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Farmers' Adoption of Finger Millet Production Technologies and the Impact on Finger Millet Yields

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Low remuneration and poor adoption of Finger millet [*Eleusine coracana*] production technologies were major constraints in yield gap in finger millet. Therefore, evaluation of production potential, adoption, economic and other benefits of the technologies in social perspectives of the farmers was undertaken. The study was conducted in two districts of Karnataka, India where the frontline demonstrations programme organized during the five years from 2017-18 to 2021-22 in 200 farmers' fields. The knowledge, adoption and impact were measured by following before and after method, and data was collected through survey, focussed group discussion and personal interview methods. The demonstrated technologies resulted into increase in Knowledge over pre demo in use of high yielding variety (85%) followed by use of nitrogen (Urea) (62%), seed treatment (62%), use of FYM (56 %). Increase in adoption over pre demo was found in use of high yielding variety 82 % followed by use of nitrogen (62%), seed treatment (55%), use of FYM (48%). The higher adoption of

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the demonstrated technologies (71%) by the farmers in Karnataka led to higher grains production (33%) with better quality (65%) and fodder yield by 38% over pre-FLD stage. The increased yields not only enabled them to obtain higher net returns (55%) and incremental increase of benefit-cost ratio (25%) but also motivated to increase in area under finger millet (20%) significantly than the pre-FLD stage. Whereas, very low increase in cost of production (10%) over the pre-FLD stage was observed. Age, education, family size, annual income, institutional support, extension contact, herd size, and utility of grain and fodder were found to be significant in explaining the variation in their adoption level of demonstrated finger millet production technologies. Among the constraints, availability of labour, wild animals (deer and wild boar) and availability of seed are the major production constraints and price fluctuation, limited quantity purchases by government, delay in payment by government, and high commission from APMC are the major market constraints. To boost-up the adoption, large family size of the farmers, their dependency on farming and continuing newly selected farmers with field demonstration of location-specific low-cost technologies up to five years should be considered.

Keywords: Adoption; Impact of production technologies; knowledge; yield advantages and finger millet.

1. INTRODUCTION

Millets are small-seeded crops grown for food and fodder. India is the largest producer of millets in the world. Among the millets, finger millet is an important crop grown in India. Globally, it is sixth most important crop among cereals in terms of production and it contributes about 12% of the total millet area. In India, finger millet is cultivated in an area of 1.208 m ha with a production of 2.06 m tonnes with average productivity of 1706 kg/ha [1]. It is grown for both grain and forage purposes. In India, Karnataka is the leading producer of finger millet with 53.94 per cent of the total area and 53.36 per cent of the total production of the crop followed by Tamil Nadu, Uttaranchal, Maharashtra and Andhra Pradesh. Finger millet has been identified as one of the future smart food crops by FAO [2] because of its nutrient-dense and climate-resilient feature. Moreover, it has gained focus of research for its potential to grow under varied climatic situation and has a potential solution for addressing malnutrition and hidden hunger worldwide [3].

Although there are many improved production practices in finger millet such as, high yielding varieties, crop rotation, IPM, INM, IFS etc. their adoption is very minimum at farm level [4]. The yield gap from potential yield to attainable yield is about 1.0 t/ha and attainable yield to farmer's yield is more than 2.0 t/ha [5]. Reasons for this lower acceptance of improved practices may be due to lack of awareness, accessibility, technical & economic feasibility and complexity of the technology etc. Greater understanding of finger millet production in terms of adoption of improved technology, constraints in production & marketing, impact of improved technology is most important to increase the production, productivity and farmer's income. Hence, there is a need of eco-friendly finger millet production technologies adoption on large scale for sustainable production. Apart from this, socio-economic and marketing aspect of finger millet is also important in order to facilitate the farmers to get maximum benefits from the crop. With this background, the present study was undertaken to ascertain impact of the demonstrated finger millet technologies on agro-economic, farming and farmers' livelihood aspects. The knowledge level and extent of adoption of these recommended production technologies were also assessed in order to replicate successful results. This study would help to develop effective extension strategies for popularizing the finger millet production technologies.

2. MATERIALS AND METHODS

The study was conducted in finger millet growing areas of Karnataka where the FLDs were conducted by ICAR-IIMR, Hyderabad during last five years. Latest released finger millet varieties FLDs viz., 'GPU 66 KMR-301, KMR-340, KMR-204, KMR-630 and VR-929 along with recommended cultivation practices were undertaken. The locally popular varieties namely, 'Indof-5', GPU-28, which were grown by the farmers along with their own cultivation practices, were taken as a check plot for comparison. Finger millet is one of the major crops grown in this region. Kolar and Chikkaballapur Districts were purposively selected for the study as majority finger millet cultivated area (61500 ha.)

comes under these districts. Purposive random sampling method was followed for selection of respondents. The sampling was done by selecting 200 farmers randomly from different categories who were the beneficiaries of the FLDs during 2017-2022. A total 200 respondents were selected randomly those who belonged to different categories (marginal, small, medium and large). Ex-post facto research design was followed utilizing both primary and secondary source of data. Survey, focussed group discussion and personal interview methods was used for collection of primary data. The secondary data was also being used to support the primary data and analysis. The adoption of the demonstrated technologies was ascertained on three-point continuum i.e. full, partial and no adoption with assigning two, one and zero score, respectively. Adoption index was used to measure the extent of adoption by using following formula [6] (Mendola M. 2007).

$$AI = \frac{Respondents\ total\ score}{Total\ possible\ score} X100$$

A knowledge test on finger millet production technology was developed for the study. Standardized knowledge test was developed as follows (Dhruw, K.S et.al & Sasane KL, 2012)

$$KI = \frac{Respondents\ total\ score}{Total\ possible\ score} X100$$

Socio-economic impact was assessed by using pre- and post-evaluation test. The data was categorized in two stages viz., pre-FLDs, and post-FLDs in order to evaluate impact of the latest demonstrated technologies. Impact index was worked out by calculating average score of the four parameters viz., grain yield, fodder yield, net returns and benefit-cost ratio (B:C) of the demonstrated technologies under pre- and post-FLDs (Thakur, A. K, 2017) [7]. The constraints were rated on a three-point continuum starting from 1= to a low extent to 5= to a high extent on different components [8]. The constraints were measured by using Garrtte's ranking method. The data were analysed with descriptive statistics; mean, correlation and 't' test analysis.

3. RESULTS AND DISCUSSION

During the last five years a total of 3100 Frontline demonstrations (FLDs) on finger millet production technologies were conducted by the All India Coordinated Research Project on Small Millets of ICAR-IIMR in major finger millet growing areas of the country.

3.1 Knowledge level of Farmers about Demonstrated Finger Millet Production Technology

Practice-wise increase in knowledge of the demonstrated production technologies over pre-demo followed by the farmers in Karnataka were significantly higher (Table 1). 85 % increase in knowledge over pre demo was found in use of high yielding variety followed by use of nitrogen (Urea) (62%), seed treatment (62%), use of FYM (56 %), timely sowing (45%) maintaining plant spacing (35%) and use of P_2O_5 (33 %). Whereas, below 30% increase in knowledge was found in irrigation application, seed rate, pest control measures, time of harvesting, timely land preparation, disease control and use of potassium fertilizer [9,10,11].

3.2 Adoption Level of Farmers about Demonstrated Finger Millet Production Technology

Practice-wise increase in adoption of the demonstrated production technologies over pre-FLD followed by the farmers in Karnataka were significantly higher (Table 1). 82 % increase in adoption over pre demo was found in use of high yielding variety followed by use of nitrogen (62%), seed treatment (55%), use of FYM (48%), weed control (45%) and use of P_2O_5 (33 %). Whereas, below 30% increase in adoption was found in time of sowing, irrigation application, pest control measures, time of harvesting, timely land preparation, disease control, seed rate, use of potassium fertilizer and spacing [12,9,10,13,11, 14,15].

3.3 Yield and Economic Benefits from the Demonstrated Technologies

The higher adoption of the demonstrated technologies (71%) by the farmers in Karnataka led to higher grains production (33%) with better quality (65%) and fodder yield by 38% over pre-FLD stage. The increased yields not only enabled them to obtain higher net returns (55%) and incremental increase of benefit-cost ratio (25%) but also motivated to increase in area under finger millet (20%) significantly than the pre-FLD stage [16]. Whereas, very low increase in cost of production (10%) over the pre-FLD stage was observed. It may be due to adoption of low-cost or no-cost production technologies like, maintaining plant geometry, seed rate and plant protection measures terms of benefit-cost ratio was not significant. It is elicited that only increase in productivity can't support farmers to get maximum benefit. Therefore, judicious use of inputs as per the recommendations coupled with adopting timely management practices also play vital role in achieving maximum profits per unit cost [17,18]. In the study, the same trend of little increase in cost of production than the pre-FLD stage was observed. It is indicated that adoption of the demonstrated production technologies helped farmers to get maximum benefit with quality production [19,20].

3.4 Regression of Socio-Economic Variables and Impact of the Demonstrations

It could be observed from the results that, 'F' value (15.31) obtained was significant at one per cent level of significance indicating that, all the independent variables put together contributed significantly to the variation in the extent of adoption of demonstrated finger millet production technologies. The coefficient of determination (R^2) was 0.71, which revealed that the variation in the extent of adoption of demonstrated finger millet production technologies by the farmers was together explained by all the independent variables selected for the study.

The study revealed that eight characteristics of farmers out of thirteen variables *viz.,* age, education, family size, herd size, annual income, extension contact, institutional support, utility of grain and fodder were found to be significant in explaining the variation in their adoption level of demonstrated finger millet production technologies [21,22]. It is referred that increasing unit of these variables results in turn increase in level of adoption of the respondents. Hence, these variables could be considered as good indicators of adoption by the farmers. The value of co-efficient of determination (R^2 =0.71) indicated that all the thirteen variables together explained 71 per cent of the variation in the adoption. Since 71 per cent of the variation could be explained in the study by thirteen variables [23].

3.5 Constraints Faced by the Farmers in Adoption of Demonstrated Finger Millet Production Technologies

An effort has been made to identify the major constraints faced by farmers for adoption of demonstrated finger millet production technologies. These constraints were compared using Friedman's two-way ANOVA.

3.5.1 Production related constrains

It is evident from the results (Table 5) that among the constraints, availability of labour, wild animals (deer and wild boar), availability of seed, erratic rainfall and high input cost are the major constraints for adoption of demonstrated finger millet production technologies [8,24].

Table 1. Increase in knowledge over pre-demo stage

S.No	Practice	Increased knowledge over pre-demo stage (%)	't' value
1	Land preparation in time	15	3.21*
2	Use of high yielding variety	85	22.16**
3	Seed treatment	62	15.6**
4	Seed rate	20	4.9**
5	Time of sowing	45	8.9**
6	Spacing	35	6.1**
7	FYM	56	14.98**
8	Nitrogen (Urea)	62	17.85**
9	P_2O_5	33	6.2**
10	K_2O	7	1.85NS
11	Weed control	14	4.6*
12	Irrigations applied	25	5.7**
13	Insecticide used	16	2.74*
14	Disease control	12	3.45*
15	Time of harvesting	15	2.64*

*** Significant at P=0.01; *Significant at P=0.05; NS= Non Significant*

Table 2. Increase in adoption over pre-demo stage

S.No	Practice	Increased adoption over pre-demo stage (%)	't' value
1	Land preparation in time	8	1.81 NS
2	Use of high yielding variety	82	21.5**
3	Seed treatment	55	14.22**
4	Seed rate	5	1.29 NS
5	Time of sowing	28	5.88**
6	Spacing	-6	1.02NS
7	FYM	48	9.65**
8	Nitrogen (Urea)	62	17.51**
9	P2O5	33	5.89**
10	K2O	5	1.42 NS
11	Weed control	45	13.2*
12	Irrigations applied	20	4.51**
13	Insecticide used	12	4.5**
14	Disease control	7	2.85*
15	Time of harvesting	10	4.98**

Table 3. Indicators of impact assessment of finger millet FLDs

S.No	Practice	Change over pre-demo stage (%)	't' value
1	Area of finger millet (ha)	20	2.65*
2	Adoption level	71	27.64**
3	Cost of production (`/ha)	10	4.23*
4	Grain yield (q/ha)	33	9.32**
5	Fodder yield (q/ha)	38	11.95**
6	Net returns (`/ha)	55	12.68**
7	Benefit-cost ratio	25	5.64**
8	Quality of grain	65	16.85**

Table 4. Variables for contribution of Adoption

S.No.	Variables for contribution of Adoption	Regression coefficient (b)	Standard error	t-value
1	Age	**.63**	**1.017**	**2.396***
2	Education	**.29**	**.241**	**1.98***
3	Land size	.196	.312	.587
4	Family size	**.467**	**.912**	**2.471***
5	Farming Experience	-.270	.816	-1.374
6	Herd size	.202	.124	**2.318***
7	Annual Income	**.611**	**.031**	**3.65****
8	Institutional support	**.251**	**1.21**	**4.767****
9	Extension contact	**.151**	**.081**	**2.24***
10	Socio-politico participation	.019	.067	.261
11	Utility of grain and fodder	.118	1.072	**2.25***
12	Training	.048	.842	.575
13	Innovativeness	.314	.557	.97*
	R^2 = 0.71			**F= 15.31****

** Significant at 5% level of probability, ** Significant at 1% level of probability*

Table 5. Mean ranks comparison of production constraints by farmers

S.No.	Problem	Mean Rank	Std. Deviation
1	Availability of labour	8.4	I
2	Wild animals (Deer and wild boar)	7.0	II
3	Availability of seed	5.5	III
4	Erratic rainfall	4.9	IV
5	High input cost	3.5	V
6	Pest and disease problem	2.9	VI
7	Irrigation availability	2.5	VII

3.5.2 Marketing related constrains

Table 6. Mean ranks comparison of marketing constraints by farmers

S.No.	Problem	Mean Rank	Std. Deviation
1	Price fluctuation	8.4	I
2	Limited quantity purchase by government	6.8	II
3	Delay in payment by government	5.2	III
4	High commission from APMC	4.1	IV
5	Lack o cooperatives for procurement	3.5	V
6	Storage facilities	2.5	VI

It is evident from the results (Table 6) that among the marketing constraints, price fluctuation, limited quantity purchases by government, delay in payment by government, and high commission from APMC are the major market constraints for finger millet [8].

4. SUMMARY AND CONCLUSION

Based on the impact assessment of the conducted FLDs, it can be concluded that the crop yield and economic return were significantly higher in the demonstrated plots than in the local check plots resulting in higher grain yield with better quality and fodder yield, and ultimately net returns. Such superior yield performance motivated the beneficiary farmers to adopt the improved finger millet production practices by replacing the existing cultivation practices. This impact enabled to motivate the farmers to extend area under Finger millet. Very low increase in cost of production (10%) over the pre-FLD stage was observed. It may be due to adoption of technologies like FYM, fertilizers application, seed treatment and plant protection measures. Effect of the FLD technologies in terms adoption of seed rate, and spacing was not significant. Farmers were adopting broad casting method for sowing followed by ploughing and thinning of the seedlings after 15 days. This was due to the scarcity of labour at the time of sowing. Out of fifteen demonstrated practices, only six practices namely, use of high yielding variety, use of treated seeds or seed treatment, use weed control measures, FYM, nitrogen fertilizer application was found to be adopted by the farmers. It was found that the farmers would like to continue with their own inputs arrangement after withdrawal from the scheme (post-FLD period), but they were unable to access required quality seeds of high yielding varieties at village level. Therefore, the inputs support mechanism in convergence mode needs to be developed at grass-root level and marketing facilities. Since, it is labour intensive crop, suitable mechanization wherever possible should be introduced especially for harvesting operations to overcome labour problems which takes major share of input-cost. These were the limiting factors in the adoption process. To boost-up the adoption, large family size of the farmers, their dependency on farming and continuing newly selected farmers with field demonstration of location specific low-cost technologies up to five years should be considered [25,26].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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