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Constraints Faced by Farmers and Suggestions for Effective Utilization of ICTs in Mitigating Climate Change Effect in Agriculture: A Study of Eastern Dry Zone of the Karnataka, India

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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

The study was conducted to reveal the constraints faced by the farmers of Bengaluru rural and Chikkaballapura districts of Karnataka to access various ICTs for mitigating the effect of climate change in agriculture. Purposively selected two rural districts (Bengaluru Rural and Chikkaballapura) based on the desirable criteria that one district (Bengaluru Rural) was very close to the urban area (Bengaluru) and another district (Chikkaballapura) was a bit far away from the urban area. To know about the problems the farmers faced during access and use of ICTs in

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mitigating climate change it is necessary to understand the profile characteristics of the respondents because of this reason the 18 independent variables as selected to know about their conditions. The farmers of both districts felt that the main constraints which hamper the effective use of icts tools to mitigate climate change in agriculture, are Cautious about new technologies as the main constraint in the category of social constraints followed by High call rates in mobile calling as their main constraint in the category of economic constraints, lack of adequate skills to use ICTs as the main constraint in the category of technical constraints. To overcome these barriers and effective use of ICTs in mitigating climate change effects in agriculture farmers suggested that there was a need for training for the proper use of ICTs followed by the Government should initiate awareness programs about available new ICTs tools and their applications in climate change the main suggestions as given by the farmers of Bengaluru Rural and Chikkaballapura district.

Keywords: Climate change; constraints; ICTs, mitigation.

1. INTRODUCTION

Climate change and the proliferation of ICTs are both realities that the world is currently experiencing (ICTs). In terms of ICTs, the majority of government institutions and urban and rural areas are now well connected, making the entire world resemble a little village. There are several ways that ICTs might be described. The World Bank's definition of ICTs anything that enables data exchange or gathering through contact or transmission, be it a device, tool, or application. Radio, satellite images, mobile devices, and electronic money transactions are all examples of this [1]. According to 2021, the World Bank collection of development indicators, compiled from officially recognized sources revealed that about 64.61 percent of people in India live in rural areas. Agriculture is the main occupation and source of livelihood in rural India. Empowerment of the rural agrarian community depends on better accessibility to ICTs and their services. But access to ICT is comparatively less in rural areas than in urban areas. Infrastructure, low literacy, inadequate information services, a lack of technical skills, and an absence of information policies and governance that are appropriate for rural communities are just a few of the hurdles that limit access to information in rural communities. The provision of information that will improve input efficiency and ultimately result in high production, however, is one way that ICTs can positively impact agricultural and rural development [2,3].

The information is a prerequisite for better adaptation and mitigation against adverse climate change and thereby maintenance of sustainable development in agriculture. To increase the flow of information and equip farmers to deal with the problems of adverse climate change, it is critical that farmers must have access to ICT tools. Hence the study was carried out in two rural Karnataka districts with the following objectives.

1. To understand the socio, economic and psychological characteristics of farmers using ICTs in mitigating climate change effect in agriculture
2. To reveal the constraints and suggestions as given by the framers for better access to ICTs in mitigating Climate change effect in agriculture

2. RESEARCH METHODOLOGY

The state of Karnataka in the Southern region was purposively selected for the proposed study. Banglore Rural and Chikkaballapur were purposively selected for the study. In Banglore Rural and Chikkaballapur districts, which comes under eastern dry zone of Karnataka. The majority of the population of these districts depended on agriculture for survival and practiced farming over the years. These are the districts that are very closer to the capital of Karnataka i.e. Bangalore which is famously called the IT hub due to its major role as the states leading information technology(IT) exporter. Two rural districts, one of which was intended to be closer to a significant urban area while the other was intended to be somewhat farther away, were one of the desired criteria. The current study employed an ex-post facto research design. The study was designed to get feedback from farmers who use ICTs and are residents of the rural areas of Bangalore (120 samples) and the Chikkaballapura district (120 samples). From each district, 2 Taluks were purposively selected based on highest geographical area and population, from each Taluk 5 villages of 12 samples each has been collected randomly thus the total sample size of

the study is 240. Statistical measures like frequency, percentage, mean, and Garratt's ranking approach were used to assess the data that had been collected. Microsoft Excel was used to examine the data. To transform the respondents' ranking of merit into ranks, the following formula was used:

$$\text{Percent Position} = \frac{100(Rij - 0.50)}{Nj}$$

Where,

Rij = Rank assigned to the i^{th} object by the j^{th} person.

Nj = Number of objects ranked by the j^{th} person.

3. RESULTS AND DISCUSSION

Table 1. Socio, economic and Psychological characteristics of the respondents

Sl. No	Variable	Districts					
		Bengaluru Rural(120)		Chikkaballapura (120)		Total(240)	
		f	%	f	%	f	%
1	**Age**						
	Young(Upto 35 years)	38	31.67	37	30.83	75	31.25
	Middle(36-50 years)	67	55.83	64	53.33	131	54.58
	Old(> 50 years)	15	12.50	19	15.83	34	14.17
2	**Caste**						
	General	24	20.00	19	15.83	43	17.92
	OBC	59	49.17	56	46.67	115	47.92
	ST	11	9.17	16	13.33	27	11.25
	SC	26	21.67	29	24.17	55	22.92
3	**Occupation**						
	Agriculture	18	15.00	17	14.17	35	14.58
	Agriculture +Allied (Horti, Animal husbandry, Fishing etc)	48	40.00	52	43.33	100	41.67
	Agriculture + Labour	15	12.50	23	19.17	38	15.83
	Agriculture + Service(Real estate, hotels, restaurants etc)	39	32.50	28	23.33	67	27.92
4	**Sex**						
	Male	103	85.83	104	86.67	207	86.25
	Female	17	14.17	16	13.33	33	13.75
5	**Education**						
	Illiterate	10	8.33	15	12.50	25	10.42
	Can only read and write	21	17.50	25	20.83	46	19.17
	Primary school	15	12.50	17	14.17	32	13.33
	Middle school	18	15.00	16	13.33	34	14.17
	SSLC	23	19.17	18	15.00	41	17.08
	PUC	16	13.33	18	15.00	34	14.17
	Degree	11	9.17	8	6.67	19	7.92
	Post-graduation	6	5.00	3	2.50	9	3.75
6	**Farming experience**						
	Low(< 5 years)	22	18.33	20	16.67	42	17.50
	Medium(5-10 years)	33	27.50	35	29.17	68	28.33
	High(>10 years)	65	54.17	65	54.17	130	54.17
7	**Family size**						
	Small(<5)	55	45.83	49	40.83	104	43.33
	Medium(5-6)	38	31.67	35	29.17	73	30.42
	Large(>6)	27	22.50	36	30.00	63	26.25
8	**Size of land holding**						
	Marginal farmers(< 2.5	17	14.17	19	15.83	36	15.00

Sl. No	Variable	Districts					
		Bengaluru Rural(120)		Chikkaballapura (120)		Total(240)	
		f	%	f	%	f	%
	acres)						
	Small farmers(2.51 – 5 acres)	57	47.50	65	54.17	122	50.83
	Medium farmers(5.01–10 acres)	36	30.00	28	23.33	64	26.67
	Big farmers(> 10 acres)	10	8.33	8	6.67	18	7.50
9	**Credit orientation**						
	Low(<$\bar{x}$ - SD)	26	21.67	29	24.17	55	22.92
	Medium($\bar{x}$± SD)	38	31.67	34	28.33	72	30.00
	High(>$\bar{x}$+ SD)	56	46.67	57	47.50	113	47.08
10	**Mass media participation**						
	Low(<$\bar{x}$ - SD)	14	11.67	19	15.83	33	13.75
	Medium($\bar{x}$± SD)	65	54.17	63	52.50	128	53.33
	High(>$\bar{x}$+ SD)	41	34.17	38	31.67	79	32.92
11	**Innovative proneness**						
	Low(<$\bar{x}$ - SD)	28	23.33	26	21.67	54	22.50
	Medium($\bar{x}$± SD)	63	52.50	69	57.50	132	55.00
	High(>$\bar{x}$+ SD)	29	24.17	25	20.83	54	22.50
12	**Extension agency contact**						
	Low(<$\bar{x}$ - SD)	31	25.83	42	35.00	73	30.42
	Medium($\bar{x}$± SD)	65	54.17	61	50.83	126	52.50
	High(>$\bar{x}$+ SD)	24	20.00	17	14.17	41	17.08
13	**Risk orientation**						
	Low(<$\bar{x}$ - SD)	23	19.17	29	24.17	52	21.67
	Medium($\bar{x}$± SD)	56	46.67	63	52.50	119	49.58
	High(>$\bar{x}$+ SD)	41	34.17	28	23.33	69	28.75
14	**Management Orientation**						
	Low(<$\bar{x}$ - SD)	29	24.17	33	27.50	62	25.83
	Medium($\bar{x}$± SD)	54	45.00	61	50.83	115	47.92
	High(>$\bar{x}$+ SD)	37	30.83	26	21.67	63	26.25
15	**Information seeking behavior**						
	Low(<$\bar{x}$ - SD)	58	48.33	63	52.50	121	50.42
	Medium($\bar{x}$± SD)	43	35.83	46	38.33	89	37.08
	High(>$\bar{x}$+ SD)	19	15.83	11	9.17	30	12.50
16	**Achievement motivation**						
	Low(<$\bar{x}$ - SD)	26	21.67	31	25.83	57	23.75
	Medium($\bar{x}$± SD)	45	37.50	48	40.00	93	38.75
	High(>$\bar{x}$+ SD)	49	40.83	41	34.17	90	37.50
17	**Preparedness for adoption**						
	Low(<$\bar{x}$ - SD)	28	23.33	36	30.00	64	26.67
	Medium($\bar{x}$± SD)	53	44.17	56	46.67	109	45.42
	High(>$\bar{x}$+ SD)	39	32.50	28	23.33	67	27.91
18	**Change resistance**						
	Low(<$\bar{x}$ - SD)	26	21.67	34	28.33	60	25.00
	Medium($\bar{x}$± SD)	73	60.83	71	59.17	144	60.00
	High(>$\bar{x}$+ SD)	21	17.50	15	12.50	36	15.00

From Table 1, More than half (54.58%) of the respondents from both districts belonged to middle age (36-50 years). It is conceivable that middle-aged farmers should receive greater attention since they are motivated and able to take full use of ICT to adapt to and mitigate the adverse effects of climate change.

Nearly half (47.92%) of the total respondents belong to the OBC category. It implies that any effort to address Climate change through the use of ICT tools and techniques should concentrate mainly on the category of Other Backward Caste followed by Scheduled caste, General and Scheduled tribe respectively.

About 41.67 percent of the respondents from both districts responded as agriculture and allied activities are their main occupations. Thus it can be concluded that the majority of the farmers from both districts chose agriculture and allied as their main occupation the reason might be due to uncertainty of yield and income from agriculture alone because of changes in climatic parameters and also there will be scope for better marketing, transportation of goods and services due to proximity to the capital city (Bengaluru) of the Karnataka.

From both districts, more than three-fourths (86.25%) of respondents were male, while the majority were female. This difference may exist because men are the family heads in both districts and are in charge of gaining access to various ICTs to adopt and lessen the negative effects of climate change on agriculture.

The Basic education possessed by the respondents of both districts was found to be can only read and write (19.17%) followed by SSLC(17.80%), Middle school and PUC(14.17%). The reason could be the recognition that basic education is imperative for operating innovative tools, understanding climate change impacts on their livelihoods, and taking advantage of the free and compulsory education scheme implemented by Karnataka's government. The findings are consolidated when compared to the 2011 Census (http://censusindia.gov.in) in which the state ranked 31st in terms of literacy rate, with 67.66 percent. The findings in line with the findings of Raghuprasad K P [4].

More than half (54.17%) of the respondents were found to be a high (> 10 years) level of farming experience. The reason might be these two rural districts had agriculture as a source of their source income and livelihood for the past long years and the majority of the families belong to the agrarian category hence that they possessed high and medium levels of farming experience.

About 43.33 per cent of respondents from both districts belongs to the small-size family (<5 members). This may be attributed to different factors, such as the adoption of the lifestyle of the capital city, literacy, level of access and availability of different ICTs and urbanization, etc. Such social changes have played a significant role in the conversion of the social structure from large families to small families.

More than half (50.83%) of respondents possessed small size of land holdings and they were grouped under the category of small farmers (2.51 – 5.00 acres). Due to land division and family segregation, the size of the land holdings remains on a decreasing trend. This pattern has been observed particularly in rural India.

Nearly half (47.50%) of respondents from both districts possessed a high level of credit orientation. Farmers have faced more difficulties in cultivating crops over the past few years as a result of frequent dry spells in both regions, which eventually cause losses compared to returns. This likely increased their dependence on credit.

More than half (53.33%) of respondents in both districts had a medium level of mass media participation. These findings indicate that the majority of respondents from both districts engaged in medium- high-level mass media consumption. The reason could be that farmers were eager to learn new adoption and mitigation strategies by accessing various ICT technologies to overcome the consequences of an abrupt shift in the climate and its adverse impact on agriculture.

The majority (55.00%) of the total respondents had a medium level of innovative proneness. Farmers in the study region have been suffering from climate change for the past few years, and they are always looking for new technologies to protect their crops and increase the returns from all of their farming activities. The fact that they were adjacent to a developed metropolis like Bengaluru and had an excellent extension

agency link with University of Agricultural Sciences. Bangalore may also have contributed to this outcome.

In both districts, more than half (52.50%) of the respondents came into the category of medium extension agency interaction. The majority of farmers in the research area are forward-thinking and equipped with cutting-edge information-sharing tools to handle unfavorable climate change. In order to stay current with new technologies, they seek information from both public and private sector entities.

Nearly half (49.58%) of respondents in the study area were found to be a medium level of risk orientation. The farmers in both regions were found to be the middle-aged group and had a medium degree of innovative proneness. Additionally, they have strong relationships with both public and commercial extension organizations. For these reasons, the majority of the farmers in both districts fell into the group of middle-level risk orientation.

As per data in Table 1 nearly half (47.92%) of the farmers in rural Bengaluru, the district fell into the medium level of management orientation. Farmers had to plan for resource allocation and have access to available ICT tools (website, mobile applications) to know about weather forecasts because the study area has a shortage of resources and is affected by unfavorable climatic conditions, especially drought and prolonged dry spells.

The majority of farmers in the rural Bengaluru district exhibited a low (50.42%) level of information-seeking behavior. This result is probably attributable to farmers' positive interactions with extension agents, media exposure, and innovative tendencies, which encourage them to seek out information from a variety of ICTs about adopting and mitigating strategies to resilient over adverse climate change variables like drought, flood, and dry spells etc.

About 38.75 percent of respondents had a medium level of achievement motivation followed by high (37.50%). The show results might be due to that they had a medium level of risk-taking ability and who were very ambitious about farming. These farmers had been engaged in agriculture for a long time despite their inability to access the necessary water resources and other government assistance, and they had been leading the state's horticulture, floriculture, fish production, and silk production under difficult circumstances.

About 45.42 per cent of respondents had a medium level of preparedness for adoption and 60 per cent of the respondents had a medium level of change resistance. The outcomes might be attributed to the farmers in both areas having good risk-taking attitudes, which makes them constantly prepared to use coping strategies in the face of challenging weather conditions to boost production and profit. Most of these farmers also had small land holdings and they had a medium level of extension agency contact and mass media participation as a result of this the farmers didn't get good exposure to new information and this makes them stick with their traditional practices.

3.1 Constraints and Suggestions as Given by the Framers for Better Access to ICTs in Mitigating Climate Change Effect in Agriculture

The results in Table 2 reveal that among the social constraints in the access and utilization of ICTs for mitigating climate change it is found to be Cautious about accessing technology (mean score 56.35) was the most important constraint and Lack of awareness about advanced icts used for accessing climate change-related information as second most constraint with a mean score of 54.19 from both districts (Bengalururu Rural plus Chikkaballapura).The findings are inline with the findings of Rebekka Syiem and Saravanan Raj [5].

Table 2 also shows that high call rates in the mobile calling (Mean score 57.17) were the most important constraint among economic constraints followed by high charges on data and validity packs (mean score 56.56), Low income of rural farmers (mean score 50.60), High initial cost investment on icts (mean score 45.25), lack of access to credit (mean score 40.40).

Table 2. Final ranking of constraints

Sl.No	Constraints	Bengaluru Rural (n1=120)		Chikkaballapura (n2=120)		Total (n=240)	
		Score	Rank	Score	Rank	Score	Rank
	Social constraints						
1	Lack of credibility of subject matter content	43.86	VII	38.00	VII	41.27	VII
2	Lack of infrastructure for proper use of ICTs	47.58	VI	45.15	VI	46.54	VI
3	Language barrier to accessing information	50.86	III	47.43	IV	49.21	IV
4	Limited digital literacy of farmers	50.43	IV	47.29	V	49.00	V
5	Lack of awareness about advanced ICTs used to get climate change-related information	51.72	II	53.86	III	52.60	III
6	Lack of training in the navigation of different mobile apps and websites	50.00	V	59.74	I	54.19	II
7	Cautious about accessing new technology	54.15	I	59.00	II	56.35	I
	Economic constraints						
1	High initial cost investment on icts	39.8	V	50.60	IV	45.25	IV
2	Low income of rural farmers	43	IV	57.60	I	50.60	III
3	High call rates in mobile calling	60	I	54.20	III	57.17	I
4	High charges on data and validity packs	57.4	II	56.00	II	56.56	II
5	Lack of access to credit	49.8	III	31.60	V	40.40	V
	Technical constraints						
1	Short-duration supply or insufficient availability of electricity	40.00	VII	42.87	7	40.03	VII
2	Low internet coverage	52.12	IV	49.37	5	51.98	IV
3	Low internet speed	52.50	III	54.12	3	52.72	III
4	Internet connectivity issue	50.12	V	45.87	6	49.87	V
5	Limited availability of computers and community centers	56.12	II	55.62	2	56.18	II
6	Lack of adequate skills to use ICT	60.87	I	59.50	1	60.76	I
7	Limited authenticity information	39.12	VIII	40.37	8	38.86	VIII
8	Untimely delivery of information	47.37	VI	50.50	4	47.77	VI

Table 3. Suggestions of farmers to improve the access and usage pattern of ICTs in Mitigating climate change effect in agriculture (n=240)

Sl. No	Suggestion	Frequency	Percentage
1	Training should be given to the farmers for the proper use of ICTs in mitigating and adopting climate change	186	93.00
2	Government should initiate Awareness programmes about available new ICTs tools and their applications in climate change	172	86.00
3	Public and private agencies should take the initiative to start community center like the common service center model of the government of India	159	79.50
4	Timely availability of credit facilities from financial institutes	162	81.00
5	Initiation of climate-resilient projects at the Panchayat level	127	63.50
6	Recruitment of technical persons in ICT to teach and guide the farmers at the hobli level	148	74.00
7	Provision of information through various icts should be in regional language	137	68.50

While in the case of technical constraints Lack of adequate skills to use ICT was ranked first by the respondents with a mean score value of 60.76. The second most important technical constraint was the Limited availability of computers and common service center (mean score 56.18). Low internet speed (52.72) is third, Low internet coverage (51.98) is fourth, Internet connectivity issue (49.87) is fifth, Untimely delivery of information (47.77) is sixth, Short duration supply or insufficient availability of electricity (40.02) is seventh, Limited authenticity of information (38.86) as eight ranks as perceived by the farmers of Bengaluru rural district. The findings in line with the findings of Ansari, M.A. and Pandey, N [6].

The data in Table 3 revealed suggestions offered by the farmers of Bengaluru rural and Chikkaballapura district to better access information through icts about climate change and its awareness for adopting and adjusting their farming activities and thereby sustaining their income. The majority (93.00%) of the farmers from both districts suggested that Training should be given to the farmers for proper use of ICTs in mitigating and adopting climate change. While 86.00 per cent of the respondents suggested that Government should initiate Awareness programmes about available new ICTs tools and their applications in climate change. Whereas, 81.00 per cent of respondents suggested that they need timely availability of credit facilities from financial institutes. The findings in line with the findings of Anand S et al. [7] Further, 79.50 per cent of respondents suggested that Public and private agencies should take initiation to start community center like the common service center model of the Government of India. Followed by the Recruitment of technical persons in ICT to teach and guide the farmers at the hobli level (74.00%) and 68.50 per cent of respondents suggested that the Provision of information through various icts should be in regional language. finally, 63.50 per cent of respondents suggested the Initiation of climate-resilient projects at the Panchayat level. The findings in line with the findings of Abhishek Mishra et al. [8].

4. CONCLUSION

In the current study, it is found that farmers were facing many problems i.e. the constraints to better access to ICTs and thereby using these technologies to minimize the effect of climate change in agriculture. In the case of social constraints from both districts, farmers were given first and second rank for being cautious about accessing innovative technologies and lack of training in the navigation of different mobile apps and websites respectively. While the case of economic constraints High call rates in mobile calling and High charges on data and validity packs might be due to the farmers using a few months of free and unlimited calling and data services provided by telecommunication wizard of India i.e. Jio-Reliance and nowadays the company charging for their service hence the farmers felt that it was an economic constraint for them. The farmers felt that they don't know the

skill of accessing the ICTs and there was dearth of computers and community center in their proximity was the main technical constraint as felt by the farmers. To overcome the constraints felt by the farmers of both districts the farmers suggested some solutions like there was a need for training for proper use of ICTs in mitigating and adopting climate change and the Government should initiate Awareness programmes about available new ICTs tools and their applications in climate change.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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