Research Article

Indian Journal of Extension Education
Vol. 60, No. 1 (January–March), 2024, (46-52)

ISSN 0537-1996 (Print)
ISSN 2454-552X (Online)

Information Sources Utilization and Adoption Behaviour of Pineapple Growers in Nagaland

Sentibenla Pongener[1] and Kaushal Kumar Jha[2]*

[1]Ph.D. Scholar, [2]Professor & Head, Department of Agricultural Extension Education, Nagaland University: School of Agricultural Sciences, Medziphema Campus, Nagaland, India
*Corresponding author email id: kkjhanurd@rediffmail.com

ARTICLE INFO

Keywords: Information sources, Technology adoption, Pineapple cultivation, Nagaland

https://doi.org/10.48165/IJEE.2024.60109

Conflict of Interest: None

Research ethics statement(s): Informed consent of the participants

ABSTRACT

Pineapple being one of the important horticultural crops of Nagaland, adoption of sustainable cultivation practices is crucial with changing climatic conditions. The study was conducted in Nagaland during 2018-2022 to evaluate the factors influencing the use of information sources and technology adoption for sustainable pineapple cultivation. Altogether 275 respondents were selected from 13 villages representing three leading pineapple growing districts of Nagaland using proportionate random sampling. The study revealed that informal sources of information were most preferred by the respondents. Selection of improved varieties, planting materials, weed management, ratooning, storage, and post-harvest management practices were fully adopted by the respondents. Variables *viz.*, size of land under pineapple cultivation, annual income, income from pineapple cultivation, training exposure, experience, social participation, attitude, economic motivation, and knowledge had significant relationships with the information sources utilization and technology adoption. The coefficient of determination (R^2) was 0.582 and 0.581 for explaining the utilization of information sources and adoption respectively. It is recommended that strengthening extension-farmer linkages and improving digital literacy may help enhance the efficacy of the information sources as well as improve technology adoption by pineapple growers.

INTRODUCTION

Information plays a very important role in adopting the agricultural practices and decision making by farmers. Optimal decision-making among the poor is often hampered by insufficient knowledge, false beliefs, or wrong perceptions (Campenhout, 2021). Socio-technical factors have been identified as playing a major role in determining adoption and use of information sources and technology (Duque et al., 2005; Harle, 2009; Ynalvez & Shrum, 2011). Real challenge in agriculture is not only to have appropriate technologies and innovations but also to make sure that farmer effectively access and use them (Wyckoff, 2016). The desired level of higher growth in the agricultural sector can be achieved only when there is proper application of ICTs (Shah, 2021), and it is very important for forecasting the climate (Parmar et al., 2019). Agricultural information services have potential contribution to agricultural production by helping farmers to adopt new technologies or farming systems. Agricultural information plays a crucial role in making farmers aware to acquire bank loans and other farming inputs, as well as measures to control pests and diseases (Adio et al., 2016). When the technology is very sound, the information related to the technology to the user and the access to additional information affect the adoption process as well (Dissanayake et al., 2022).

Pineapple (*Ananas comosus*), is one of the important tropical fruit crops of the world. Pineapple has been cultivating in Nagaland

Received 14-10-2023; Accepted 24-12-2023

state of India since time immemorial. With its favourable soil and climatic conditions and interventions by the state government, pineapple is considered as one of the important horticultural crops and has been instrumental in contributing to both the local economy and livelihood of the farmers (Das et al., 2015). According to National Horticultural Board Report 2020-21, West Bengal was the highest pineapple producing state (354.64 tonnes) with a share of 19.72 per cent of the total production of the country, while Nagaland recorded a total production of 114.77 tonnes with a total contribution of 6.38 per cent. Considering the change in climatic conditions, there is a growing concern for adoption of sustainable cultivation practices mitigating environmental impacts and ensuring long term productivity.

Information source utilization refers to the degree of utilization of sources from where a farmer can derive information related to farming. It encompasses mass media sources, digital technologies or ICTs, personal localite sources and personal cosmopolite channels (Singh et al., 2022). Adopting sustainable practices in pineapple cultivation also require access to relevant and reliable information sources related to sustainable farming practices, soil and water conservation, pest and disease management, irrigation practices, production and marketing information and weather forecasting. Utilization of information sources by farmers play a key role in influencing their knowledge, decision-making and farming practices (Nain et al., 2019). Understanding the utilization of information sources by the pineapple growers is essential for embracing sustainable practices and enhancing the profitability and productivity of pineapple and improving the livelihood of the pineapple growers. On this backdrop, the present study was conducted to analyze the information sources utilization pattern and adoption behaviour of pineapple growers in Nagaland.

METHODOLOGY

The study was conducted during 2018 to 2022 in three leading pineapple producing districts of Nagaland *viz.* Dimapur, Peren and Mokokchung by following *ex-post facto* research design. One Rural Development (RD) Block from Dimapur and Mokokchung districts and two RD Blocks from Peren district with high pineapple production were purposively selected for the study. From these RD blocks, thirteen (13) villages leading in pineapple production were purposively selected. Further, a sample size of 275 respondents was selected from these villages using proportionate random sampling procedure. Data were collected from the respondents through a pre tested interview schedule. Information sources utilization was operationalized as the dependent variable and referred to the process through which pineapple growers gathered information related to sustainable cultivation practices of pineapple through various sources *viz.*, mass media, formal and informal information sources. Mean score was calculated to analyze the preference of use of the information sources by the pineapple growers in line with the method followed by Raina et al., (2011). Adoption index by Lakshminarayan (1997) was used to study the adoption level of the respondents. Independent variables which were most likely to influence the utilization of the information sources in adoption of sustainable cultivation practices of pineapple were also subjected to empirical measurement. The data were analysed to derive the mean, standard deviation, correlation and regression using SPSS software. Regression model was developed for predicting the variations in information sources utilization, using the following equation:

$$Y = a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_5 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + \beta_8X_8,$$

Where, Y.... Predicted variable (Information sources utilization).

$X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8$ ... Independent variables, $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8$ ... Regression coefficients, a ... Intercept constant.

RESULTS

Information sources utilization pattern by pineapple growing farmers

Table 1 reveals that 16.73 per cent of the respondents utilized radio sometimes as an information source in adoption of sustainable pineapple cultivation practices. The study also revealed that 10.91 per cent of the respondents utilized exhibition and 24.73 per cent of them used newspaper sometimes as information sources for adoption of sustainable cultivation practices of pineapple. Newspapers are widely accessible, comparatively cheaper, available in local dialects and provide location specific information 47.27 per cent of them made use of SMS as information sources sometimes. Radio is easily accessible medium which caters to the interest and relevance of the local community even in limited areas with internet connectivity. Mass media information sources were observed to be the least preferred source of information utilization. Formal information sources were found as the second preferred information sources for gaining information on sustainable cultivation practices of pineapple. Around 27.27 per cent of the respondents contacted AFA/HEA sometimes for getting the required

Table 1. Information sources utilization by the pineapple growers

Sources of information	Utilization (%)			Mean score	SD
	Most often	Some times	Never		
Mass media					
Radio	3.27	16.73	80.00	1.48	1.04
Television	1.09	4.73	94.18		
Exhibition	0.36	10.91	88.73		
Newspaper	0.00	24.73	75.27		
SMS	9.09	47.27	43.64		
Apps/Whatsapp/ Facebook	0.00	5.82	94.18		
Formal					
AFA/HEA	0.00	27.27	72.73	2.08	1.31
AO/SDAO	0.7	29.82	69.45		
KVK	2.55	44.00	53.45		
ATMA	2.18	50.91	46.91		
NGOs	0.73	4.73	94.54		
CIH	6.18	26.91	66.91		
Informal					
Friends	84.00	13.09	2.91	4.75	1.5
Relatives	38.55	43.64	17.81		
Neighbours	31.64	56.00	12.36		
Progressive/contact farmers	5.45	42.91	51.64		

information. It was also found that 29.82 per cent of the respondents gained information from AO/SDAO, 44.00 per cent of the respondents utilized KVK and 50.91 per cent of them utilized ATMA sometimes as information sources. It was found that majority (84.00%) of the respondents gained information most often from their friends. Further, 42.91 per cent of them gained information sometimes from progressive/contact farmers.

Determinants of utilization of information sources

Table 2 envisages that a positive and significant relationship was observed between education, size of land under pineapple cultivation, annual income and income from pineapple cultivation, training exposure, experience in pineapple cultivation, social participation, attitude, economic motivation and knowledge level and information sources utilization of the respondents.

Table 2. Correlation of attributes of farmers with their utilization of information sources

Variables	Pearson's correlation coefficient
Age	-0.033
Education	0.046*
Size of land under agriculture	0.082
Size of land under pineapple cultivation	0.314**
Annual income	0.142*
Income from pineapple cultivation	0.355**
Training exposure	0.250**
Experience	0.126**
Social participation	0.119**
Attitude	0.386**
Economic motivation	0.289**
Knowledge	0.436**

** Significant at 1% level; **Significant at 5% level

Table 3 reveals the regression analysis of the selected independent variables with the information sources utilization of the respondents. The regression model included five variables which is presented below:

Information sources utilization = 0.396 + 0.529 (Training exposure) + 0.836 (Experience) + 0.892 (Attitude) + 0.611 (Economic motivation) + 1.100 (Knowledge).

Extent of technology Adoption by pineapple growers

Table 4 shows that all the respondents (100.00%) fully adopted the use of Giant Kew and Kew varieties, suckers and slips as planting material, uprooted weeds used as organic compost and mulch, weed management, control of pest by using unaffected and healthy planting material, harvesting, ratooning, storage and post-harvest management respectively whereas none of the respondents adopted the practice of treating the planting materials, use of biofertilizers and growth regulators. Majority of the respondents fully adopted the recommended practice of digging of pits and solarising the soil (87.64%), planting during March-May and September-November (96.73%), use of baits for rodent management (65.45%), maintenance of good drainage (83.64%) and harvesting of fruit 15-20 months after planting (65.82%). It was also found that majority of the respondents did not adopt filling of pits with manure (75.27%), queen variety (84.00%), manuring (71.64%), irrigation (83.27%), use of black polythene for mulching (98.55%) and value addition (78.18%).

Table 3. Multiple regression analysis of the selected independent variables with information sources utilization

Variables	Regression coefficient (b)	SE	t stat
Constant	0.396	0.493	0.803
Training exposure (X_1)	0.529**	0.205	2.579
Experience (X_2)	0.836**	0.209	4.003
Attitude (X_3)	0.892**	0.204	4.375
Economic motivation (X_4)	0.611**	0.179	3.395
Knowledge (X_5)	1.100**	0.176	6.219

R^2 = 0.582 F = 75.064 **Significant at 1% level

Association of independent variables with adoption of technology

Table 5 reveals that independent variable age exhibited positive and significant relationship with adoption level. Variables like social participation, size of land under agriculture and pineapple cultivation, annual income, income from pineapple cultivation, economic motivation, knowledge level, attitude, training exposure and experience had positive and significant association with the adoption level of the respondents.

The regression model consisting of seven independent variables is presented as follows:

Adoption level = 32.927 + 1.976 (Experience) + 0.917 (Size of land under pineapple cultivation) + 1.696 (Economic motivation) + 1.834 (Knowledge) -9.960 (Income from pineapple cultivation) + 1.249 (Social participation) + 2.616 (Attitude).

DISCUSSION

The usage of radio as a medium of information sources utilization may be due to the fact that radio is easily accessible over mobile even in limited internet connectivity areas which does not require technical knowledge or education and radio programmes cater to the interest and relevance of the local community. Naveed & Hassan (2020); Karangami et al., (2021) also reported the use of radio as an information source in their studies. The limited use of television as information source might be due to limited access to television, financial instability and preference for other information sources. The use of SMS indicates that mobile technology plays a significant role in adoption of technology. The pineapple growers were able to receive weather updates and guidance on cultivation practices through SMS. Pineapple growers were generally digitally and technologically illiterate, had poor internet connectivity, language barrier or lack of knowledge to access these sources. Patra & Kense (2021); Biam et al., (2022) also reported the utilization of mass media by respondents in their studies. With respect to formal information sources utilization, these sources played a collective role in disseminating relevant information on sustainable pineapple cultivation. Similar results were observed by Das et al., (2014); Adio et al., (2016); Patra & Kense (2021); Das & Jha (2022). Friends, relatives, neighbours and progressive farmers were more approachable to share their experiences, idea and knowledge

Table 4. Extent of adoption of sustainable cultivation practices by pineapple growers

S.No.	Recommended practices	Adoption level		
		Full adoption (%)	Partial adoption (%)	No adoption (%)
1.	Land preparation			
	a. Digging of pits and solarizing the soil	87.64	12.36	00.00
	b. Pits filled with manure	8.00	16.73	75.27
2.	Varieties			
	a. Giant Kew and Kew	100.00	00.00	00.00
	b. Queen	8.36	7.64	84.00
3.	Planting materials			
	Suckers and slips are used as planting material	100.00	00.00	00.00
4.	Treatment of planting material			
	a. Suckers/slips are dipped in a mixture of cow pat pit and dried for 6-10 hours before planting	00.00	00.00	100.00
	b. Suckers/slips treated in neem oil solution @ 5ml/l before planting	00.00	00.00	100.00
5.	Spacing			
	a. Single row system: 30 cm x 60 cm x 75 cm	28.37	46.18	25.45
	b. Double row system: 30 cm x 60 cm x 90 cm	50.91	24.00	25.09
6.	Plant population			
	a. Single row: 44,500 plants/ha	20.36	53.82	25.82
	b. Double row: 60,000 plants/ha	26.18	49.09	24.73
7.	Planting time			
	March-May and September-November	96.73	3.27	00.00
8.	Manuring			
	a. A dose of 18t/ha of FYM (compost/cattle manure) as basal dressing	7.27	21.09	71.64
	b. Green leaf + compost/manure + soil	00.00	12.73	87.27
	c. Azotobacter/*Azospirillum* + Phosphotika	00.00	00.00	100.00
9.	Irrigation			
	The field is irrigated 5-6 times at an interval of 20-25 days during the dry period	5.09	11.64	83.27
10.	Cropping pattern			
	a. Intercropped with mango, arecanut, coconut, ginger, turmeric, cowpea, colocassia, etc	2.91	37.09	60.00
	b. Intercropped with colocassia, yam, chillies, sweet potato, cabbage, cauliflower, soybean, etc	3.27	36.00	60.73
11.	Intercultural operations			
	1. Mulching			
	a. Pineapple plants are covered with straw to prevent sunburn	46.55	3.63	49.82
	b. Black polythene is used to cover the plants as mulches	1.09	0.36	98.55
	c. Uprooted weeds are used as organic compost and mulch	100.00	00.00	00.00
	2. Weed management			
	Weeds are uprooted at least twice in year	100.00	00.00	00.00
12.	Growth regulators			
	Application of planofix and celemone @ 10-20 ppm to induce flowering	00.00	00.00	100.00
13.	IPM and DM:			
	1. Mealy bug			
	a. Controlled by cultivating unaffected plant material	100.00	00.00	00.00
	b. Ants harbouring in the field are removed	20.36	29.09	50.55
	c. Application of *Bacillus gordonae*	00.00	00.00	100.00
	2. Rodenta.			
	Cage trap with attractive baits.	65.45	13.82	20.73
	b. Poison bait (Crushed rice/maize grains with vegetable oil & zinc phosphide/sodium fluoro acetate) is fed.	5.09	28.00	66.91
	3. Heart rot, black rot, leaf rot & fruit rot			
	a. Good drainage is maintained	83.64	5.09	11.27
	b. Healthy planting material is used	100.00	00.00	00.00
	c. Suckers are treated with *Trichoderma* @ 200 g in 15-20l water for 10 minutes before planting	00.00	00.00	100.00
14.	Harvesting			
	a. The fruits are harvested 15-20 months after planting	65.82	34.18	00.00
	b. Fruits are harvested when the fruit turns yellow at the base and angularities of eyes start reducing and the bract withers	100.00	00.00	00.00
	c. Matured fruits are harvested by breaking/ cutting the stalk a few cm below the fruit	100.00	00.00	00.00

Table 4. Extent of adoption of sustainable cultivation practices by pineapple growers

S.No.	Recommended practices	Adoption level		
		Full adoption (%)	Partial adoption (%)	No adoption (%)
15.	Ratooning			
	a. Desuckering is done immediately after harvest leaving 1-2 suckers on the mother plant	100.00	00.00	00.00
	b. Proper fertilization and earthing up is done for good anchorage of the ratoon crop	28.73	71.27	00.00
16.	Storage			
	a. Harvested fruits are well ventilated and kept in shade/cool place for long storage	100.00	00.00	00.00
	b. Harvested fruits are protected against pest and disease infestation during storage	100.00	00.00	00.00
17.	Post harvest management			
	a. Harvested fruits are sorted and graded according to shape and size	100.00	00.00	00.00
	b. Clean bamboo baskets are used for packing the harvested fruits	100.00	00.00	00.00
18.	Value addition			
	a. KMS, sugar and citric acid are used as preservatives during pineapple squash, juice & jam preparation	13.09	8.73	78.18
	b. Finished product is stored in sterilized bottles	15.64	5.45	78.91

Table 5. Relationship between independent variables and adoption

Variables	Pearson correlation	Variables	Multiple regression		
			Regression coefficient (b)	SE	t stat
Age	0.157**	Constant	32.972	1.201	27.453
Education	0.049	Experience (X_1)	1.976**	0.433	4.559
Experience	0.191**	Size of land under pineapple cultivation (X_2)	0.917**	0.242	3.787
Size of land under pineapple	0.341**	Economic motivation (X_3)	1.696**	0.368	4.607
Economic motivation	0.298**	Knowledge (X_4)	1.834**	0.359	5.115
Knowledge	0.399**	Income from pineapple cultivation (X_5)	-9.960*	-2.635	5.128
Annual income	0.240**	Social participation (X_6)	1.249**	0.356	3.511
Income from pineapple	0.251**	Attitude (X_7)	2.616**	0.398	6.572
Attitude	0.321**				
Size of land under agriculture	0.249**		R^2 = 0.581	F = 52.99908	
Social participation	0.179**				
Training exposure	0.131*				

**Significant at 1% level *Significant at 5% level

during frequent social gatherings. Bhagat et al., (2004) found that contact farmers had the highest credibility index. These findings align with the results reported by Ndimbwa et al., (2021); Das & Jha (2022); Kalamakr et al., (2022).

Formal education might have helped the pineapple growers in acquiring knowledge from various information sources. Biam et al., (2022); Singh et al., (2022) also showed similar results. Farmers with large farms tend to have more access to more diverse needs; resources, technology information and government support. A positive and significant relationship of land under agriculture with information sources utilization was also reported by Naveed & Hassan (2020); Panda et al., (2022); Acharya et al., (2023). Annual income and income from pineapple cultivation showed a positive association with their information sources utilization. The income of the farmers directly affected their accessibility to diverse forms of information (Naveed & Hassan, 2020; Chandra et al., 2023). Training proves to enhance knowledge, skill and attitude of an individual as well as the ability to access and utilize various sources of information effectively. Similar findings were reported by Naveed & Hassan (2020). With gain of more experience, the pineapple growers were able to gain more knowledge, skills and expertise in various domains which eventually helped them in their preference for various sources of information related to sustainable pineapple cultivation practices. The results of Biam et al., (2022); Panda et al., (2022) displayed positive and significant relationship of experience with information sources utilization whereas Singh et al., (2022) reported contrasting result. A farmer actively engaged in various social activities is exposed to a number of information sources and perspectives. This made an impact on the famer in information exchange, influencing one another and staying updated with the latest information. Gutama et al., (2019) have also shown similar findings. The attitude of the pineapple growers played a pivotal role in seeking and accepting information from different sources. This finding aligns with the results reported by Gutama et al., (2019); Thangjam & Jha (2020). Respondents with higher economic motivation tend to have more access to various information sources. With higher economic stability, they are more active in seeking information and utilizing it from various information sources to achieve their target. Respondents possessing higher knowledge level had an inclination to make more extensive and

effective use of the various information sources as they were actively engaged in knowledge sharing and learning. This finding was in conformity with the results of Singh et al., (2022). The coefficient of determination (R^2) was found to be 0.582 which inferred that all the selected variables jointly contributed 58.2 per cent in comprehending the variations in information sources utilization of the respondents. The t-value exhibited that the information sources utilization was significantly related to training exposure, experience, attitude, economic motivation and knowledge of the respondents and were found as predictors of information sources utilization by the respondents.

Non-adoption of recommended practices such as treatment of planting materials, use of biofertilizers and plant regulators could be attributed to lack of awareness and knowledge on importance of these practices in pineapple cultivation. The possible reason for limited adoption of manuring and black polythene for mulching might be due to factors such as lack of knowledge, financial constraint as well as lack of proper understanding regarding the appropriate application of the right amount of nutrients. Pineapple cultivation being considered a rainfed crop in the state, irrigation was given less importance. The minimal adoption of value addition could be attributed to lack of knowledge on value addition, non-availability of labour and time constraint during peak harvesting season and lack of infrastructures for value addition purposes. Chanu et al., (2014) reported similar findings with respect to varieties, weed management, ratooning and storage practices. Farmers with higher level of education, social participation, agricultural land, land under pineapple cultivation, annual income, economic motivation, knowledge level, training exposure and farming experience were more likely to adopt recommended pineapple cultivation technologies. Similar findings were reported by Baite et al., (2014); Chanu et al., (2014); Marak et al., (2015); Roy & Ghosh (2022).) Based on the R square value of 0.581, it may be implied that the selected variables jointly contributed 58.1 per cent in the total variation in comprehending the adoption level of the respondents. Variables experience, size of land under pineapple cultivation, economic motivation, knowledge, income from pineapple cultivation, social participation and attitude were found significant and may be considered as good predictors of adoption level of the respondents.

CONCLUSION

The study revealed that informal information sources were mostly utilized by farmers as sources of information followed by formal and mass-media sources. Discrepancies in use of biofertilizers, growth regulators, value addition methods and intercultural operations were quite evident. There is an urgent need to use mass media and ICT based interventions by including young farmers with requisite farm experience to include for capacity building programmes in the paradigm of accelerating the adoption of sustainable pineapple farming technology. A collaborative effort among the research organizations, policymakers and stakeholders may be initiated for transfer of latest technologies and enabling farmers to adopt sustainable cultivation of pineapple for increased productivity and profitability.

REFERENCES

Acharya, S., Acharya, S. K., Mandal, T. K., Mohanty, B. K., & Haque, M. (2023). Information receiving behavior of farmers: The structural and functional analysis. *Indian Journal of Extension Education, 59*(3), 58-62.

Adio, E. O., Abu, Y., Yusuf, S. K., & Nansoh, S. (2016). Use of agricultural information sources and services by farmers for improve productivity in Kwara state. *Library Philosophy and Practice*, 1456.

Baite, D. J., Chanu, T. M., Singh, M. K., Ram, D., Ahuja, S., & Devi, B. (2014). Factors related with adoption of pineapple cultivation practices by the tribal farmers of Manipur. *International Journal of Tropical Agriculture, 32*(3-4), 847-849.

Bhagat, G. R., Nain, M. S., & Narda, R. (2004). Information sources for agricultural technology. *Indian Journal of Extension Education, 40*(1&2), 111-112.

Biam, K. P., Devi, L. S., Khate, K., Singh, N. U., Paul, P., & Gowda, C. (2022). Information sources, their utilization pattern vis-à-vis mithun (*Bos frontalis*) husbandry in Arunachal Pradesh. *Indian Journal of Extension Education, 58*(3), 14-17.

Campenhout, B. V. (2021). The role of information in agricultural technology adoption: Experimental evidence from rice farmers in Uganda. *Economic Development and Cultural Change, 69*(3), 903-1272.

Chandra, S., Singh, A. K., Ghadei, K., & Pradhan, S. (2023). Exploring the relationship between socio-economic factors and ICT adoption among farmers. *Indian Journal of Extension Education, 59*(3), 54-57.

Chanu, T. M., Baite, D. J., Singh, M. K., & Rao, D. U. M. (2014). Adoption of pineapple cultivation practices by the farmers in Manipur state. *Indian Research Journal of Extension Education, 14*(1), 17-20.

Das, L., Nain, M. S., Singh, R., & Burman, R. R. (2014). Constraints in marketing of fruits as perceived by the fruit growers and NERAMAC in Assam. *Journal of Community Mobilization and Sustainable Development, 9*(2), 114-117.

Das, L., Nain, M. S., Singh, R., & Burman, R. R. (2015). Effectiveness of backward and forward linkage in fruit cultivation: A study of NERAMAC. *Indian Journal of Extension Education, 51*(1&2), 70-74.

Das, R., & Jha, K. K. (2022). Information sources utilization among potato farmers in North East India. *Indian Research Journal of Extension Education, 22*(1), 44-49.

Dissanayake, C. A. K., Jayathilake, W., Wickramasuriya, H. V. A., Dissanayake, U., & Wasala, W. M. C. B. (2022). A review on factors affecting technology adoption in agricultural sector. *The Journal of Agricultural Sciences - Sri Lanka, 17*(2), 280-296.

Duque, B., Ynalvez, M., Sooryamoorthy, R., Mbatia, P., Dzorgbo, D., & Shrum, W. (2005). Collaboration paradox: scientific productivity, the internet, and problems of research in developing areas. *Social Studies of Science, 35*(5), 755-785.

Gutama, A. M., Megerssa, G. R., & Sima, A. D. (2019). Factors affecting information utilization in coffee production packages among smallholder farmers in West Ethiopia. *Agricultural Socio-Economics Journal, XIX*(3), 125-134.

Harle, J. (2009). The Nairobi report: Frameworks for Africa-UK research collaboration in the social sciences and humanities. London: British Academy/The Association of Commonwealth Universities.

Kalamakr, R. B., Ahire, M. C., Bhange, S. B., Kulkarni, S. R., & Nimbalkar, C. D. (2022). Extent of utilization of information

input pattern of pomegranate growers. *The Pharma Innovation Journal*, *11*(7), 2451-2454.

Karangami, R. S., Bhange, S. B., Ahire, M. C, Chavai, A. M., Kabre, G. B., & Wani, V. S. (2021). Sources of agricultural information in utilization pattern of pesticides by grape growers. *The Pharma Innovation Journal*, *10*(12), 1038-1041.

Lakshminarayan, M. T. (1997). Adoption of sustainable sugarcane farming practices – An analysis. Ph. D. Thesis submitted to University of Agricultural Sciences, Bangalore.

National Horticulture Board (2021). National Horticulture Board report 2020-2021.

Naveed, M. A., & Hassan, A. (2020). Sustaining agriculture with information: An assessment of rural citrus farmers' information behaviour. *Information Development*, *37*(3), 496–510.

Ndimbwa, T., Mwantimwa, K., & Ndumbaro, F. (2021). Channels used to deliver agricultural information and knowledge to smallholder farmers. *International Federation of Library Associations and Institutions Journal*, *47*(2), 153–167.

Panda, P., Tiwari, R., Handage, S., & Dutt, T. (2022). Information source utilization by livestock and poultry farmers of Uttar Pradesh. *Indian Journal of Extension Education*, *58*(1), 172-175.

Parmar, I. S., Soni, P., Kuwornu, J. K. M., & Salin, K. R. (2019). Evaluating farmers' access to agricultural information: Evidence from semi-arid region of Rajasthan state, India. *Agriculture*, *9*(60), 1-17.

Patra, N. K., & Kense, P. (2021). Socio-economic features of mandarin (*Citrus Reticulata* Blanco) Growers: A Case Study in Nagaland, India. *Indian Journal of Extension Education*, *57*(2), 87-93.

Raina, V., Nain, M. S., Hansra, B. S., & Singh, D. (2011). Marketing behaviour and information sources utilization pattern of flower growers in Jammu region. *Journal of Community Mobilization for Sustainable Agriculture*, *6*(2), 180-184.

Roy, P., & Ghosh, S. (2022). Pineapple cultivation in Tripura: Differential knowledge and adoption of scientific practices and their determinants. *Journal of Community Mobilization and Sustainable Development*, *17*(1), 1-11.

Sarker, M. A., & Itohara. (2007). Information sources used by the farmers regarding the practice of organic farming – A study from Bangladesh. *Journal of Rural Problems*, *43*, 234-239.

Shah, D. (2022). Role of information and communication technology in agricultural development of India. *Review of Market Integration*, *14*, 2-3.

Singh, A., Tiwari, R., Panda, P., Kour, G., & Dutt, T. (2022). Information source utilization for organic waste management with special reference to digital technologies: A qualitative study on dairy farmers of district Ludhiana, Punjab. *Cogent Education*, *9*, 2062093.

Singh, R., Doharey, R. K., Meena, N. R., Satyapriya, & Kumar, M. (2022). Study of information processing behaviour of radish growers in eastern Uttar Pradesh, India. *Indian Journal of Extension Education*, *58*(1), 78-82.

Thangjam, B., & Jha, K. K. (2020). Paddy cultivation in Imphal, West Manipur: Status of information sources utilisation. *Plant Archives*, *20*(1), 1229-1234.

Wyckoff, A. (2016). *Measuring science, technology and innovation.* OECD, Paris.

Ynalvez, M., & Shrum, W. (2011). Professional networks, scientific collaboration, and publication productivity in resource-constrained research institutions in a developing country. *Research Policy*, *40*(2), 204–216.