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Research Article

UNLOCKING MILLET PRODUCTION: A RAPID RURAL APPRAISAL (RRA) OF PROSPECTS AND CONSTRAINTS

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Abstract: Among major millet producing states in India, Tamil Nadu's contribution for sorghum, pearl millet and finger millet are high but low in minor millets like foxtail millet, barnyard millet, kodo millet, proso millet and little millet. Therefore, it was felt to conduct a rapid rural appraisal on the needs and constraints of millet growers in Tiruvannamalai and Vellore District. The results revealed that, pests and diseases in finger millet, persistent drought, exhausted soils, shortage of labour for harvesting and weeding, and high weed infestation were found to be major constraints. Among prospects, it was found that, technologies that are labour saving, particularly during weeding and harvesting, and development of farmer friendly soil improvement package for millet are urgently needed to prosper millet production in the state.

Keywords: *Millets, RRA, Constraints, Prospects, Vellore, Tiruvannamalai*

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Introduction

The need for identifying healthy and environmentally sustainable diets and enhanced usage of underused plant species, such as quinoa, millets, sorghum, or teff grains, due to their climate resilience and dense nutritional content [1]. It also clearly captured that among 14,000 edible plants, only three crops, namely, rice, maize, and wheat, contribute 60% of caloric intake. On the other hand, the SDGs 2030 have its ambitious goal of eliminating all forms of malnutrition by 2030. To achieve this, interventions are required to replace the major portion of the diet currently occupied by rice, wheat, and maize with highly nutritious grains, such as millets. Rainfed agriculture contributes nearly half of the total food grain production of the country and produces 75 per cent of pulses, more than 40 percent of minor millets and more than 50 per cent of groundnut from arid and semi-arid regions. During 1960s the nationwide average production of three major millets grown in India *viz*., pearl millet, sorghum and finger millet were 9.11 mt, 4.66 mt and 1.89 mt respectively. In over three decades the production of finger millet and pearl millet had shooted up to 2.2 mt and 8.49 mt [2].

India dominates the global production of millets with a total share of about 40.62% and an estimated production of about 10.91 million tonnes during 2018–2019 [3]. In India and other Asian and African countries, millets commonly include sorghum, pearl millet, and a range of small millets [4]. The results of the present day shows that, the country is sharply focusing on millets. Among major millet producing states in India, Tamil Nadu's contribution for sorghum, pearl millet and finger millet are high. Minor millets like foxtail millet, barnyard millet, kodo millet, proso millet and little millet are least concentrated by farmers of Tamil Nadu though these crops are extremely nutritious and show promise for future farming. Traditionally, many kinds of foods and beverages were made from these grains in different regions, which played an important role as a staple food in the local food culture. However, their presence in the Indian food basket has been declining over the years largely due to government policies favoring the production and consumption of fine cereals, such as rice and wheat [5], as well as rising incomes and urbanization. Between 1960 and 2015 in India, wheat production more than trebled, and rice production increased by ~800%; on the contrary, millet production was stagnant at low levels. Between 1962 and 2010, India's per capita consumption of millets fell drastically from 32.9 to 4.2 kg, while that of wheat almost doubled from 27 to 52 kg. Another study reported in particular on pearl millet that per capita consumption trend declined between 1972/1973 and 2004/2005 in both rural and urban regions of India from 11.4 to 4.7 and from 4.1 to 1.4 kg per year, respectively [6]. A similar declining trend in per capita consumption was reported for sorghum in both rural and urban India from 19.1 to 5.2 and from 8.5 to 2.7 kg per year, respectively, representing 68 and 70% reduction [7].

Millets are often referred to as smart food, which is "good for the individual" (nutritious and healthy), "good for the planet" (environmentally sustainable), and "good for the farmer" (resilient). Millets are recognized for their resilience, ability to survive under high temperatures and in degraded soils, and minimum requirements of water, pesticides, and fertilizers [8]. Their farming methods leave a lower carbon footprint than the major staples that are grown with greater use of fertilizers and pesticides. Millets complement commonly used legumes in India, such as pigeon pea and chickpea, for amino acid content to form complete protein with improved digestibility upon cooking [9]. Apart from protein, depending on the variety and species, millets are also rich in minerals, such as iron, zinc, and calcium, which deliver health benefits to all age groups and genders. It was a time, when millets were ruling the Asian Continent. Statistics says that, in India, 44% of the cultivable land area was occupied by millets between 1966 and 2006 [10]. Due to the intervention of Green Revolution and changing food habits of the population, these millets started to decline and lost importance both in farming and in consumption. The high nutritional content of millets compares well with other foods with similar nutritional value; it is especially high compared with polished rice, maize, and refined wheat flour, the post-green revolution major staples [11]. Innovative millet processing technologies that provide safe, easy-to-handle, ready-to-cook, and ready-to-eat products and meals at a commercial scale are mainly available in urban areas [12], where rice and refined wheat flour dominate and are much more accessible and affordable. The consumption of refined grains, namely, refined white rice, is shown to be associated with non-communicable diseases, such as type II diabetes mellitus [13] and obesity. This has led to an increasing emphasis globally on consuming whole grains [14], underlining the importance of mainstreaming nutritious smart food crops and promoting them as a staple.

This is one of the major objectives of the Smart Food initiative [15]. Providing more nutritious and healthier traditional whole grain and multigrain substitutes for refined carbohydrates can be an important aspect of therapeutic dietary modification and diversity.

There is a growing interest in reviving millets in India and also globally, owing to their nutrition content and ability to grow in harsh climatic conditions due to their climate smart traits. The Government of India declared 2018 as a National Year of Millets and followed on with preparing a national Millet Mission, as well as a proposition to the Food and Agricultural Organization of the United Nations (UN) for a UN International Year of Millets. Several state governments in India also followed suit to establish state millet missions. These initiatives all recognized the need and built-in components to engage with consumers to drive demand and not only to invest in agricultural production and productivity. This transition phase during which perceptions of millets are changing and there is greater health consciousness [16] is the right stage to assess current knowledge, perceptions, and practices related to millets, which will lay the foundation for a plan to promote millets as a staple effectively. Understanding the need and constraint of a millet farmer is important for researchers, nutrition volunteers, community health workers, and food manufacturers in planning millet-based products, interventions, and promotional activities to improve the nutritional status and general health of the population and for companies to make nutritious foods a viable business. A limited number of studies have investigated the needs and constraints using Rapid Rural Appraisal method. To our knowledge, no formal study has focused on understanding the needs and constraints of the farmers producing millets using a considerable sample size. Therefore, this study aimed to assess the needs and constraints of millet growing farmers in Vellore and Tiruvannamalai districts of Tamil Nadu [17-20].

Material and Methods

The research mainly focused on assessing the needs and constraints faced by small millets cultivating farmers. Therefore, crop specific research did not aroused here. Thiruvannamalai and Vellore District were taken for the study because of its growing awareness on millet consumption among natives of these district and willingness shown by farmers in acquiring tips on new cultivation practices in millets, its advanced technology in production and processing. A rapid rural appraisal was carried out in the districts of Tiruvannamalai and Vellore during April – December, 2015. To have representative sample of millet growing areas of Tiruvannamalai and Vellore, farmers from six blocks (3 blocks in each district) and twelve villages (two village from each block) where millets are predominantly cultivated were selected and ten farmers from each village forming an overall sample size of 120 respondents interviewed with a semi - structured questionnaire with the help of Department of Agriculture and local panchayat leaders.

The major aspects considered in the questionnaire included socio-economic and biophysical issues at household level in relation to millet production as well as the other enterprises associated with millets. Farm resource base and flow among enterprise, labour structure and adequacy, general management related issues, post-harvest, marketing, gender roles and production constraints were among the key questions asked during the survey. Respondents were asked to rank constraints affecting the productivity of their farms.

The respondents consisted of men and women. As much as possible, the interview session was kept informal to ensure a relaxed atmosphere for the interviewees. For each household, at the end of session, interviewers were conducted around the farm setting to observe directly the nature of field where millets were grown. Soil samples report was also obtained from the respondents to have an idea about the history of their soils and its health status.

Findings and Discussion

The major needs and constraints pertaining to millet farmers were studied during the survey. From the results it was observed that, resource base and access are among the factors that remains major concern for agriculture potential and millet sustainability in the farm level. Table below presents data of household land size, millets in hectare and yield; as well as livestock numbers per household in study district. Household land size was marginally greater in Tiruvannamalai district than in Vellore district. Overall millet hectare compared to oilseeds and pulses, however, was smallest in Tiruvannamalai district.

Table-1 Household resource data of Vellore and Tiruvannamalai District

SN	Variables	Vellore	Tiruvannamalai
1	Average Farm Area (ha)	4.40	4.64
2	Average Millet area (ha)	2.10	2.12
3	Average millet yield (Kg ha^{-1})	963	876
4	Average Animals / household	3.6	4.7

Generally, average household land size was not a factor limiting crop production, compared to other highly populated districts in Tamil Nadu such as Madurai & Coimbatore, where household land size ranges from 0.2-2 ha. The hectarage occupied by minor millets ranged from 6% (Vellore) to 12% (Tiruvannamalai) of land owned by each household. Over all, up to 24% of the land under crops was occupied by minor millet, an indication of the significance of the crop at household level in the study area. Despite the large hectarage devoted to millet production in Tiruvannamalai district, grain yield per unit area was rather low compared to Vellore district.

Both Tiruvannamalai and Vellore district had decent number of farm animals and were the only districts in Tamil Nadu in which manure was applied in fields deliberately to address the low fertility problem. In fact, there is overwhelming belief by farmers that crop performance is invariably poor without manure use. Some farmer were found applying green manure like Sun hemp on their farms as a means of soil fertility management. The amount of manure applied per unit area was not known, but was dependent on the quantities provided by the animals. In contrast, none of the respondents in Tiruvannamalai and Vellore district indicated use of manure as an input for crop production. All these could be attributed to the fact that Tiruvannamalai and Vellore district soils were relatively more fertile and productive. Nevertheless, there was unawareness of the value of manure as a farm input both in Tiruvannamalai and Vellore districts; extension efforts are definitely needed in this direction.

In Tiruvannamalai and Vellore districts, majority of the farmers (80%) possessed tractors. Very few households (25% respondents) were found possessing tillage facilities and majority of the farmers (75% respondents) depended on hiring them from other farmers. Weed management is, by far, the most important pre-occupation in minor millet production in the study region. This is even more serious in Tiruvannamalai (100% respondents), where weeding is done twice per season. Parthenium weed were reported to be the most obnoxious in minor millet fields more specifically in finger millet fields because of their abundance, which makes weeding, particularly in broadcast millet, cumbersome. It is recognised as a highly debilitating weed on farm. Farmers lacked experience with Parthenium management, yet they associated its proliferation with soil fertility decline.

Family labour is invariably inadequate and every household interviewed hired labour for weeding. Owing to the field sizes being unmatched by the required labour force, timely weeding is often unattainable.

It is, therefore, likely that the crop is severely stressed by weed competition resulting in low yields. There is need for research to assess the impact of weeds and weed management in general on finger millet yield losses in this region and also create awareness among farmers about machine weeder and balram weeder. It was generally expressed that the introduction of ban of child labour by the Indian government, had reduced child involvement in weeding and other farm activities. Gender was not a factor in weed management since all gender groups were equally represented. Generally, hired labour predominated family labour and more men than women were hired for this purpose.

Table-2 Seasonal labour structure and availability for weeding, by gender and age in Tiruvannamalai & Vellore Districts

SN	Age (Years)	Family Labours (Persons)		Hired Labours (Persons)		Total (%)
1	<18	1	1	1	1	25
2	>18	1	2	3	2	75
3	Total	2	3	4	3	100
4	Labour (%)	75	25	75	25	

The roles of men and women in minor millet production activities in the study districts are presented in Table below.

Generally, bush clearing is done by men in these districts. It was found that, both gender groups participated equally in sowing in Tiruvannamalai and Vellore districts. Weed management and harvesting were also done by both sexes. However, while both sexes are involved, it was found that dominance of male was more in carrying out agricultural operations compared to female.

Table-3 Gender profile in minor millet production in Tiruvannamalai and Vellore district

SN	Activity	Respondents (%)		
		Female	Male	Both
1	Bush cleaning	0	95	5
2	Sowing	37	26	37
3	Weeding	0	0	100
4	Harvesting	5	0	95
5	Marketing	30	55	15

Farmers ranking of millet production constraints in Vellore and Tiruvannamalai District

The major constraints included pests and diseases in finger millet, common constraints like persistent drought, exhausted soils, shortage of labour for harvesting and weeding and high weed infestation were found during the study. The rankings differed among the two districts, but overall, shortage of labour for weeding and harvesting were considered the most important. This was followed by drought across the districts. Soil exhaustion was ranked the least serious problem in Vellore and Tiruvannamalai districts. It was, however, apparent that farmers were not familiar with soil related issues. Nevertheless, it was reported in Vellore district that manure application was becoming mandatory for viable crop production. Other constraints observed in Vellore district was soil salinity and alkalinity problem due to tannery effluents, low rain fall and continuous irrigation along with stagnation of problem water. In these areas only, finger millets were cultivated and the study was conducted. As majority of population were unaware about the salt tolerant millet variety like TRY 1 & TRY 2 in Finger Millet, they were found using local seeds which were susceptible to salt and due to it the yield was very poor. Such areas need intervention of frontline demonstrations and on farm testing of salt tolerant millet variety and thereby create awareness for the localites and improve their socio economic status.

Prospects of millet production & Need of millet farmers in Vellore and Tiruvannamalai Districts

Despite the gravity of the production constraints expressed by millet farmers, households remain committed to production of the crop due to the socioeconomic importance attached to it. This will require that the planting pattern is changed from broadcast to row planting, which has been shown to save as much as 80% labour requirement for millet weeding.

To address the problem of drought, creating awareness of early maturing millet varieties developed by Tamil Nadu Agricultural University would be most appropriate. It was found from the study that majority of the farmers were found growing local millet variety. Regarding soil fertility management, farmers were very receptive to ideas that augment their traditional soil improvement approaches. In Vellore district, some farmers maintained their harvest remains in rotation with cropping fields and in the process input manure into fields without incurring labour expenses for application. Furthermore, farmers in both the districts were found to practice crop rotation with leguminous & oil seed crops like cowpea, green grams and groundnuts, which contribute towards soil fertility improvement through N fixation. There is certainly a need to develop a farmer friendly soil improvement package for millet in the region to prevent the extinction of this community-valued crop.

Conclusion

From the study it was found that millets are gaining popularity among farmers only because of its ability to grow under hot dry conditions in low fertile soils of low water-holding capacity where other crops generally fall completely. Correspondingly, it is produced mainly in remote areas outer to the major production and population centres of the developing world. Prospects for the adoption of improved management technologies in both Vellore and Tiruvannamalai are limited, for several reasons. Firstly, the high variability in annual rainfall, especially in Tiruvannamalai, makes it difficult for farmers to judge potential investment returns. Secondly, labour scarcity restricts the adoption of improved soil and water conservation systems as households send children to school and adults to urban areas in search of employment. And thirdly, farmers benefit cost ratio fluctuations are leaving the farmers in dark. Such factors require scientists and extension workers to be more imaginative in developing technologies suited to these difficult production environments. Scientist of Crop Improvement section need to consider more carefully the trade-off that farmers calculate between grain and fodder, between yield and yield stability, and between input responsiveness and productivity under low input conditions. These may include aiming for a small investment in chemical fertilizer to complement the use of manure, or a crop rotation rather than a short run profit maximizing investment entailing higher production risk.

Small quantities of millet grain are marketed for use as flour, bird feed and making of health mix in both Vellore and Tiruvannamalai districts of Tamil Nadu. In Vellore, low productivity and high transport costs was found restricting millet market to a high-priced premium market and consumers preferability. While assessing the market potential of millets, it was found that, millet had more market ability for bird feed and value-added millet products like biscuits and vermicelli was found moving very frequently in commercial markets. In Tiruvannamalai, higher productivity and lower marketing costs (associated with higher population densities and better market infrastructure) offer better prospects for expanding millet sales. However, it will still be difficult for millet to compete with other cereals grown on substantially more productive land in these regions. Millets have the advantage of superior adaptation to high temperatures and infertile soils with low water holding capacity. In specific villages around Tiruvannamalai and Vellore districts where these constraints are important, millet grain can compete effectively as a food crop and as a fodder against other cereals that must be transported across long distances at considerable expense. Further, there is also a market niche for millet trade as bird seed.

As a result of this project, opportunities for millet based value added products and production possibilities of millets in low fertile soil was found having more potentiality in Vellore and Tiruvannamalai Districts. However, there is no significant association with farmer's decision towards adopting modern varieties in millets. This finding is extremely crucial for policy since these channels comprise direct policy levers in a fragmented society like Tamil Nadu. Indeed several government programmes in Tamil Nadu have relied on these channels to run large scale adoption programme but were ineffective due to the lack of decision making ability of farmers.

Application of research: The assessment of processing needs and constraints in the study are of Tiruvannamalai and Vellore district revealed that excess awareness between the links of production and consumption of millets needs to be created among farm households.

Research Category: Extension Education

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Study area / Sample Collection: Tiruvannamalai and Vellore District

Cultivar / Variety / Breed name: Minor millets *viz*., Finger Millet, Little Millet and Kodo Millet

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