds of NSSO

Figure 2. Consumption of ragi in India (Urban) across groups

Table 8. Parameter estimates of food expenditure function for all India (Total population)

Variable	Parameter Estimate	t Value	Pr > |t|
Intercept	0.98	78.62	<.0001
Food price	0.19	62.55	<.0001
MPCE	0.67	450.31	<.0001
Household size	-0.05	-34.33	<.0001
Age	0.07	31.03	<.0001
68th NSS Round #	-1.23	-124.20	<.0001
61stNSS Round #	-0.13	-72.98	<.0001
55th NSS Round #	-0.02	-8.87	<.0001

 # Dummies of National Sample Survey rounds 68, 61 and 55 pertaining to the years 1999-2000, 2004-05 & 2011-12. Round no. 50 pertaining to the year 1994-95 was used as reference.

expenditure on food is slowly coming down. As compared to the 50th round of NSSO surveys, the proportion of food expenditure has come down by 1.21 percent.

Expenditure estimates of individual food items (Total population)

It can be seen from Table 9 that the expenditure elasticities of all food items were inelastic, which means that the expenditure of food is changing less proportionately to changes in expenditure. When one percent increase in expenditure happens, ragi consumption shows an increase of 0.25 percent, which is inelastic. Similarly, one percent increase in expenditure increases consumption of rice, wheat, other cereals and all food items by 0.09, 0.09, 0.38 and 0.01 respectively. Ragi, though appears inelastic, is relatively more elastic as compared to rice and wheat.

(vii) Demand forecast for ragi in India, under existing situation

Since income elasticity of demand for ragi was found to be inelastic, it was decided not to use this factor in demand projections for ragi. Instead, it was decided to use the growth rates in per capita consumption of ragi obtained from various NSS rounds and the population growth rates from census data, employing the trend equation analysis.

Table 9. Expenditure elasticity of individual food items in India (Total population)

Food item	Expenditure elasticity
Rice	0.09
Wheat	0.09
Ragi	0.25
Other cereals	0.38
All food	0.01

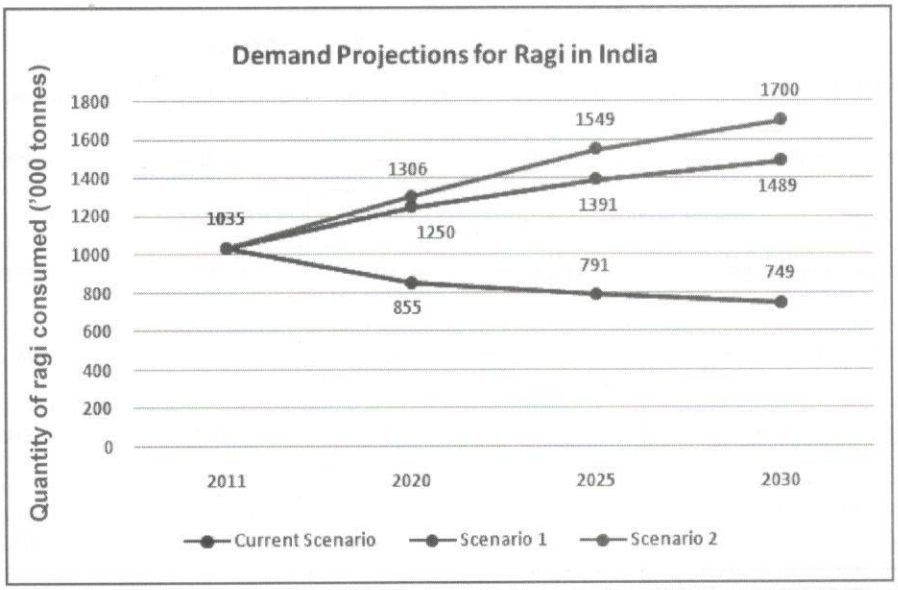
Table 10. Demand forecast of ragi among rural population in India

Particulars	States				
	Karnataka	Tamil Nadu	Maharashtra	Andhra Pradesh	All India
Per capita ragi consumption in 2011-12 (kg)	1.130	0.128	0.048	0.136	0.075
Population at 2011 (crores)	3.747	3.719	6.155	5.631	83.300
Monthly per capita ragi consumption in 2011-12 ('000 tonnes)	42.341	4.760	2.954	7.658	62.475
Ragi consumption per annum in 2011-12 ('000 tonnes)	515	58	36	93	760
Growth in per capita ragi consumption per annum (c^o)	-0.041	-0.154	-0.059	-0.063	-0.051
Growth in population per annum (p^o) Overall growth (r)	0.007 -0.034	0.006 -0.148	0.010 -0.049	0.031 -0.032	0.012 -0.040
Ragi consumption during 2020 ('000 tonnes)	378	14	23	70	527
Ragi consumption during 2025 ('000 tonnes)	318	6	18	59	430
Ragi consumption during 2030 ('000 tonnes)	268	3	14	50	351

Accordingly, the quantity demanded for the rural population is projected and presented in Table 10. It is found from the table that the quantity demanded by rural population at country level would fall from 760,000 tonnes in 2011–12 to 527,000 tonnes in 2025, 430,000 tonnes in 2025 and 351,000 tonnes in 2030. This decline is due to the negative growth rate in consumption by the rural population in all the major ragi-producing states.

Table 11. Demand forecast of ragi among urban population in India

Particulars	States				
	Karnataka	Tamil Nadu	Maharashtra	Andhra Pradesh	All India
Per capita ragi consumption in 2011-12 (kg)	0.784	0.047	0.003	0.05	0.06
Population at 2011 (crores)	2.363	3.495	5.083	2.835	37.7
Monthly per capita ragi consumption in 2011-12 ('000 tonnes)	18.526	1.643	0.152	1.418	22.62
Ragi consumption per annum in 2011-12 ('000 tonnes)	225	20	2	17	275
Growth in per capita ragi consumption per annum (c^o)	-0.109	-0.006	0.001	-0.007	-0.008
Growth in population per annum (p^o)	0.028	0.024	0.022	0.002	0.028
Overall growth (r)	-0.082	0.018	0.022	-0.006	0.020
Ragi consumption during 2020 ('000 tonnes)	105	23	2.3	16	328
Ragi consumption during 2025 ('000 tonnes)	68	26	2.5	16	361
Ragi consumption during 2030 ('000 tonnes)	45	28	3	15	398



Note: Current scenario represents current growth rates of per capita ragi consumption and population growth rate Scenario 1 represents 0.5% growth in per capita consumption of ragi and the current population growth rate Scenario 2 represents 1% growth in per capita consumption of ragi and the current population growth rate.

Figure 3. Demand of ragi in India

Conversely, the quantity demanded by urban population at country level would increase from 275,000 tonnes in 2011–12 to 328,000 tonnes in 2025, 361,000 tonnes in 2025 and 398,000 tonnes in 2030 (Table 11). This increase is due to the positive growth rate in urban population, but a very negligible negative growth rate in consumption by the urban population in all the major ragi-producing states.

(viii) Demand forecast for ragi under different policy scenarios

In the light of the above findings, it is further felt that there is a consistent improvement in the awareness levels about the nutritive values of this cereal among the Indian population. Hence, a scenario analysis was attempted to project the demand by the total population in the country, by assuming 0.5 per cent and 1 per cent growths in the per capita consumption of ragi. Accordingly, the demand of ragi in 2020, 2025 and 2030 under the two scenarios for the country was depicted in Figure 3.

As it is assumed that there would be a positive growth rate in ragi consumption by the population in future, the quantity demanded of ragi would expectedly increase from 1,035,000 tonnes in 2011–12 to 1,250,000 tonnes in 2020, 1,391,000 tonnes in 2025 and 1,549,000 tonnes in 2030 under Scenario 1, and the same would increase to 1,306,000 tonnes in 2020, 1,489,000 tonnes in 2025 and 1,700,000 tonnes in 2030 under Scenario 2.

Conclusion

Finger millet is continuously being replaced by other competing fine cereals and commercial crops due to different reasons. The profitability of ragi cultivation is also affected due to its low productivity, absence of an organized seed supply chain, high labour requirement and lack of markets. Besides, ragi is a crop that faces various myths and taboos when one comes to think of producing or consuming. There are cultural issues in adoption and diversification of food. There is a lack of technical know-how in the processing methods, while the conventional method of hand-pounding is a tedious process. Besides, there is also a lack of awareness about the nutritive value of ragi with an opinion that this is a poor man's crop. But, there are evidences that there is a perceptible demand among the urban population. Various measures are very much warranted to save and promote this much-neglected crop in our country not just to double the income of the farmers, but to sustain the current income of the farmers, especially in marginal and tribal areas where this is being cultivated. There are efforts to come out with high yielding varieties along with traits of drought resistance through All India Coordinated Project on Small Millets in India, which should be continued. There should be sincere efforts by the government to protect the price risk faced by the farmers, by developing the markets exclusively for millets, which are scattered and small at present. In Karnataka, finger millet is among the 'climate smart' crops that figures high on the agenda of the government. The state has included finger millet in its flagship mid-day meal scheme called 'Anna Bhagya Yojana' to supply this grain at free of cost to Priority Household families, which includes Antyodaya Anna Yojana (AAY) scheme beneficiaries and the Below Poverty Line (BPL) families across the state. Such proactive policy initiatives should be considered by other leading states in finger millet production. More awareness needs to be created about the health benefits of ragi and thereby remove the myth on this crop—not as poor men's crop, but rich people's diet.

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Notes :

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[2] Cost A1: Out-of-pocket cost + Interest on working capital + Depreciation of assets and machinery

Cost A2: Cost A1 + Rent paid for leased-in land

Cost B: Cost A2 + Imputed rental value of own land

Cost C: Cost B + Imputed value of family labour

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