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Farmers' Willingness to Pay for Climate Smart Agriculture in Flood Vulnerable Areas of Assam

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HIGHLIGHTS

- Climate smart agriculture practices namely 'Stress Tolerance Varieties of rice' (STVs), 'Integrated Pest Management (IPM) and 'Integrated Nutrient Management' (INM) were found as high degree of willingness to pay.
- The highest average bidding value was found in case of STV (Rs. 251.00) followed by INM (Rs. 185.00) and IPM (Rs. 174.13).
- Age, educational experience, market accessibility, institutional contact cropping intensity, adoption consistency and degree of preferences to CSA practices significantly influence in explaining the variation of degree of farmers' willingness to pay.
- Selected variable explained 74% (R^2=0.74) variation in WTP for CSA practices

ARTICLE INFO

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ABSTRACT

The current study was carried out during 2020 in flood vulnerable district of Assam to measure the farmers' Willingness to Pay (WTP) for climate smart agriculture practices and factors likely to influence thereon. The study reveals that degree of farmers 'willingness to pay was found high for 'Stress Tolerance Varieties of rice (STVs)', 'Integrated Nutrient Management (INM)' and 'Integrated Pest Management (IPM)' while low degree of WTP was found for 'Vermicompost preparation and application (VC)' and 'Minimum Tillage (MT)'. The highest average bidding value was recorded for STV (Rs. 251.00) followed by INM (Rs. 185.00) and IPM (Rs. 174.13) while for VC and MT the average bidding value was Rs. 158.63 & Rs 79.75 respectively. The LMR analysis confirmed that the selected explanatory variables expressed variation in willingness to pay for CSA practices about 74% (R^2=0.74). The variable 'educational status' (x_2), 'accessible to market' (x_7) 'cropping intensity' (x_9), 'adoption consistency' (x_{13}) and 'preferences to CSA practices' (x_{14}) were found to have positive while variable 'age' (x_1) and 'institutional contact' (x_6) have negative and significant influence on WTP. Popularizing CSA practices available in the research front, various organizations (both public and private) in input and output chains should work together as a common entity so that farmers get necessary nurture for adoption of technologies.

INTRODUCTION

Climate change is likely to have the worst impact on agriculture which is the major source of livelihood for resource poor farmers. Climate smart agriculture (CSA) is one of the important options for adapting and mitigating ill effect of climate change. CSA is capable of increasing productivity, adaptability and reducing GHG emission (FAO, 2012) and thus transform the current agricultural system to support sustainable food production and safeguard it during increased climate vulnerabilities. Acceptance and adoption CSA practices are crucial for a climate resilient agriculture as it can sustainably boost productivity, improve resilience, and lower GHG

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emissions (Shitu et al., 2018; Sisay et al., 2023). Therefore, all the pertinent organizations should put their best to assist and facilitate farmers in the process of adoption of such technologies. But adoption of CSA is low in developing country likes India dominated with small holder farmers (Das et al., 2022). The adaptability of farmers in climate change situation is governed by too many performer variables with diverse nature. Thus, understanding and analysing the casual factors of farmers' decision to use one practice may give insights into those factors enabling or restricting adaptation. Moreover, CSA technologies are situation specific, and their large-scale adoption is mostly determined by the compatibility of skills and degree of willingness of users to pay for them (Long et al., 2016). A detail comprehension about willingness to pay of prime partners is essential for formulating strategy and policy framework. In the context of agriculture, it is very significant to understand and determine about farmers' readiness to pay in agricultural technologies prior to fix their values. Pragmatic analysis based on facts and experimental data on Willingness to pay will help policy makers to formulate appropriate policies and programmes (Taneja et al., 2014). Besides, it requires good network among the private and government institutions. So, farmers' WTP for climate smart technologies is very crucial to mitigate the bad effect of climatic changes. Further, identifying the socioeconomic factors which govern the degree of WTP for climate smart agricultural practices is key to understand and address them for making agriculture sustainable and resilient. This is also important for formulation or reformation of policies or programmes to stimulate climate smart behaviour (Mutoko et al., 2015; Long et al., 2016). As an activity of National Innovation on Climate Resilient Agriculture (NICRA) project, on farm participatory demonstrations cum training on climate smart practices viz. stress tolerant rice varieties (STVs), integrated pest management (IPM), integrated nutrient management (INM), vermicompost preparation and application (VC) and minimum tillage (MT) were implemented in between 2011 and 2015 in the flood vulnerable districts viz. Dhubri, Cachar, Dibrugarh and Sonitpur district in Assam (Rama Rao et al., 2013). These technologies are regarded as climate smart as because they satisfy minimum two pillars of climate smart technology (FAO, 2012; Saravanan, 2013; Thierfelder et al., 2015; Bedmar et al., 2016; Deng et al., 2016; Khatri-Chhetri et al., 2016 & CIAT, 2017). The degree of willingness to pay for climate smart agriculture technologies will reflect the farmers' readiness to invest on technologies. This will depict a clear picture regarding adoption of technology even after withdrawal of government assistance. Again, farmers to farmers the degree of WTP is different as because their socioeconomic condition or choices of farmers to CSA practices are varied. Taking into considering of above points this study was planned to assess farmers' willingness to pay for CSA practices and determine factors influence thereon.

METHODOLOGY

Ex post facto research design was followed for the present study. The study was conducted in four purposively selected districts of Assam namely Dibrugarh, Sonitpur, Dhubri and Cachar in 2020. Krishi Vigyan Kendras of these districts implemented NICRA activities since 2011. From each district, one village was selected purposively where NICRA project was implemented, Thus, four villages were selected for the study. A total of 400 farmers participated in the project were selected as sample, 147 from Namtemera missinggaon, 111 from Punioni Bhaghchung,75 from Udmari Part IV and 40 from Salchapra village by following proportionate random sampling methods. The formula used for drawing sample respondents from each village is

$$Q_I = \frac{A_i \text{ x } N}{B_i}$$

Where, Q_I = Number of respondents selected from ith village, A_i = total respondents in the ith village, B_i = total respondents, N = Sample size

After reviewing the relevant literatures, consulting with experts and scientists 14 explanatory variables were selected to find out degree of influence on WTP towards CSA practices. For measurement about WTP for CSA practices two widely used methods are- "revealed preference method" and "stated preference method (contingent valuation or choice experiment)". For revealed preference method, an assumption is made about relationship of exchangeability between market product and nonmarket product of interest. But in case of stated preference methods, preferences of respondents are enquired either directly or indirectly. In direct methods respondents' preferences are assessed by asking how much they are ready to pay for a product, while in indirect method a rating or ranking procedure is followed for different products to create a preference order and based on that calculated the WTP (Marbeau, 1987; Taneja et al., 2014).

Degree of willingness to pay (WTP) of farmer refers here the maximum price at or below which a farmer will buy one CSA practices. In order to access WTP for selected CSA practices, contingent valuation or choice experiment methods followed by Taneja et al., (2014) was followed with slight modification. In this method, respondents were offered with selected CSA practices one at a time and then they were requested to rate their preferences on the four-point continuum as 'not preferred' (0) 'less preferred' (1) 'moderately preferred' (2) 'strongly preferred' (3) against each selected attributes of CSA practices. The percentage of score was calculated by following formula

$$\text{Percentage Wtg} = \frac{\text{Total Wtg}_{\text{score}}}{\text{Total probable score}} \times 100$$

The responders were categorised based on percentage scores obtained as very low (0-25%), low (26-50%) medium (51-75%) and high (76-100%). Then, CSA practices were assigned score as 1, 2, 3 and 4 based on rank very low, low, medium and high respectively. The bidding method was started with pseudo currency. Then respondents were requested to tender for CSA practices placed before them. A two-parameter criterion –weight assigned to given CSA practices in bidding process and rank obtained in scoring process was considered to determine the degree of WTP. The technology weight (W_t) and average technology weight (W_{tav}) for CSA practices were worked out by using following formula

$$\text{Technology weight in bidding } (W_t) = \frac{\text{Amount bid by respondent to a CSA practice (Rs.)}}{\text{Cumulative amount bid by respondents for CSA practices (Rs.)}}$$

$$\text{Average weight of technology } (W_{tav}) = \frac{\text{Sum of weights assigned to a CSA practice by respondents (Rs.)}}{\text{Number of respondents participated in bidding}}$$

A scale with ranges from 0 to 100 was considered to categorise CSA practices into two distinct groups on the basis of mean weight (W_{tm}) and average weight (W_{tav}). i. If for a CSA practice $W_{tav} \geq W_{tm}$, rated as a high-weighted CSA practice; ii. If for a CSA practice $W_{tav} \leq W_{tm}$, rated as a low-weighted CSA practice. The CSA practices were further weighed based on percentage of respondent's bids in the bidding game as 4($W_{tav} \geq W_{tm}$ and freq > 50%), 3($W_{tav} \geq W_{tm}$ and freq < 50%), 2($W_{tav} \leq W_{tm}$ and freq > 50%) and 1($W_{tav} \leq W_{tm}$ and freq < 50%)

Based on technology weight in bidding game and rank score obtained in preference rating, the degree of WTP of respondents was categorised as 4 (if rank score>3 and $W_t > W_{tav}$), 3 (if rank score < 3 and $W_t > W_{tav}$), 2 (if rank score > 3 and $W_t < W_{tav}$) and 1(if rank score <3 and $W_t < W_{tav}$). Again, Pearson's Correlation Coefficient (r) as well as Multiple Linear Regression (MLR) analysis were work out for finding out association and effect of explanatory variables on dependent variables.

RESULTS

Choice of CSA practices based on level of WTP

Table 1 reveals that the three CSA practices namely, STVs, IPM and INM were found as high level of willingness to pay as their weighted bids was higher than average weighted bid and participating farmers in bidding process was higher than 50%. The low degree of farmers' willingness to pay was found for VC and MT practice as these two practices had less weighted bids than average and participating farmers was less than 50%.

Distribution of farmers based on their degree of WTP for CSA practices

The Table 2 reveals that the level of WTP towards 'VC' was found to be of moderate for the most of respondents (47%), followed by high (25.5%). The low level of WTP for this practice was found for 6.25 per cent of respondents. Around 21.25 per cent of farmers had very low level of WTP for this practice. In case of INM, the degree of WTP was found to be of moderate level for majority farmers (43.25%) followed by high degree of WTP (23.75%). The next order of majority of respondents was found in very low category of WTP level with 23 per cent of respondents.

About 40.75 per cent farmers were moderately ready to pay for minimum tillage practice followed by 29.50 per cent respondents with very low degree of WTP towards the technology. But, only 13.75 per cent respondents were enormously ready to pay for the technology (Table 2). In case of IPM practices, majority of farmers (50.25%) showed moderate level of willingness to pay followed by high level with 42.75 per cent. Table 2 also reveals that 59.50 per cent of respondents showed moderate level of WTP towards 'STVs'. Most respondents (37.50%) were found in high degree of WTP. Only 3 per cent farmers showed least degree of WTP for this technology. The level of WTP for all CSA practices were found

Table 1. Degree of farmers' WTP for CSA practices

CSA	Amount bid (Rs)	Weighted bid # (%)	Farmers participated in bidding ##	Percentage of farmer	Degree of WTP### 1-4
Vermicompost preparation and application	63450	18.69	220	55.00	2
Integrated nutrient management	74000	21.80	330	82.50	4
Minimum Tillage	31900	9.40	208	52.00	2
Integrated pest management	69650	20.52	240	60.00	4
Stress tolerant rice varieties	100400	29.58	368	92.00	4
Total	339400	100.00			

#Bid for each practices; total bids for all practices = 100; ##Total farmers = 400. Average weight (100/No. of tech.) = 20.00; ### 1 = poorly preferred, 2 = low preferred, 3 = moderately preferred, 4 = highly preferred

Table 2. Distribution of farmers based on their WTP for selected CSA practices (N=400)

CSA practices	Level of WTP				Mean	SD	CV
	High	Moderate	Low	Very low			
Vermicompost preparation and application	25.50	47.00	6.25	21.25	158.63	113.03	0.71
Integrated nutrient management	23.75	43.25	10.00	23.00	185.00	134.57	0.73
Minimum Tillage	13.75	40.75	16.00	29.50	79.75	56.40	0.71
Integrated pest management	42.75	50.25	5.00	2.00	174.13	115.73	0.66
Stress tolerant rice varieties	37.50	59.50	0.00	3.00	251.00	144.05	0.57
Overall	42.25	32.50	17.50	7.75	606.61	220.99	0.36

high for majority farmers (42.25%) followed by moderate with 32.25 per cent. Around 17.75 and 7.75 per cent farmers had low and very low degree of WTP for selected CSA practices. It is also cleared from the Table 2 that the highest average bidding value was recorded in case of STV (Rs. 251.00) followed by INM (Rs. 185.00) and IPM (Rs. 174.13). The average bidding values for VC and MT were Rs. 158.83 and Rs. 79.75, respectively.

Correlation of independent variables with Willingness to Pay (WTP)

Table 3 reveals that educational status (X_2), dependent members (X_3), share of low land (X_4), annual farm income (X_5), institutional contact (X_6), accessible to market (X_7), degree of commercialization (X_{10}), adoption consistency (X_{13}) and preferences to CSA practices (X_{14}) had significant and positive correlation with degree of WTP for CSA practices. The negative and significant relationship with WTP was found for age (X_1) and farming experience (X_8). The rest variables were showed no significant association with WTP.

Table 3. Relationship of independent variables with Willingness to Pay (WTP)

Independent variables	r	P value
Age (X_1)	-.393**	0.000
Educational status (X_2)	.371**	0.000
Dependent members (X_3)	.194**	0.000
Share of low land (X_4)	.438**	0.000
Annual farm income (X_5)	.175**	0.000
Institutional contact (X_6)	.145**	0.004
Accessible to market (X_7)	.402**	0.000
Experience in farming (X_8)	-.128*	0.011
Cropping intensity (X_9)	-.088	0.078
Degree of commercialization (X_{10})	.209**	0.000
Innovative proneness (X_{11})	.060	0.228
knowledge about CSA practices (X_{12})	-.068	0.175
Adoption consistency (X_{13})	.338**	0.000
Preferences to CSA practices (X_{14})	.778**	0.000

* Significant at 5% level of probability; ** Significant at 1% level of probability; r = Correlation coefficient, $p < 0.05$

The findings is supported by the findings of Horna et al., (2007); De Chaisemartin & Mahé (2009); Temesgen & Tola (2015).

Contribution of explanatory variables to degree of WTP for CSA practices

Table 4 depicted that out of 14 explanatory variables 7(seven) variables were recorded to have significant contribution for explaining predictive variable i.e. degree of willingness to pay for CSA practices. The explanatory variables like educational status (X_2), accessible to market (X_7), cropping intensity (X_9), adoption consistency (X_{13}) and preferences to CSA practices (X_{14}) were found as positive and significant contributions in explaining the deviation on level of WTP for CSA practices while variable age (X_1) and institutional contact (X_6) had negative but significant contribution towards explaining the variation of the predictive variable.

DISCUSSION

The findings of the study indicate that Stress tolerance varieties of rice, integrated nutrient management and integrated pest management had high degree of willingness to pay (Table 1). As in flood vulnerable area of Assam stress tolerance varieties of rice which have high adaptability and might be useful for managing flood risk over the existing varieties and hence majority of farmer are ready to invest on it (Singh et al., 2008; Veettil et al., 2009; Rejula et al., 2017; Chouksey et al., 2021; Koppa & Giriraj, 2021; Yadav et al., 2022). In regard to INM and IPM practices, as farmers are convinced with the result or suitability in their situations. (Sarkar et al., 2022; Sisay et al., 2023) and they will continue even after withdraw of government subsidies or assistance. Bisen et al., (2023) advocated that India needs to either boost up its agri-infrastructure or free up some of its rice area in favour of resource conservation and crop diversification. Vermicompost preparation and application less preferred in flood affected areas as because of frequent submergence in summer season. Likewise, farmers show reluctance

Table 4. Regression analysis of willingness to pay with selected explanatory variables

	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Intercept	1.355	1.080		1.254	.210
Age (X_1)	-.046*	.011	-.162	-4.252	.000
Educational status (X_2)	.222*	.029	.256	7.545	.000
Dependent members (X_3)	-.282	.302	-.028	-.934	.351
Proportion of low land (X_4)	.007	.004	.068	1.634	.103
Annual farm income (X_5)	.002	.004	.014	.491	.624
Institutional contact (X_6)	-.595*	.103	-.227	-5.784	.000
Accessible to market (X_7)	.337*	.067	.189	5.040	.000
Farming experience (X_8)	.020	.012	.088	1.628	.104
Cropping intensity (X_9)	.010*	.003	.157	4.086	.000
Degree of commercialization (X_{10})	-.003	.003	-.035	-1.199	.231
Innovative proneness (X_{11})	-.014	.019	-.019	-.731	.466
Knowledge on CSA practices (X_{12})	.007	.022	.009	.329	.743
Adoption consistency (X_{13})	.031*	.008	.121	3.767	.000
Preferences to CSA practices (X_{14})	.658*	.038	.647	17.343	.000
	R^2=0.74	Adjusted R^2= 0.73	F= 77.478*	$p< 0.05$	

to invest on minimum tillage practices. This finding is in the line of findings reported by Singh et al., (2008); Chouksey et al., (2021).

The result of correlation highlights that farmers who have more years of formal education, more annual farm income, more dependent family members and more institutional contact have high degree of WTP for CSA practices (Taimour et al., 2022; Anugwa et al., 2021; Sisay et al., 2023; Pabba et al., 2022). The reasons may be due to high annual farm income farmers had high investment capability and risk-taking ability so they have high degree of WTP for CSA practices. Likewise, farmers have more institutional contact there is the probability to get hand holding support and get more recent information and assistance thus their degree of wiliness to pay for CSA practices is high (Onugo & Onyeneke, 2022; Anugwa et al., 2021). Young farmers with frequent access to market have higher degree of WTP for CSA practices as compared to old aged farmers (Sisay et al., 2023; Angella et al., 2014). This may be due to young aged farmers are more worried about impact and adaptable technologies to climate change (Mekonnen, 2017). Experienced farmers have low level WTP towards CSA practices as they develop own adaptable strategies for addressing the issue of climate change. Farmers who have high degree of preference and adoption of CSA practices their WTP is higher (Taimour et al., 2022).

Results of MLR analysis show that R^2 value is 0.74 (Table 4) which indicates that the six explanatory variables will express 74.00 per cent variation of farmers' degree of willingness to pay for CSA practices. It has been observed that one unit change of educational experiences, market accessibility of farmers will increase the degree of WTP by 0.22 and 0.34 times. Likewise, one unit increases in cropping intensity, adoption consistency and degree of preferences will increase degree of WTP of farmers towards CSA practices 0.01, 0.03 and 0.66 times respectively. The findings are in line of findings reported by Temesgen & Tola (2015) & Horna et al., (2007).

The best predictive model from the selected explanatory variables for the predictor variable degree of WTP of farmers for CSA practices is

$$Y= 1.355 - 0.046 X_1 + 0 .222 X_2 - 0.595 X_6 + 0.337 X_7 + 0.01 X_9 + 0.031 X_{13} + 0.658 X_{14} – e$$

Where, X_1= Age of farmers, X_2 =Educational experience, X_6= Institutional contact X_7 = accessible to market, X_{13} = adoption consistency X_{14}= preference for CSA practices

CONCLUSION

Stress tolerance rice varieties, INM and IPM practices were high choice of technologies in terms of willingness to pay. Hence, both public and private organizations should make plan and policy for making these technologies available to the farmers. Farmers' having high adoption consistency and degree of preferences had high degree of willingness to pay for climate smart agriculture practices. Thus, farmers who have been following climate smart agriculture practices in more area for long period and high preferences towards climate smart agriculture practices were ready to invest for CSA practices. As farmers' willingness to pay has significant and positive correlation with farmers' preferences on CSA practices, specific technology package of climate smart practices should be assessed both at scientist and farmers' perspective in terms of CSA assessment criteria in context to their farm situation, and make them readily available either through public or private institutions.

REFERENCES

Angella, N., Dick, S., & Fred, B. (2014). Willingness to pay for irrigation water and its determinants among rice farmers at Doho Rice Irrigation Scheme (DRIS) in Uganda. *Journal of Development and Agricultural Economics*, *6*(8), 345-355.

Anugwa, I. Q., Onwubuya, E. A., Chah, J. M., Abonyi, C. C., & Nduka, E. K. (2021). Farmers' preferences and willingness to pay for climate-smart agricultural technologies on rice production in Nigeria. *Climate Policy*, *22*(1), 112–131. https://doi.org/10.1080/14693062.2021.1953435

Bedmar, V. A., Jha, Y., Ogwal-Omara, R., Welch, E., & Halewood, M. (2016). Adoption of climate smart technologies in East Africa: Findings from two surveys and participatory exercises with farmers and local experts. CCAFS Info Note, CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

Bisen, J., Kumar, S., Singh, D. R., Nain, M. S., Arya, P., & Tiwari, U. (2023). Performance and macro-economic scenarios of rice market outlook in India. *Oryza*, *60*(Special Issue), 78-90, https://doi.org/10.35709/ory.2023.60.0.7

Chouksey, R., Singh, K. C., Singh, C., & Birle, Y. (2021). Adaptation of farmers regarding climate resilient technologies in Rewa Block of Rewa District in Madhya Pradesh. *Indian Journal of Extension Education*, *57*(1), 26-31.

CIAT World Bank. (2017). Climate-Smart Agriculture in Bangladesh. CSA Country Profiles for Asia Series. International Center for Tropical Agriculture (CIAT); World Bank. Washington, D.C. 28 p.

Das, U., Ansari, M. A., & Ghosh, S. (2022). Effectiveness and upscaling potential of climate smart agriculture interventions: Farmers' participatory prioritization and livelihood indicators as its determinants. *Agricultural Systems, 203*, 103515. https://doi.org/10.1016/j.agsy.2022.103515

De Chaisemartin, C., & Mahe, T. (2009). How to understand our willingness-to-pay to fight climate change? A choice experiment approach. Retrieved January 10, 2024 https://hal.science/hal-00370738v1/file/cahier_de_recherche_2009-08.pdf

Deng, A., Chen, C., Feng, J., Chen, J., & Zhang, W. (2016). Cropping system innovation for coping with climatic warming in China. *The Crop Journal*, *5*(2), 136-150.

Food & Agriculture Organization of the United Nations. (2013). Climate-smart agriculture sourcebook. FAO. http://www.fao.org/3/i3325e/i3325e.pdf

Horna, J. D., Smale, M., & Von Oppen, M. (2007). Farmer willingness to pay for seed-related information: rice varieties in Nigeria and Benin. *Environment and Development Economics*, *12*(6), 799-825.

Khatri-Chhetri, A., Aryal, J. P., Sapkota, T. B., & Khurana, R. (2016). Economic benefits of climate-smart agricultural practices to smallholder farmers in the Indo-Gangetic plains of India. *Current Science*, *110*(7), 1244-1249.

Koppa, N., & Amarnath, G. (2021). Geospatial assessment of flood-tolerant rice varieties to guide climate adaptation strategies in India. *Climate, 9*(10), 151. https://doi.org/10.3390/cli9100151

Long, T. B., Blok, V., & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: Eevidence from the Netherlands, France, Switzerland & Italy. *Journal of Cleaner Production*, *112*(I), 9-21.

Marbeau, Y. (1987). What value pricing research today. *Journal of the Market Research Society*, *29*(2), 153-182.

Mekonnen, T. (2017). *Willingness to pay for agricultural risk insurance as a strategy to adapt climate change* (No. 028). United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT).

Mutoko, M. C., Rioux, J., & Kirui, J. (2015). Barriers, Incentives and benefits in the Adoption of Climate-smart Agriculture: Lessons from the MICCA Pilot Project in Kenya. Food and Agriculture Organization of the United Nations FAO, Rome.

Onugo, T. N., & Onyeneke, R. U. (2022). Farmers, preference and willingness to pay for climate-smart rice varieties in Uzo-Uwani Local Government Area of Enugu State, Nigeria. *Ekológia (Bratislava), 41*(3), 262–271. doi:10.2478/eko-2022-0027

Pabba, A. S., Naik, R. V., & Sudha Rani, V. (2022). Adoption of climate resilient agricultural technologies by farmers in Nalgonda district of Telangana State. *Indian Journal of Extension Education*, *58*(2), 30-34.

Rama Rao, C. A., Raju, B. M. K., Subba Rao, A. V. M., Rao, K. V., Rao, V. U. M., Ramachandran, K., Venkateswarlu, B., & Sikka, A. K. (2013). Atlas on vulnerability of Indian agriculture to climate change. Central Research Institute for Dryland Agriculture, Hyderabad. p. 116.

Rejula K., Singh, R., & Nain, M. S. (2017). Rice farming for food security and ecological sustainability: An analysis of farmers' awareness in Kerala. *Indian Journal of Extension Education, 53*(4), 101-106.

Saravanan, R. (2013). E-Agriculture prototype for knowledge facilitation among tribal farmers of North-East India: Innovations, impact and lessons. *The Journal of Agricultural Education and Extension*, *19*(2), 113-131.

Sarkar, S., Padaria, R. N., Das, S., Das, B., Biswas, G., Roy, D., & Sarkar, A. (2022) Conceptualizing and validating a framework of climate smart village in flood affected ecosystem of West Bengal. *Indian Journal of Extension Education*, *58*(2), 1-7.

Shitu, A. G., Nain, M. S., & Singh, R. (2018). Developing extension model for smallholder farmers uptake of precision conservation agricultural practices in developing nations: Learning from rice-wheat system of Africa and India. *Current Science*, *114*(4), 814-825.

Singh, A. K., Narain, S., & Chauhan, J. (2008). Capacity and willingness of farmers to pay for extension. *Indian Research Journal of Extension Education*, *8*(2&3), 60-62.

Sisay, T., Tesfaye, K., Ketema, M., Dechassa, N., & Getnet, M. (2023). Climate-smart agriculture technologies and determinants of farmers' adoption decisions in the great Rift Valley of Ethiopia. *Sustainability*, *15*(4), 3471. https://doi.org/10.3390/su15043471

Taimour, H., Farhadian, H., & Saadvandi, M. (2022). Farmers' agreement to apply and willingness to pay for climate-smart agricultural technologies at the farm level. *Journal of Agricultural Science and Technologies*, *24*(4), 779-791.

Taneja, G., Pal, B. D., Joshi, P. K., Aggarwal, P. K., & Tyagi, N. K. (2014). *Farmers preferences for climate-smart agriculture: an assessment in the Indo-Gangetic Plain* (Vol. 1337). Intl Food Policy Res Inst.

Temesgen, D., & Tola, T. (2015). Determinates of small holder farmers willingness to pay for agricultural extension services: A case study from Eastern Ethiopia. *African Journal of Agricultural Research, 10*(20), 2152-2158.

Thierfelder, C., Rusinamhodzi, L., Setimela, P., Walker, F., & Eash, N. S. (2015). Conservation agriculture and drought-tolerant germplasm: Reaping the benefits of climate-smart agriculture technologies in central Mozambique. *Renewable Agriculture and Food Systems, 31*, 414-428.

Veettil, C. P., & Venkataranga Naika, K. (2009). Farmers willingness to pay for privatized agricultural services: An analysis with plantation growers. *Indian Journal of Extension Education*, *45*(3&4), 1-6.

Yadav, P., Maiti, S., Jha, S. K., Meena, H. R., Bhakat, M., & Dixit, A. K. (2022). Participatory evaluation of effectiveness of farmer-led adaptation strategies to climate change in Eastern Uttar Pradesh. *Indian Journal of Extension Education, 58*(1), 146-150.