Extended Abstract
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Paper Title	Using Climate Smart Technology in Agriculture to Enhance Subjective Wellbeing of Farmers: Empirical Findings from Micro-level Data

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***
The study investigates the impact of climate-smart agriculture technology (CSAT) on the subjective well-being of agrarian households in Odisha, India. The usage of CSAT is a behavioral choice that has an impact on subjective well-being. Climate change and weather patterns make agricultural output vulnerable, demanding a transition to more efficient, productive, and climate-resistant agricultural practices. CSAT should be used by practitioners to make agricultural operations more adaptable. Smart agriculture reduces the impact of climate change on agricultural productivity and promotes sustainable agriculture, resulting in enhanced well-being for those who practice it. The Beta regression results show that the marginal effect of CSAT use on farmers' happiness is 0.149, 0.181, and 0.144 for farmers whose intensity of use is 0.251-0.500, 0.501-0.750, and 0.751 and above, respectively, compared to farmers whose intensity is 0.0 to 0.250. This suggests that farmers with a moderate CSAT are reasonably content. Households with less land or land that is fragmented have less opportunities to employ CSAT and cannot improve their quality of life. Few big landowners having more land have left their land undeveloped and do not use CSAT. This necessitates a reconsideration of government land and tenancy regulations, as well as farmer technological adaptation policies.	

Keywords	Climate-smart agriculture technology (CSAT), Subjective well-being, Land Fragmentation, Beta Regression, Odisha.
JEL Code	O12, O13, Q12, Q15, C13

Introduction	***100 – 250 words***
The global population is predicted to grow by one-third by 2050, and the agricultural system must evolve to meet the increased food demand. The UN Food and Agriculture Organization (FAO) (2013) recommends a 60% increase in agricultural production by 2050. Food security requires increasing agricultural production to balance food supply and demand with a growing	

population (Fischer, 2018). Climate change and weather unpredictability make agricultural production fragile and smallholder farmers usually face the most hardships due to limited resources. Because it adds to social unrest and financial instability, climate change has a negative influence on people's mental health (Berry et al., 2010; Kam et al., 2023). This requires changing agricultural practices to make them more efficient, productive, and climate-resistant. Practitioners should use climate-smart technology (CST) to make agricultural inputs more adaptive. However, CSAT use will affect subjective wellbeing as a behavioral choice. Traditional top-down and linear approaches of producing and transferring agricultural innovations to end users have hampered technology uptake in underdeveloped nations like India as these methods cannot recognize and promote interactive social learning and innovation processes that assist farmers manage the increased complexity of their farming operations. A rising body of literature stresses the importance of CSA adoption on a worldwide scale (Ugochukwu and Phillips 2018; Rosenstock et al. 2019; Sapkota et al. 2015). Under this background, and without belittling past studies, the research question addressed here is: what is the impact of the use of CSAT on the subjective wellbeing of the farmers in Odisha, India?

Methodology	***100 – 250 words***

The study is carried out in Odisha, one of the states of Eastern India which is divided into ten Agro-climatic Zones (ACZs) as per different agro-climatic parameters. A combination of multi-stage simple random sampling and judgmental sampling techniques was used to select the agrarian households to represent all the ACZs. Primary data were collected through a semi-open ended schedule after a pilot survey. After careful screening and cleaning of data, the effective sample size is 1001. An index of happiness (HI) to measure subjective well-being is developed for the sample households in line with the studies by Diener et al. (1985) and Lyubomirsky and Lepper (1999). However, we have modified the questions (in total 10 questions) asked to the farmers to capture the different components of HI, keeping in mind the requirement of our study. The responses of the farmers on various attributes are collected in 5-point Licket scale and an index is constructed by using the response of households through Principal Component Analyses (PCA) method. Further, eighteen types of CSAT practices adopted by the farmers of Odisha are identified and a CSAT adaptation index (CSATAI) is developed through tetra-choric PCA techniques to understand the intensity of the use of CSAT by the household. Since the Dependent Variable (DV) HI is a fraction with the problem of heteroscedasticity and asymmetry, the beta regression model is used to estimate the relation

between HI and CSATAI and other control variables to draw relevant conclusion with policy implications.

Results	***100 – 250 words***

The findings indicates that implementing the CSAT leads to an increase in the farmers' level of contentment. The impact of using CSAT on the happiness of farmers varies depending on the degree of its use. For farmers with a CSAT usage intensity between 0.251-0.500, the marginal effect on happiness is 0.149. For those with a usage intensity between 0.501-0.750, the marginal effect is 0.181. Finally, for farmers with a usage intensity of 0.751 and above, the marginal effect is 0.144. These effects are compared to farmers with a CSAT usage level between 0.0 to 0.250. Therefore, it may be inferred that farmers who utilize moderate levels of CSAT experience greater levels of happiness compared to those who do not. This could be attributed to the disparity between the benefits that farmers can obtain at lower levels of technology usage and the relatively little impact of costs at greater levels of technology usage. Households with a moderate amount of social capital (0.251-0.500) adversely affect the farmers' contentment. The LSC has a negative marginal effect of -0.047 on the happiness of these groups of farmers, compared to farmers with lower LSC (0.00-0.250). One notable finding from the data is that when the LSC (Livelihood Sustainability Composite) among farmers increases, there is a corresponding increase in their degree of happiness. This relationship is supported by a statistically significant positive coefficient of LSC, which is significant at the 12 percent level. This underscores the significance of social capital in fostering pleasure among farmers.

Discussion and Conclusion	***100 – 250 words***

The degree of CSAT use, a behavioural decision of rural households, can affect subjective wellbeing. The result shows that increasing use of CSAT increases farmer wellbeing. Farmers with moderate CSAT are the happiest; may be because farmers may not gain the benefits of technology at lower levels, and the costs may be more at higher levels. The land is a major natural and/or physical capital for agrarian households that affects the decision of the household to use CSAT and ultimately their income, livelihood and happiness. The marginal effect on the wellbeing of the household is negative for households having moderate land. This implies that households with less land (at times fragmented land) have less opportunity to use CSAT and thus are unable to uplift their wellbeing. Further, few landlords have kept their land barren and are indifferent to the use of CSAT. One noteworthy finding is that farmers with higher social capital are happier. This illustrates why social capital is essential to farmer happiness. Farmers

who spend moderately on agriculture report higher-than-average wellbeing. The result also showed that agricultural households are more likely to adopt CSAT as people get older and more experienced, which boosts happiness. Thus to summarise, CSAT is less accessible to households with less land/or fragmented land, preventing them from improving their wellbeing. Few landowners have kept their property undeveloped and don't employ CSAT. This requires revisiting government land and tenancy policies, so that adaptation of CSAT can be promoted to enhance the wellbeing of the farmers.