



Study on production and utilization of minor millets in Madhya Pradesh

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ABSTRACT

Neglected and underutilized species (NUS) worldwide are gaining attention as they are suited to sustainable food systems offering food and nutritional security to people in marginal regions. Minor millets are one such group of crop species that can be utilized to supplement the cereal-centric diet. But they are largely neglected in terms of research and development, policy support, and consumer demand. Present study was carried out during 2020 in selected districts of Madhya Pradesh to explore the production, consumption and utilization of minor millets and to identify the problem faced by the farmers at the field level. Farmers grow local varieties of millets with poor management under rainfed conditions. The price received by the farmers vary widely, although it is economically viable. Most sample farmers were unaware of the possibility of processing the grain into various products that suit consumer demand and fetch better prices. They perceive the unavailability of high-yielding variety as the major production constraint. The revival of millets requires a multidimensional approach involving government support, research and development, awareness campaigns, and consumer demand.

Keywords: Minor Millets, Nutri-cereals, Sustainable food systems

The changing climate, depleting natural resources and increasing incidence of malnutrition across the globe necessitate the identification, and utilization of alternate crops suited to sustainable food production systems. The cereal-centric diet based on rice, wheat, and maize seems unsustainable in the long run and poses a significant challenge in ensuring food and nutritional security worldwide. A total of 60% of the calorie intake is contributed by three crops—rice, wheat, and maize (Potaka *et al.* 2021), whereas nearly half of the people suffering from hidden hunger lives in India (Ritchie *et al.* 2018). The major crops contributing to unsustainable portion of blue water footprint (WF) globally are rice (17%), wheat (27%) and maize (5.9%) and about 31% of the global unsustainable blue WF is located in India (Mekonnen and Hoekstra 2020). Therefore, dietary shifts from water-intensive to less water-intensive crops are crucial for sustainable water use. Millets are less sensitive to climate variation than rice (Davis *et al.* 2019). So, millets are among the best sustainable crop substitutes to ensure for food and nutritional security (Kumar *et al.* 2018).

Millets are one of the oldest foods known to humans but were overshadowed by other cereals such as rice

and wheat because of the focus given to the later post-green revolution (millets.dacfw.nic.in), which caused a reduction in production and consumption of millets in India. Although millets such as bajra, jowar, and ragi are receiving attention because of recent initiatives by central and state governments, remaining minor millets are still left behind regarding policy support and varietal development. Presently, minor millets are cultivated in an area of 0.54 million hectares with a production of 0.40 million tonnes in India. Nutritionally, they are rich in fibre, essential amino acids, and micronutrients and have a low glycaemic index, making them a healthy diet for combating lifestyle diseases. Studies related to production and utilisation of minor millets by farmers at field level are scanty. In this context, a study has been attempted to understand the production, utilization, and marketing of minor millets [Kodo (*Paspalum scrobiculatum* L.) and Kutki (*Panicum flexuosum* Retz.)] in selected districts of Madhya Pradesh.

MATERIALS AND METHODS

A study was carried out during 2020 in selected districts of Madhya Pradesh among farmers to understand the socio-economic status, production aspects and constraints of minor millets production. Madhya Pradesh stands first in area (26%) and production (26.03%) of minor millets in the country as of 2018–19. The area and production in the state had decreased at a rate of 5.01% and 3.39% per annum between 1970 and 2019. Seven districts from the state were selected

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purposely, with a higher area under minor millets. The selected districts were Dindori, Mandla, Umari, Chhindwara, Annupur, Shahdol, and Sidhi. The area shares of minor millets in these districts were 24.77%, 17.92%, 11.18%, 8.99%, 8.91%, 6.62% and 1.09% as of 2018–19. 30 respondents were randomly selected from each district, making a sample size of 210. The sample farmers mainly cultivate two types of minor millets: Kutki and Kodo.

The data were analysed using tabular and percentage analysis to draw meaningful conclusions. The cost of cultivation was calculated using the standard methodology followed by the Directorate of Economics and Statistics, Government of India. The garret ranking method was employed to identify and prioritize the constraints of millet cultivation. The statements for ranking were decided based on discussion with experts. These statements were ranked based on the standard garret ranking procedure. In this method, respondents were asked to rank the statements based on their perception and these ranks were converted into percent scores as:

$$\text{Percentage score} = 100 (R_{ij} - 0.5) / N_j$$

where R_{ij} , Rank given for i^{th} item by j^{th} individual, N_j , Number of items ranked by j^{th} individual.

For each statement, the scores of individual respondents were added and divided by the total number of statements to rank. These mean scores for all the statements were ranked to identify the critical constraints.

RESULTS AND DISCUSSION

Production and consumption trends: The historical data indicate that in India, both production, as well as consumption have been on the decline over the years. The factors such as comparatively low remuneration, lack of policy support, availability of rice and wheat through the Public Distribution System (PDS) at a reasonable rate, processing difficulties and low shelf life of flour, low social status attached to millets and research focus given to rice and wheat during the green revolution (GoI 2014) made millets an unappealing crop.

The cultivation of minor millets is widely distributed geographically as the group involves different species suiting various agroecological conditions of the country (Table 1). Madhya Pradesh leads in kodo and kutki production, whereas Andhra Pradesh and Maharashtra lead in producing foxtail millet and proso millet, respectively (Dhan Foundation 2012). The area and production share of minor millets for Triennium Ending (TE) 2021 was 3.39% and 2.14% respectively while the shares were 12.52 and 10% during TE 1971. As in Fig. 1, the area and production of minor millets have reduced by 90 and 80.98%, respectively, between TE 1971 and TE 2021, although productivity has almost doubled. The area and production have decreased

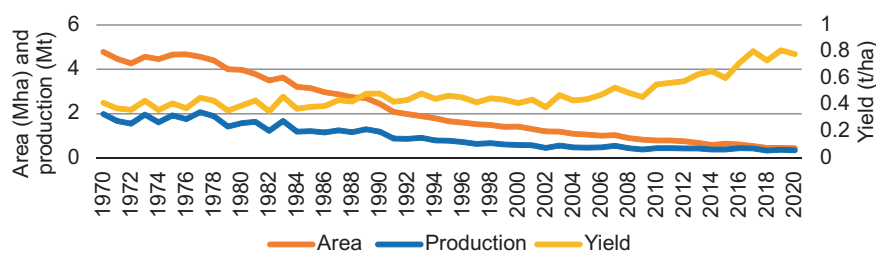


Fig. 1 Trends in area, production and productivity of minor millets at the national level.

at a rate of 4.84 and 3.73% respectively, during the study period, which is comparatively higher than other millets. At the same time, productivity has increased at a rate of 1.17% which is relatively lower than other millets. The area of all millets declined, but except for bajra, the reduction in production could not be compensated by the rise in productivity (Sukumaran Sreekala *et al.* 2023).

Madhya Pradesh stands first in area and production. Nevertheless, Uttarakhand stands first in terms of productivity, and Madhya Pradesh is not there in the first five positions, indicating an enormous scope in enhancing productivity. The reasons for low productivity in Madhya Pradesh based on the primary survey are discussed in the coming sections. The growth rates of the area and production in almost all the top five states are negative, although productivity growth is positive. This implies that the productivity growth is insufficient to compensate for the area reduction; hence, to improve production, there must be remarkable growth in productivity or a halt in area decline.

The consumption of minor millets (excluding ragi) also follows the same pattern as area and production. Fig. 2 shows the trend in the consumption of minor millets across selected states where consumption was comparatively higher. We can observe a steep decline in consumption irrespective of the state. The per-capita consumption varied in pre-2000s but converged to a meager amount (0.01 to 0.18 kg/annum/person in rural and 0 to 0.06 in urban households as of 2011–12) across the states in the recent past. In Madhya Pradesh,

Table 1 Major states in terms of area, production and productivity of minor millets

Particulars	States
Area	Madhya Pradesh (26; -5.01), Chhattisgarh (16.36; -6.97) *, Uttarakhand (10.99; -3.67) *, Maharashtra (10.64; -2.84), Odisha (5.52; -5.57)
Production	Madhya Pradesh (26.03; -3.39), Uttarakhand (19.02; -0.81) *, Tamil Nadu (7.21; -5.57), Maharashtra (7.14; -2.46), Arunachal Pradesh (6.73; 1.68)
Productivity	Uttarakhand (1.3 kg/ha; 0.66) *, Tamil Nadu (1.24; 1.03), Gujarat (1.15; 0.68), Sikkim (1.02; 2.05), Arunachal Pradesh (1.01; 0.70)

Figures in parenthesis indicate the area share (%); production share (%); productivity (kg/ha) for TE 2018–19; and annual growth rate between 1970–71 and 2018–19. * Growth rate was calculated for the period 2013–14 to 2018–19.

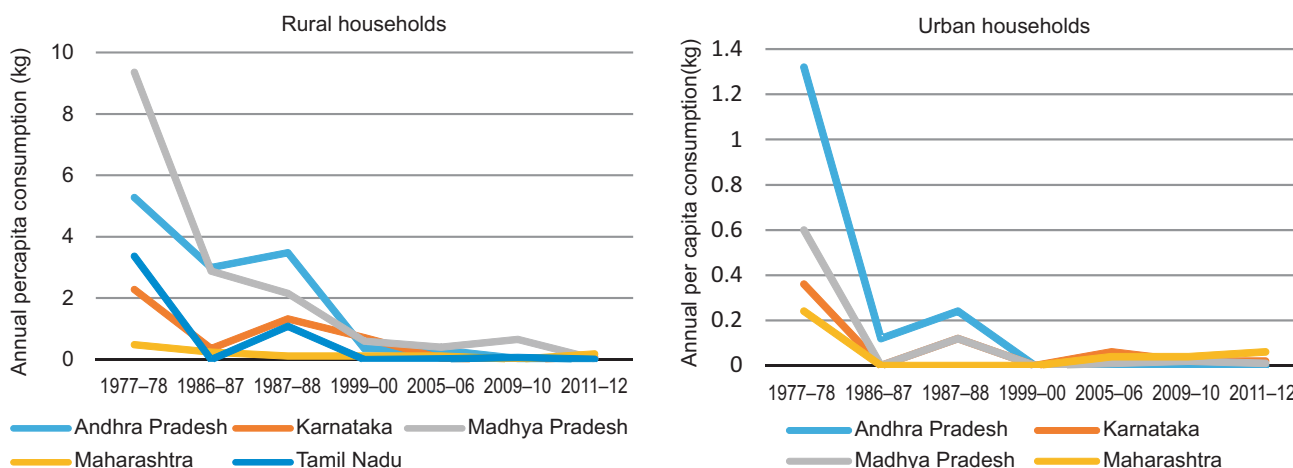


Fig. 2 State-wise consumption trends of minor millets; Data source: NSSO survey on consumption expenditure (various rounds).

the average per-capita consumption was as high as 9.36 kg per annum in rural areas, and now it has reduced to a minuscule amount of 20 g.

Cultivation aspects: The primary survey indicates that, the crop is grown under rainfed conditions without fertilizer, irrigation, and growing local varieties. On average, a farmer possesses 2.09 ha land, of which 98.33% was owned, and the rest was leased. Kodo/Kutki was grown solely during the *kharif* season. Over 70% of the land cultivated by farmers was dry/rainfed, and 23% was irrigated, but both kodo and kutki were grown completely as rainfed crops without irrigation. The use of inputs and economics of minor millet cultivation in the study area are provided in Table 2. Although a farmer possesses 2.09 ha of land, only a third of that was utilized for growing millets, and the remaining land was used to cultivate rice and maize. About 96% of the sample farmers were cultivating local varieties, mainly due to the unavailability of quality seeds. In terms of research and development, millets received lesser attention than rice and wheat, and among millets, minor millets are the most neglected group. The number of varieties developed and released for cultivation is comparatively less for minor millets. As per (GoI 2014) report, only 34 varieties of different minor millets have been released during the last 15 years (kodo millet-9, little millet-6, foxtail millet-5, barnyard millet-6, and proso millet-8), of which, only 11 have become popular in some states. However, in Chhattisgarh and Madhya Pradesh, none of the new varieties could reach the farmers (GoI 2014). Both conventional breeding and biotechnological improvement are limited in the case of small millets and Pal *et al.* (2023) reported that genome sequencing, which is crucial for breeding has been completely done only in the case of foxtail millet, while draft genome sequencing has been attempted in the case of proso millet and barnyard millet, but it was not attempted in case of little millet and kodo millet. The sample farmers identified the unavailability of quality seeds as the major constraint. In addition, kodo and kutki were grown without providing any irrigation and fertilizer. Therefore, it can be said that minor millets

are grown under marginal conditions in these districts. On average, a farmer could realize a yield of 831 kg/ha, which is far below better-performing states such as Uttarakhand, Tamil Nadu, and Gujarat in terms of productivity. Hence, the adoption of new varieties and improvement in management practices will improve productivity to a great extent.

To determine the economic viability of the crop, net returns over total cost (including both fixed cost and variable cost) and net returns over cost A2 plus imputed value of family labour (FL) (that includes all variable cost-plus rent paid for leased-in land) were worked out. Net returns over total cost were ₹3117.54/ha, while net returns over cost A2 + FL were ₹7160/ha. Verma and Banafar (2013) reported that the net income per hectare received by farmers growing minor millets in Bastar district of Chhattisgarh was ₹959.63 for kodo and ₹771.26 for kutki.

Utilization pattern: Utilization and consumption are equally important as improving production when considering millets in general and minor millets in particular. The minor millets produced by farmers in the study area are utilized for their own consumption, feed for livestock, seed, etc.

Table 2 Input use and economics of cultivation of minor millets

Particulars	Values
Land size (ha)	0.66
Per cent irrigated area	0
Fertilizer (kg/ha)	0
Varities (% of farmers)	
Local	96.19
High yielding varieties	3.81
Yield (kg/ha)	831
Cost/Returns (₹/ha)	
Gross income	20525.73
Cost A2 + FL	13365.15
Total cost (Cost C2)	17408.19
Net returns over total cost	3117.54
Net returns over cost A2 + FL	7160.58

Table 3 Utilization pattern of millets

Utilization	Quantity (Share)
Total production (q)	5.91 (100%)
Self-consumption (q)	1.72 (29.19%)
Feed (q)	0.16 (2.78%)
Seed (q)	0.38 (6.39%)
Marketed (q)	3.44 (58.18%)
Gift to others	0.21 (3.47%)

Almost one-third of the total production is utilized for self-consumption, whereas the remaining quantity is used for seed (6.39%), a gift to others (3.47%), and feed (2.78%) (Table 3).

On average, a farmer produced 5.91 quintals of minor millets, of which 58.18% of the share was sold in the market. Over 70% of the farmers in the sample had a marketed surplus of 3.44 quintals. Farmers mainly sell their products through village merchant/commission agents for an average price of ₹3025.89. In the study area, out of the total marketable surplus almost 60% was sold in the market, but there is a wide variation in price received by the farmers from ₹1500 to 3500 in various districts. Although a minimum support price (MSP) exists for all other millets, it is not announced for minor millets. A stable price environment would incentivize farmers to go for the cultivation of minor millets. Gruere *et al.* (2009) based on a case study conducted in the Kolli hills of Tamil Nadu, India, indicated that collective action initiatives are necessary for the development of a robust marketing channel for underutilized crops like minor millets as it facilitates the pooling of resources, realizing scale economies, sharing information, and developing a community-based incentive structure. Sangappa *et al.* (2023) suggested that millet value chain can be revamped by the adoption of improved technologies, better market linkages, and increased investment in infrastructure as in traditional supply chain, millet farmers are not getting remunerative prices to their produce because of the existence of various actors/middle men in the chain.

The respondents in the sample were consuming minor millet cooked like rice. The survey on awareness about other value-added products of minor millets revealed that the respondents from Chhindwara and Umaria districts were unaware of any of the products in the list. In contrast, respondents from all other districts knew that it could be utilized as atta/flour. None of the respondents in the sample were aware of products like rawa, puffs, flakes, etc. Hence, it is important to create awareness among farmers about different value-added products and provide training about different processing technologies. The demand for millet-based ready-to-eat food items is escalating owing to the increasing awareness about the health benefits of millet consumption. However, most sample farmers were unaware of the possibility of processing the grain into various products that could suit consumer demand and fetch better prices. Rao and Tonapi (2022) stated that the processing of

minor millets has improved over the years, but the lack of availability of de-hullers and separators with more than 80 per cent efficiency in primary processing is a concern as it determines the secondary processing and share of producers in consumers' rupee.

Production constraints: Major production constraints faced by the farmers were ranked based on the garret ranking technique and are listed in Table 4.

The farmers perceived the unavailability of high-yielding varieties as the major problem, followed by a lack of technical knowledge, pest and diseases, high cost of seed, and labour unavailability. Das and Rakshit (2016) also reported droughts, pests, diseases, socio economic factors and diversion of lands to other remunerative crops as the reasons for reduction in millet area at global level.

In an environment of changing climate and exhausting resources, alternate crops suited to sustainable production systems may be given focus to ensure food and nutritional security. Also, the hidden hunger due to heavy reliance on two or three major staple grains affects people worldwide. Hence, diversifying the diet with underutilized crops such as small millet is a sustainable way to healthy living. A study was undertaken to explore the production, consumption, and utilization of minor millets in selected districts of Madhya Pradesh. The study revealed that most sample farmers lack knowledge about good agricultural practices and quality seeds. Therefore, the focus must be given not only to the development of varieties suiting various agro-climatic conditions but also to the adoption of varieties by the farmers. The price received by the farmer varies widely, although it is economically viable. So, a stable price environment will encourage more farmers to cultivate minor millets. Creating awareness, provision of training, village-level processing facilities and development of value chain will motivate farmers to process millets into value-added products. There are many state and central government-sponsored programmes to promote millet production, utilization, and consumption, but there is a long way to go to bring the crop into the mainstream. The revival of millets hence requires a multidimensional approach involving government

Table 4 Major production constraints faced by farmers in millet cultivation

Constraints	Mean garrett score	Garrett rank
Unavailability of high-yielding varieties	65.57	1
Lack of technical knowledge	63.75	2
Occurrence of pests and diseases	53.60	3
High cost of seed	52.95	4
Labour unavailability	48.32	5
High cost of plant protection chemicals	47.50	6
Lack of sufficient rainfall	47.02	7
High cost of fertilizer	45.46	8
Others	22.79	9

support, research and development, awareness campaigns and consumer demand.

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