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Original Research Article

Extent of Adoption of Bengalgram Technologies Developed by UASR in NEK Region

S. Brunda[1], G. M. Hiremath[1], B. S. Reddy[1], Amrutha T. Joshi[1] and S. B. Goudappa[2*]

[1]Department of Agricultural Economics, University of Agricultural Sciences, Raichur - 584104, Karnataka, India
[2]Department of Agricultural Extension Education, University of Agricultural Sciences, Raichur - 584104, Karnataka, India
**Corresponding author*

A B S T R A C T

Agriculture is often characterized by low use of modern technology and low productivity. Improving the productivity, profitability and sustainability of small holder farming is the main pathway to reduce poverty. Achieving agriculture productivity growth will not be possible without developing and disseminating cost effective yield increasing technologies because, it is no longer possible to meet the needs of growing population by expanding area under cultivation. For this study purpose, the data were collected from 120 bengalgram growers from two districts *viz.*, Kalaburagi and Raichur of NEK region using multistage purposive sampling technique. The demographic and socio-economic factors that determine the adoption of bengalgram technologies were age of household head, education of household head, farming experience, extension contact, size of landholding and working family labour. The method of principal component analysis was used to estimate composite index revealed that out of 120 sample farmers, 39 farmers were categorized as low technology adoption group, 50 farmers as medium technology adoption group and 31 farmers were grouped in high technology adoption group. The extent of adoption of improved bengalgram technologies revealed that cent per cent of adoption could be found in sowing and nipping. The higher per cent of adoption of most of improved technologies of bengalgram could be seen in high adopter categories followed by medium and low adopter categories. The majority of the respondent farmers adopted JG-11 variety followed by Annigeri-1 and GBM-2. The extent of adoption of improved practices such as disease and insect pest management were found to be least in low and medium adopter categories.

Keywords

Adoption, technology and productivity

Introduction

The agricultural sector has been recognized as a key fundamental for spurring growth, overcoming poverty and enhancing food security. Around 60-70 per cent of population depends upon agriculture and allied sectors in India and currently it contributes to 16-17 per cent of the GDP (MoF, 2018). Agriculture is often characterized by low use of modern technology and low productivity. Improving the productivity, profitability and sustainability of small holder farming is the main pathway to reduce poverty. Achieving agriculture productivity growth will not be possible without developing and disseminating cost effective yield increasing technologies because it is no longer possible to meet the needs of growing population by expanding area under cultivation. Agricultural research and technological

improvements are therefore crucial to increase agricultural productivity and thereby reducing poverty and meeting demands for food without irreversible degradation of natural resource base (Afsaw *et al.,* 2012).

Technical innovations and improved farming practices that increase agricultural production and productivity while enhancing climate resilience exist. These include drought tolerant seed varieties, drip irrigation, the precision application of fertilizers and agrochemicals as well as practices such as integrated pest management, conservation farming, improved watershed and soil management among others. However, getting these technologies into the hands of the farmers who will benefit most from them is not straightforward. Although technology is not a panacea, it is key to addressing the food production side of the food security equation.

Increasing food production simply by using more land, water, seeds, fertilizer, and pesticides will not achieve the significant improvements in productivity necessary to advance the economic well-being of the food insecure countries. Equally important, the "more" approach is limited by the scarcity of resources and contributes to greenhouse gas emissions, deforestation and other environmental ills. Hence, widespread use of advanced technologies and practices is critical to intensifying production in an environmentally sustainable manner (Weisenfeld and Wetterberg, 2015).

Bengalgram is the third most important pulse crop after dry bean and peas, produced in the world. It accounts for 20 per cent of the world pulses production and its global importance has increased considerably during the past three decades. The number of bengalgram growing countries has increased from 36 to 52 and importing countries from 30 to 150 during 1981 to 2011.

India is the largest producer and consumer of bengalgram followed by Pakistan, Turkey and Iran. Madhya Pradesh is the single largest producer in the country, accounting for over 40 per cent of total production. Rajasthan, Maharashtra, Uttar Pradesh and Andhra Pradesh contributed about 14 per cent, 10 per cent, 9 per cent and 7 per cent respectively.

In Karnataka, bengalgram is grown in 9.26 lakh hectares with production of 7.03 lakh tonnes and productivity of 799 kg/ha. Major bengalgram growing districts in Karnataka are Belagavi, Bidar, Vijayapura, Dharwad, Gadag, Kalaburagi, Haveri, Koppal and Raichur. Bengalgram is major pulse crop in North-Eastern Karnataka (NEK) region as region contributes to 55.29 per cent to total bengalgram production of the state.

Materials and Methods

In order to test the specific objective of the investigation, primary data required for the study were collected by directly interviewing sample farmers using pre-tested schedule. The present study was confined to the North-Eastern dry Zone of Karnataka as North-Eastern Karnataka region (NEK) contributes 55.29 per cent to bengalgram production of the State. For the present study the systemized multistage purposive sampling technique was used to select the sample farmers from the two districts *viz.*, Kalaburagi and Raichur. In the first stage, Raichur and Kalaburagi districts were selected based on bengalgram production potential and the technology interventions. At the second stage, two taluks *viz.*, Sedam and Chittapur were selected from Kalaburagi district and similarly, two taluks *viz.*, Manvi and Lingasugur were selected from Raichur district using same criterion, accordingly four taluks were selected in consultation with KVK and AEEC of University to get the

required number of sample farmers. At third stage, three villages from each taluk were selected. Accordingly, 12 villages, 10 sample farmers were selected from each village. In total, 120 sample farmers were selected from two districts. The information pertaining to socio-economic features of the sample farmers such as age, education level, family size, experience in farming, size of land holding and working family labour were collected.

Composite index

The components of technology recommended by the University of Agricultural Sciences, Raichur (UASR) for bengalgram crop in terms of adoption scores (X1..... Xn) were utilized for developing composite index of technology adopted. A composite index is a single numerical value representing the net adoption of all components of technologies whose values lies in between 0 and 1 (Nimbalkar *et al.,* 2014).

The Principle Component Analysis (PCA) approach was used for developing composite index. A set of Kth components explaining 100 per cent of total variation of all components of recommended technologies were considered correlation matrix where row represents variables and columns represents Eigen vectors from which weight (wi) coefficients of components of technology say Σ is determined as,

$Wi = \sum Mi/Mi$

Where,

Wi = Weight or coefficient of component of technology

Mi = Maximum element in ith row

ΣMi = Sum of maximum element in ith row

The required linear function for deriving composite index were,

$Si = W1X1 + W2X2 + ...+ WnXn$

Where,

Si = Composite index score

Xi's = Adoption scores for individual component of technology

This provides adoption index (of all components of technologies) for each cultivator. The composite index obtained in the process lie in between 0 and 1. The composite score of farmers was classified as low level adoption (below 60 per cent) medium level (61-80 per cent) and high level of adoption (above 81 per cent).

Results and Discussion

Socio-economic characteristics of sample farmers

An understanding of socio-economic characteristic features of sample farmers is expected to provide socio-economic status of farmers in the study area. Therefore, an attempt has been made to analyze some of important characteristic features of sample farmers and the results are presented in Table 1. The results presented in the table indicated that majority of the farmers under low, medium and high adopter categories were in middle age group. Similar results were quoted by Thoke and Gunjal (2010), Dayal and Mehta (2015), Singha *et al.,* (2016) and Thinde *et al., (*2017). They reported in their studies that majority of the farmers who adopted different crop technologies were found in middle age group.

The highest percentage of middle age farmers were medium adopters (76.00%) followed by

high adopters (64.52%) and low adopters (51.28%). The participation of young age group was found to be higher in case of medium adopters (12.00%) followed by low adopters (7.69%) and high adopters (6.45%). The per cent of old age group was found to be highest in case of low adopters (41.03%) followed by high adopters (29.03%) and medium adopters (12.00%).

With respect to education level, it was observed that majority of low adopters were illiterate (51.28%) compared to medium adopters (28.00%) and high adopters (22.58%). These results gain supported from Siddayya *et al.*, (2016) and Thinde *et al.*, (2017). It was reported by Siddayya *et al.*, (2016) in their study that less percentage of illiterates (30%) were found in adopters of improved technologies of pigeon pea as compared to non-adopters (50%). It was also observed from the study of Thinde *et al.*, (2017) that most of the farmers who adopted improved production technologies of wheat were literate (89.99%). The low adopters had maximum education up to high school level.

Among medium adopters, 32 per cent had primary, 28 per cent had high school level education and 12 per cent of them together had pre university or above college level education. In case of high adopters, highest percentage of them had high school level (25.81%), equal percentage of them (19.35%) had primary and pre university level education. More number of high adopters had pre university and above college level education as compared to medium adopters.

Majority of the farm families of low, medium and high adopters fall under nuclear type. The results were in conformity with results of Raghav and Sen (2014). They reported in their study that higher percentage of families of sample farmers were nuclear ones (58%) and lesser percentage (42%) of sample famers were living in joint family system and majority of marginal and small farmers follow nuclear family system, whereas the majority of semi-medium, medium and large farmers still live in a joint family system.

However, higher joint families were noticed among high adopters (45.16%) followed by medium adopters (36.00%) and low adopters (28.21%). Majority of low, medium and high adopters were residing in Pucca houses.

The average family size of low, medium and high adopters was found to be six, seven and eight respectively. There was not much variation in male and female composition in the family size across the different level of adopters. The number of children in a family varied between three in high adopters and two in medium and low adopters. The average size of operational landholding was found to be high in case of high adopters (5.05 ha) followed by medium adopters (4.23ha) and low adopters (3.10 ha). The results were in conformity with results of Raghav and Sen (2014).

They reported in their study that higher percentage of families of sample farmers were nuclear ones (58%) and lesser percentage (42%) of sample famers were living in joint family system and majority of marginal and small farmers follow nuclear family system, whereas, the majority of semi-medium, medium and large farmers still live in a joint family system

It was also observed that majority of medium adopters and high adopters were medium and large farmers. Whereas, majority of farmers were small and medium under low adopter category. More number of marginal farmers were found in case of low adopters (15.38%) followed by medium adopters (6.0%). No marginal farmers were found in case of high adopter category.

Table.1 Socio-economic characteristics of sample farmers

Sl. No.	Particulars	Adopters					
		Low (n=39)		Medium (n=50)		High (n=31)	
I	**Age**	**No.**	**Per* Cent**	**No.**	**Per cent**	**No.**	**Per cent**
a	Young age (<35 years)	3	7.69	6	12.00	2	6.45
b	Middle age (35-55 years)	20	51.28	38	76.00	20	64.52
c	Old age (>55 years)	16	41.03	6	12.00	9	29.03
II	**Education level**						
a	Illiterate	20	51.28	14	28.00	7	22.58
b	Primary	12	30.77	16	32.00	6	19.35
c	High school	7	17.95	14	28.00	8	25.81
d	Pre University	-	-	4	8.00	6	19.35
e	College & above	-	-	2	4.00	4	12.90
III	**Type of family**						
a	Joint	11	28.21	18	36.00	14	45.16
b	Nuclear	28	71.79	32	64.00	17	54.84
IV	**Type of house**						
a	Kaccha	5	12.82	3	6.00	2	6.45
b	Pucca	31	79.48	47	94.00	29	93.55
c	Thatched	3	7.69	-	-	-	-
V	**Average family size**						
a	Men	2.00	-	3.00	-	3.00	-
b	Women	2.00	-	2.00	-	2.00	-
c	Children	2.00	-	2.00	-	3.00	-
	Total	6.00	-	7.00	-	8.00	-
VI	**Average size of operational landholding (ha)**						
a	Owned	2.97	-	3.87	-	4.58	-
b	Leased in	0.13	-	0.36	-	0.47	-
	Total	3.10	-	4.23	-	5.05	-
VII	**Category of farmers**						
a	Marginal (up to 1ha)	6	15.38	3	6.00	-	-
b	Small (1 to 2ha)	14	35.90	12	24.00	7	22.58
c	Medium (2 to 4 ha)	13	33.33	15	30.00	9	29.03
d	Large (> 4ha)	6	15.38	20	40.00	15	48.39
VIII	**Working family labour**						
a	Men	1.10	-	1.23	-	1.43	-
b	Women	0.33	-	0.43	-	0.50	-
	Total	1.43	-	1.66	-	1.93	-
IX	**Farming experience (years)**						
a	Low (Upto 17.9)	10	25.64	18	36.00	7	22.58
b	Medium (17.9-24.24)	8	20.51	23	46.00	17	54.84
c	High (Above 24.24)	21	53.84	9	18.00	7	22.58
X	**Extension contact**						
a	Once in a week	-	-	9	18.00	8	25.81
b	Once in a fort night	3	7.69	5	10.00	9	29.03
c	Once in a month	7	17.95	12	24.00	5	16.13
d	Not at all	29	74.36	24	48.00	9	29.03

Note: Per cent to respective total

Table.2 Distribution of selected bengalgram growers on the basis of composite index (CI)

Sl. No.	Level of adoption	No. of sample farmers	Per cent
1	Low adopters (<0.60)	39	32.50
2	Medium adopters (0.60-0.80)	50	41.66
3	High adopters (>0.80)	31	25.83
	Total	120	100.00

Table.3 Extent of adoption of improved technologies by bengalgram growers

Sl. No.	Technologies	Extent of adoption					
		Low (n=39)	Per* cent	Medium (n=50)	Per cent	High (n=31	Per cent
I	**Varietal technologies**						
1	GBM-2	2	5.12	4	8.00	6	19.35
2	Annigeri-1	17	43.58	9	18.00	5	16.12
3	JG-11	20	51.28	37	74.00	20	64.51
II	**Production technologies**						
1	Sowing time	39	100.00	50	100.00	31	100.00
2	Recommended fertilizer application	11	28.20	41	82.00	26	83.87
3	Seed rate	16	41.00	39	78.00	28	90.32
4	Seed treatement	-	-	15	30.00	23	74.19
5	Nipping	39	100.00	50	100.00	31	100.00
6	Intercultivation	21	53.84	44	88.00	28	90.32
III	**Protection technologies**						
1	Insect pest management	15	19.73	34	44.73	27	87.09
2	Disease management	1	2.22	21	46.66	23	74.19

Note: Per cent to respective total

With respect to working family labour, more number of working family labour (both men and women) was found in case of high adopters (1.93) followed by medium adopters (1.66) and low adopters (1.43). This might be due to higher number of joint families were noticed in high adopter category followed by medium adopter category and more number of males were noticed in both categories. This eventually contributed more number of working family labours in both categories.

With respect to farming experience, majority of medium (46.00%) and high adopters (54.84%) were found in medium level of farming experience of about 17.9 years to 24.24 years. Majority of low adopters (53.84%) had high level of farming experience (above 24.24 years). These results were contradictory to results of Maraddi *et al.*, (2014). They reported in their study that half of respondents (49.17%) possessed low experience followed by medium experience (31.67%) and high experience (19.17%) category.

With respect to extension contact, majority of low adopters (29) were not having contact with extension agencies followed by

medium adopters (24) and high adopters (9). More number of medium adopters and high adopters meet extension agencies weekly, fort nightly and monthly.

Distribution of selected bengalgram growers on the basis of composite index (CI)

Even though the technology package was developed by the Agricultural Universities for respective region, it is important to examine the extent of adoption and its cost effectiveness. Hence, the method of Principal Component Analysis (PCA) was used to estimate the composite index for individual farmer. Thereafter, all the farmers under study were grouped according to composite index ranging from 0.01 to 0.60, 0.61 to 0.80 and above 0.81 as low, medium and high technology adoption groups. Distribution of selected cultivators showed the adoption of recommended technologies in the bengalgram cultivation.

It is clear from Table 2 that out of 120 sample farmers, 39 farmers were categorized as low adopters, 50 farmers as medium technology adoption group and 31 farmers were grouped in high technology adoption group. The composite index of individual farmer showed the adoption of recommended technologies in bengalgram cultivation. These results were contradictory to results of Datarkar *et al.,* (2015). In their study they used PCA to estimate CI. Most of the sample farmers were found in low adopter category as compared to medium and high adopter category.

Extent of adoption of improved technologies by bengalgram growers

The data pertaining to the practice wise adoption of improved technologies of bengalgram cultivation is presented in Table 3 revealed that the practices adopted by all the respondent farmers were sowing time (100%) and nipping (100%). The results were in line with study of Chatterjee *et al.,* (2003) and Singh *et al.,* (2017). They reported in their studies that majority of bengalgram growers and blackgram growers have completely adopted the practices *viz.*, time of sowing. It was also evident from the studies of Dwivedi *et al.,* (2011), Islam *et al.,* (2013) and Dhayal and Mehta (2015) the majority of farmers who adopted recommended practices were found to be high in case of time of sowing. It is also evident from table that the higher per cent of adoption of most of improved technologies of bengalgram could be seen in high adopter categories followed by medium and low adopter categories. With respect to varietal technologies, majority of the sample farmers were adopted JG-11 variety. This was due to the fact that JG-11 variety gives relatively higher yield as compared to Annigeri-1 and GBM-2 varieties and this variety fetches higher price in the market and per cent of adoption of JG-11 was highest in medium adopter categories (74%) followed by high adopter categories (64.51%). The highest per cent of adoption of GBM-2 variety was observed in high adopter categories (19.35%) followed by medium (8%) and low adopter categories (5.12%). This might be due to the fact that the higher adopters were more innovative, optimistic and ready to take risk in the farming. So they have adopted this new variety with a curiosity of obtaining higher yield. In case of Annigeri-1 variety, the percentage of adoption was highest in low adopters categories (43.58) followed by medium (18%) and high (16.12%) adopter categories. This was because of most of the farmers in low adopter category belonged to old age group. They may behave like laggards and not ready to accept any changes in society and they are last adopters of any new

technologies. They were bound to customs and traditions.

With respect to production technologies, under low adopter categories none of them practiced seed treatment. Similar results quoted by Dwivedi *et al.,* (2011) and Maraddi *et al.,* (2014). They reported in their studies that majority of farmers were not adopted seed treatment due to lack of knowledge. Lesser proportion of them adopted recommended fertilizer application and higher proportion of (53.84%) low adopters adopted intercultivation. However, even under low adopter category also cent per cent of farmers have adopted proper sowing time and nipping. Among medium and high adopter categories, least per cent of adoption could be observed in seed treatment. The highest per cent of adoption was observed in both seed rate (90.32%) and intercultivation (90.32%) in case of high adopter categories. Whereas, extent of adoption was highest in intercultivation (88.00%) in case of medium adopter categories. These results are in conformity with findings of Patel *et al.,* (2016) who reported that 96.22 per cent and 85.55 per cent mean score was recorded for tillage and inter cultivation and ranked first and second, respectively in adoption of groundnut production technologies in Banaskantha district in North Gujarat

With respect to protection technologies, per cent of adoption in case of disease management was highest in high adopter categories (87.09) followed by medium (44.73%) and low (19.73%) adopter categories. The similar trend was observed with respect to insect pest management. These results got support from studies conducted by Dwivedi *et al.,* (2011) and Maraddi *et al.,* (2014). It was reported by Dwivedi *et al.,* (2011) that plant protection measures were not adopted by majority of the farmers due to lack of knowledge, high cost involved in purchasing agro-chemicals, use of sprayers in standing long duration crop for control of pod fly and pod borer. It was quoted by Maraddi *et al.,* (2014) that lesser percentage of respondents noticing in full adopter category in disease management (2.50%). High adopters were adopted pest and disease management to greater extent this is due to fact that they were economically good as compared to low and medium adopters as the insecticides recommended for pest control are costly. They also have good knowledge about seed treatment with trichoderma as compared to low and medium adopters.

Conclusion

Results of the study indicated that highest percentage of sample farmers under all adopter categories were found in middle age group. Most of famers under low adopter categories were illiterate and had education up to high school level. Whereas, farmers under medium and high adopter categories had education up to college and above college level. The average size of operational land holding was found to be high in high adopter categories followed by medium and high adopter categories. More number of working labour was found to be in high adopter categories followed by medium and low adopter categories. Majority of medium and high adopters were found in medium level of experience in farming. Whereas, most of low adopters were found in high level of experience in farming. Highest proportion of farmers in low adopter categories were not having contact with extension agencies followed by medium and high adopter categories. Highest percentage of sample farmers were categorized as medium technology adoption group followed by low and high technology adoption groups. All the sample farmers

were adopted practices such as nipping and sowing time. Majority of the farmers under all adopter categories have followed practices such as seed rate and intercultivation to a greater extent. The practices such as disease and insect pest management were found to be least in case of low and medium adopter categories.

Policy implication

The study revealed that there was 41.66 and 25.83 per cent of farmers were categorized as medium and high adopters indicating the less adoption of technologies. Further many of the farmers are not aware of improved agricultural technologies such as seed treatment, integrated disease and pest management and intercropping system. Hence, there is a need for strengthening of seed distribution center and also extension activities through result demonstrations and method demonstrations and field days before releasing any technologies related to crop in order to bring confidence in the farming community.

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