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Knowledge Level and Adoption Behaviour of Maize Growers in Selected Districts of Nagaland, India

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ABSTRACT

The paper examined the knowledge level and adoption behaviour of maize growers in Nagaland. Altogether, 120 respondents were selected following proportionate random sampling from 8 villages from four blocks of two districts. Two indices, namely, knowledge and adoption indices were developed. The maize growers had inadequate knowledge of improved cultivation practices of maize. Respondents had inadequate adoption index. The variables- age, marital status, and family size had having statistically significant relationship at 5% with knowledge level. Simultaneously, income from maize cultivation, informal information, mass media, social participation, and experience in maize cultivation established a statistically significant relationship at 1% with the knowledge level. Similarly, marital status, education, and informal sources of information established a statistically significant relationship at 5% with the adoption level, and annual income was found to be statistically significant at 1% with the adoption level. It is recommended that all the stakeholders and extension systems take the initiative to improve maize cultivation in Nagaland, which will accelerate the socio-economic up-scaling of the study community. Concerned authorities may also carry out frequent capacity development and technology transfer drives for improvement.

INTRODUCTION

Adoption of innovations or modern technologies in the farming sector is one of the most promising alternatives to maximize the productivity (Duflo et al., 2011; Mason & Smale, 2013), up-scale the farmer's income (Varshney et al., 2019) and better livelihood (Benjongtoshi & Patra, 2021). The adoption of innovations or modern technologies in the farming sector had direct influence on the growth and development of the agricultural sector and economy of the country. Further, the crop's sustainable performance is desirable to address the issues of food security, nutrition security, global warming, and climate change (Patra & Babu, 2017; Gamlin et al., 2021; Patra & Babu, 2023). Adoption of technology or innovation in the production process is a decision of individual farmers. Farmers' knowledge about the technology or innovation is a pre-requisite to bringing it in the adoption process or innovation-decision process. The time span for adoption can be reduced by up-scaling the knowledge level of the intended adopter through better extension service, apart from the relative advantages attached to the technology or innovation. Despite India's largest agricultural extension system, 60 per cent of farmers yet not come under any form of extension service in 2002 (NSSO, 2005), and the condition is worst in the North-eastern part of the country.

Nagaland, a state of NER of India, was taken for the study. Entire NER is growing maize for food, feed and economic reason. Globally, maize is regarded as the "Queen of cereals" and "Miracle crop" because of its high genetic yield potential. Globally, it is being grown in more than 100 countries and is one of the principal

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crops in America, Africa and Asia. In spite of wide adaptability, maize cannot withstand frost at any stage of its growth (Reddy, 2004). The crop cannot withstand waterlogged conditions. It can be preferably grown on soil with a pH ranging from 5.0-7.0 but requires a moderate pH of 6.0-7.0. The optimum temperature for growing maize is around 30°C and can be grown within a temperature range of 10-40°C. Maize is also cultivated on a wide range of soil but requires well-drained, well-aerated, deep loam and silt loam with adequate organic matter and available nutrients for its cultivation.

The climatic condition of the NER is very much favourable for maize cultivation. The climatic condition of the region ranges from subtropical, tropical to temperate, and the topography is mainly hilly. It is grown primarily as a pure or mixed crop under *jhum* or shifting cultivation. As instance, In Nagaland, most (97.08%) of the French bean grower were also growing maize (Benjongtoshi & Patra, 2021a). However, large scale cultivation is becoming popular among farmers. In mixed cropping under shifting cultivation in the NER, maize yield varies from 0.30-1.70qt/ha. In Nagaland, the area and production of maize were recorded at 69,130 ha and 1,37,160 MT, respectively (Govt. of Nagaland, 2020).

METHODOLOGY

There are 12 districts in Nagaland. Out of these districts, Dimapur and Peren were purposively selected for the study because maize is one of the most important crops in these districts. The area and production of maize under the Dimapur district are 6,770 ha and 13,473 MT and under the Peren district are 3,100 ha and 6,149 MT, respectively (Govt. of Nagaland, 2020). Medziphema, Niuland, Peren and Jalukie blocks were purposively selected, and a list of all maize-growing villages under the selected blocks was prepared. Out of these, two villages with a maximum number of growers were purposively selected from each block making eight villages. A list of all households engaged in maize cultivation for each village was prepared, and 120 maize growers were selected based on the proportionate random sampling method.

To evaluate the level of knowledge, 15 aspects, and 47 issues relevant to improved cultivation practices were included in the interview schedule. The scoring was done as fully knowledge-rich with a score of 2, partially knowledge-rich with a score of 1 and no knowledge with a score of 0. To measure the adoption level of the respondents regarding the recommended maize cultivation practices, all the 15 aspects with 47 issues (as mentioned under the knowledge test) were included in the test. The scoring was done as: fully adopted with a score of 2, partially adopted with a score of 1 and not adopted with a score of 0. The maximum achievable score in both cases was 94 (47 x 2). A knowledge as well as adoption index was developed

$$\text{Adoption / knowledge index} = \frac{\text{Total score achieved}}{\text{Total achievable score}} \times 100$$

The respondents were further categorised under low, medium and high catagories based on mean and standard deviation from the score obtained. Further, a relationship study was conducted between socio-economic status versus knowledge and the adoption level of respondents through the Pearson correlation method.

RESULTS AND DISCUSSION

Knowledge level of maize growers on improved practices

Table 1 reveals that 90 per cent of the respondents lacked knowledge about land preparation and selection of suitable soil for maize cultivation. 100 per cent of the respondents had acquired complete knowledge about local cultivars. In contrast, 52.50 per cent of the respondents knew hybrid varieties100.00 per cent of the respondents had acquired knowledge about the normal seed rate, while only 32.50 per cent of the respondents knew about recommended hybrid seed rate, 14.17 per cent of the respondents knew about seed treatment, 95.00 per cent of the respondents lacked an understanding of recommended spacing, 100.00 per cent of the respondents knew about sowing time during the *kharif* season, 41.67 per cent of the respondents knew about the *rabi* season, and 100.00 per cent of the respondents had known the recommended depth of sowing. 100.00 per cent of the respondents knew about the broadcasting and dibbling method, most (94.17%) of the respondents lacked knowledge of the drilling method of sowing, and 100 per cent of the respondents lacked knowledge of sowing the seed behind the plough, 100.00 per cent of the respondents lacked knowledge of recommended NPK dose/ requirement. In comparison, around 25.84 per cent of the respondents knew about the recommended dose of FYM. 84.17 per cent of the respondents knew about recommended water management in the seedling stage whereas76.67 per cent lacked knowledge of recommended water management in the knee-high, flowering and grain-filling stages. 100.00 per cent of the respondents had complete knowledge about weed management, while most (97.50% and 98.34%) of the respondents were unaware about Simazin/Atrazin and 2-4-D, respectively.

All the respondents had a lack of knowledge of maize stem borer and pink borer, whereas most (97.50%) of them had a lack of knowledge of earworm and shoot fly management, while around 89.17 per cent and 50.00 per cent of the respondents knew armyworm and termite management, respectively. Patra & Lianzami (2021) also reported a lack of knowledge regarding insect and disease management of chow-chow in Mizoram. It was also found that around 90.00 per cent of the respondents had a lack of knowledge of diseases and their management. For instance, damage to plants during the harvesting of king chilli and yield loss during the harvesting was also reported by Patra et al., (2019). Around 90.00 per cent of the respondents knew about harvesting and, around 45.00 per cent of the respondents had knowledge of storage and packaging practices.

Status of adoption of improved practices by maize growers

It was found that around 4.79 per cent of the respondents had completely adopted the land preparation methods (Table 2). Another 4.17 per cent of the respondents had partially adopted of growing maize in well-drained sandy loam soil. It was also revealed that none of the respondents had adopted the concept of optimum pH for maize cultivation and was unaware of it. It was also found that 0.83 per cent of the respondents had fully adopted hybrid varieties. Most (90.80%) of the respondents had partially adopted the normal seed rate. It was also observed that 0.83 per

Table 1. Knowledge level on improved maize cultivation practices

S.No.	Aspects along with recommended practices of maize cultivation	Knowledge level		
		Fully (%)	Partially (%)	No knowledge (%)
1.	Land preparation			
	(i) Well prepared flat beds	8.33	8.33	83.33
	(ii) 1 deep ploughing	3.33	6.67	90.00
	(iii) 2-4 harrowing	3.33	4.17	92.50
	(iv) Provide Ridge and furrow for proper drainage	3.33	7.50	89.17
2.	Suitable soil			
	(i) Well drained sandy loam	0.00	10.83	89.17
	(ii) Thrives well in pH 5.5-8.0	0.00	1.67	98.33
3.	Varieties			
	(i) Local cultivar	100.00	0.00	0.00
	(ii) Hybrid-Ganga safed, HQPM-1	7.50	45.00	47.50
4.	Seed rate			
	(i) Normal seed rate -6-8 kg/acre	1.67	98.33	0.00
	(ii) Hybrid 7-9 kg/acre	0.00	32.50	67.50
5.	Seed treatment			
	(i) Seed treatment with thiram / captan @ 4g/kg seeds	0.00	14.17	85.83
6.	Spacing			
	(i) 70 cm R-R and 25cm P-P	0.00	5.00	95.00
7.	Sowing time			
	(i) *Kharif*- summer	16.67	83.33	0.00
	(ii) *Rabi*- Mid oct to Mid Nov	2.50	39.17	58.33
	(iii) Depth of sowing: 4-6 cm	65.00	35.00	0.00
8.	Method of sowing			
	(i) Broadcasting	93.33	5.00	1.67
	(ii) Drilling	0.00	5.83	94.17
	(iii) Dibbling	100.00	0.00	0.00
	(iv) Sowing the seed behind the plough	0.00	0.00	100.00
9.	Nutrient requirement/acre			
	(i) FYM or Compost: 2 t/acre	1.67	24.17	74.17
	(ii) N:40-50 kg/acre	0.00	2.50	97.50
	(iii) P: 25 kg/acre	0.00	0.00	100.00
	(iv) K: 12.5-16 kg/acre	0.00	2.50	97.50
10.	Water management			
	(i) Seedling stage	70.00	14.17	15.83
	(ii) Irrigation at knee high stage	1.67	21.67	76.67
	(iii) Flowering	0.83	22.50	76.67
	(iv) Grain filling stage	0.83	5.83	76.67
11.	Weed management			
	(i) As soon as the weed appears	91.67	8.33	0.00
	(ii) Hand hoeing and hand weeding.	96.70	3.33	0.00
	(iii) simazine or atrazine @ 0.5 ai/acre	0.00	2.50	97.50
	(iv) 2,4-D@0.5-0.8 kg ai/acre	0.00	1.67	98.33
12.	Insect pest management			
	(i) Maize stem borer	0.00	0.00	100.00
	(ii) Army worm	0.00	89.17	10.83
	(iii) Ear worm	0.00	1.67	98.33
	(iv) Shoot fly	0.00	2.50	97.50
	(v) Pink borer	0.00	0.00	100.00
	(vi) Termites	2.50	47.50	50.00
13.	Diseases control			
	(i) Leaf blight	0.00	0.00	100.00
	(ii) Downy mildew	0.00	4.17	96.00
	(iii) Maydis leaf blight	0.00	0.00	100.00
	(iv) Soft rot	0.00	1.67	98.33
	(v) Common rust	0.00	14.17	85.83
	(vi) Smut	0.00	1.67	98.33
	(vii) Charcoal rot	4.17	9.17	86.67

Table 1 contd...

S.No.	Aspects along with recommended practices of maize cultivation	Knowledge level		
		Fully (%)	Partially (%)	No knowledge (%)
14.	Harvesting method			
	(i) Cob shed turns brownish	95.83	4.17	0.00
	(ii) Grain become hard, containing 20% moisture	68.33	26.67	5.00
	(iii) For fodder- milking or sub-dough stage	58.30	24.20	17.50
15.	Storage practices			
	(i) Stored by drying seed to 12% moisture content and	0.00	75.83	24.17
	(ii) packing in 700 gauge polythene bags	1.67	14.17	84.17

Table 2. Adoption behaviour on improved maize cultivation practices

Aspects along with recommended practices of maize cultivation		Adoption level		
		Fully (%)	Partially (%)	Not adopted (%)
1.	Land preparation			
	(i) Well prepared flat beds	9.17	0.00	90.83
	(ii) 1 deep ploughing	3.33	5.74	90.83
	(iii) 2-4 harrowing	3.33	5.74	90.83
	(iv) Provide Ridge and furrow for proper drainage	3.33	5.74	90.83
2.	Suitable soil			
	(i) Well drained sandy loam.	0.00	4.17	95.80
	(ii) Thrives well in pH 5.5-8.0	0.00	0.00	100.00
3.	Varieties			
	(i) Local cultivar	100.00	0.00	0.00
	(ii) Hybrid- Ganga safed, HQPM-1	6.67	2.50	90.83
4.	Seed rate			
	(i) Normal seed rate -6-8 kg/acre	0.83	90.83	8.33
	(ii) Hybrid 7-9 kg/acre	0.83	7.50	91.67
5.	Seed treatment			
	(i) Seed treatment with thiram or captan @ 4g/kg Maize seeds	0.00	0.00	100.00
6.	Spacing			
	(i) 70 cm R-R and 25 cm P-P	0.00	1.67	98.33
7.	Sowing time			
	(i) *Kharif*- summer	5.83	93.33	0.83
	(ii) *Rabi*- Mid oct to Mid Nov	0.00	0.83	99.17
	(iii) Depth of sowing: 4-6 cm	7.50	90.83	1.67
8.	Method of sowing			
	(i) Broadcasting	0.00	0.83	99.17
	(ii) Drilling	0.00	0.00	100.00
	(iii) Dibbling	99.17	0.83	0.00
	(iv) Sowing the seed behind the plough	0.00	0.00	100.00
9.	Nutrient requirement/acre			
	(i) FYM or Compost: 2 t/acre	0.83	7.50	91.67
	(ii) N: 40-50 kg/acre	0.00	0.00	100.00
	(iii) P: 25 kg/acre	0.00	0.00	100.00
	(iv) K: 12.5-16 kg/acre	0.00	0.00	100.00
10.	Water management			
	(i) Seedling stage	4.17	3.33	92.50
	(ii) Irrigation at knee high stage	0.00	5.00	95.00
	(iii) Flowering	0.00	2.50	97.50
	(iv) Grain filling stage	0.00	2.50	97.50
11.	Weed management			
	(i) As soon as the weed appears	13.33	86.67	0.00
	(ii) Hand hoeing and hand weeding	60.00	40.00	0.00
	(iii) simazine or atrazine @ 0.5 ai/acre	0.00	0.00	100.00
	(iv) 2,4-D@0.5-0.8 kg ai/acre	0.00	0.00	100.00

Table 2 contd....

Aspects along with recommended practices of maize cultivation	Adoption level		
	Fully (%)	Partially (%)	Not adopted (%)
12. Insect pest management			
(i) Maize stem borer	0.00	0.00	100.00
(ii) Army worm	0.00	0.00	100.00
(iii) Ear worm	0.00	0.00	100.00
(iv) Shoot fly	0.00	0.00	100.00
(v) Pink borer	0.00	0.00	100.00
(vi) Termites	0.00	0.00	100.00
13. Diseases control			
(i) Leaf blight	0.00	0.00	100.00
(ii) Downy mildew	0.00	0.00	100.00
(iii) Maydis leaf blight	0.00	0.00	100.00
(iv) Soft rot	0.00	0.00	100.00
(v) Common rust	0.00	0.00	100.00
(vi) Smut	0.00	0.00	100.00
(vii) Charcoal rot	0.00	0.00	100.00
14. Harvesting method			
(i) Cob shed turns brownish	85.83	14.17	0.00
(ii) Grain become hard, containing 20% moisture	53.33	30.00	16.67
(iii) For fodder- milking or sub-dough stage	10.83	3.33	85.83
15. Storage practices			
(i) stored by drying seed to 12% moisture content and	0.00	3.33	96.67
(ii) packing in 700 gauge polythene bags	0.00	0.00	100.00

cent and 7.50 per cent of the respondents had fully and partially adopted the recommended seed rate for hybrid maize, and the remaining were not adopted the same. It was revealed that none of the respondents had adopted seed treatment. Only 1.67 per cent of the respondents had partially adopted recommended spacing. Another 5.83 per cent of the respondents had full adoption of recommended sowing time during *kharif* (summer), while 93.33 per cent of the respondents had partially followed the practice. The study also observed that 99.17 per cent of the respondents had never followed the recommended sowing time during the *rabi* season. Most (99.17%) of the respondents had fully adopted dibbling method of sowing.

The study reveals that only 0.83 per cent of the respondents had fully adopted the FYM application. It was found that only 4.17 per cent of the respondents had fully adopted water management at the seedling stage. Most (95.00%) of the respondents had never adopted water management on knee height, flowering and grain filling stage. Around 86.67 per cent of the respondents had partially adopted weed management as soon as the weed appeared. Another 60 per cent had fully adopted hand hoeing and hand weeding, none of the respondents had adopted the application of NPK, chemical control for weed management, recommended insect pest and disease management on maize cultivation and storage method (in 700-gauge polythene). Only traditional practices like manual handpicking and removal were followed to control the insect pests in the field. The majority (85.83%) of the respondents had full adoption of the harvesting method when the cob shed turned brownish. In contrast, 14.17 per cent had partial adoption of this method. The majority (55.33%) of the respondents had fully followed the harvesting of the maize at the grain-hardened stage with containing sufficient moisture, another 10.83 per cent of the respondents had fully adopted the harvesting method for fodder purposes,

Table 3 shows the distribution of respondents based on their overall knowledge and adoption level. The mean value of the knowledge index was 24.60 (i.e., less than 1/5th of the maximum index value) with SD of 3.70. Based on the overall knowledge score, 72.50 per cent of the respondents were under the category of medium knowledge level, The average of adoption index was 16.20 (i.e., less than 1/5th of the maximum index value) with SD of 2.70. The study reveals that 89.17 per cent of the respondents had a medium level of adoption. Concerning adoption, Chandran

Table 3. Overall knowledge and adoption level

S.No.	Categories	Knowledge			Adoption		
		Percentage	*Mean#	SD	Percentage	*Mean#	SD
1.	Low level (< mean-SD)	9.17			0.83		
2.	Medium level (mean-SD to mean + SD)	72.50	24.60	3.70	89.17	16.20	2.70
3.	High level (> mean + SD)	18.33			10.00		

*Maximum achievable Index=100.00; #Maximum achievable score=94 (47 × 2)

Table 4. Relationship between independent variables and the dependent variables

Variables (Unit)	Knowledge Value of 'r'	Adoption Value of 'r'
Age (Years)	-0.184*	-0.005 NS
Marital status (married=1; unmarried=0)	-0.196*	0.203*
Family size (Numbers)	0.189*	0.051 NS
Education {Actual year(s) of education}	0.107 NS	-0.213*
Total land holding (Acre)	0.048NS	0.109 NS
Total land holding under maize (Acre)	0.141 NS	0.007 NS
Annual income (Rs.)	-0.082 NS	-0.283**
Income from maize (Rs.)	0.388**	0.074 NS
Training exposure (Not attended=0; Attended=1...n)	0.007 NS	0.129 NS
Formal information (Score)	0.403**	0.070 NS
Informal information (Score)	0.265**	0.182*
Mass media exposure (Score)	0.372**	0.099 NS
Social participation (Score)	0.247**	-0.013 NS
Experience in maize cultivation (Years)	-0.319**	-0.044 NS

*=Significant at 5%; **=significant at 5%; NS=Non significant

& Chakravarty (2022) also reported on the low level of adoption by farmers practicing integrated farming systems. Therefore, it can be concluded that the knowledge and adoption level of the study community (maize growers under the investigation) had extremely inadequate and in a pitiful state. The universally accepted concept is that knowledge about the innovation is a prerequisite for the adoption of the same innovation (Rogers, 2003). Inadequacy of knowledge about improved cultivation practices has a direct reflection on the adoption level. Therefore, an improvement in the knowledge level of respondents on improved cultivation practices is needed for the adoption of improved cultivation practices/ technologies in the production system.

Table 4 shows that independent variables- education, total landholding, landholding under maize, annual income and training exposure established a non-significant relationship with knowledge level. On the other hand, correlation values between age, marital status and family size were established to have a statistically significant (at 5%) relationship. Patra et al., (2020) viewed that income from the cultivation of crops has a direct and positive influence on the modernization of cultivation. Income from maize, formal information, informal information, mass media, social participation and experience in maize cultivation established a statistically significant relationship with knowledge level. Concerning social participation, IWMP performed moderately in social participation and inclusion (Ao & Patra, 2018). The findings have partial agreement with the results of Nain et al., (2007); Kumari et al., (2022). Acharya et al., (2023); and age, family size, total land holding, landholding under maize, income from maize cultivation, training exposure, formal source of information, mass media, social participation, experience in maize cultivation, and attitude were not established as statistically significant relationship to adoption level. It also indicates that the variables- marital status and informal source of information established a statistically significant relationship (at 5%), while annual income established a statistically significant relationship at 1% to adoption level. Varshney et al., (2019a) viewed that the level of education directly influences the act upon innovation by the intended adoption. This study also established a positively significant relationship between education and the adoption index.

CONCLUSION

This paper explored that the overall knowledge and adoption levels of the maize growers were in a pitiful state. Respondents are somehow knowledgeable about weed management, irrigation management, sowing method, and proper time of harvesting, and huge inadequacy was observed in the remaining aspects. In spite of, maize being a primary crop of the state of Nagaland, the status of adoption of improved technologies in maize cultivation was immensely lagged behind. Socio-economic status of the respondents had a non-significant influence on the knowledge and adoption levels of improved technologies. But the universally accepted trend is socio-economic status has a direct and significant relation with knowledge level and adoption behaviour. Therefore, all the stakeholders take the initiative to improve maize cultivation in Nagaland, which will accelerate the socio-economic up-scaling of the respondents and also bring the adoption of innovations in maize cultivation. Concerned stakeholders may also carry out a technology transfer drive for improvement.

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