Willingness to pay of tobacco farmers for adapting climate change and social capital influence.

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Abstract. Meteorologists expect that climate change will have an increasing impact on ecosystems and agricultural productivity, nevertheless, many farmers are unsure how climate change will affect crop yields and overall farming operations soon. This study investigates farmers' willingness to pay in the process of climate change adaptation in Temanggung, Indonesia. We looked at how various aspects of social capital influence tobacco farmers' willingness to pay financially to adapt to climate change using a logistic regression model. There were 270 farmers surveyed in this study by purposive sampling. The findings of binary logistic regression demonstrate that tobacco farmers are at least somewhat inclined to contribute to climate change adaptation, and that this decision is primarily and strongly driven by social capital factors. it shows that 82.2% of respondents are willing to pay contributions of IDR 12,000 (USD 0.78). The results showed the importance of the social capital characteristics such as community participation and trust each have a significant effect on Willingness to pay (WTP) for adapting the climate change. From a policy standpoint, it is critical to provide all farmers with knowledge that will assist them in adapting to climate change using appropriate farming technologies and practices.

1 Introduction

There are many people around the world who are concerned about how climate change may affect how much food is produced [1] and farmers' welfare [2]. Extreme weather, an unanticipated rise in temperature, and changes in rainfall may pose a threat to the agro-economy [3]. Farmers' ability to maintain their social and economic stability is impacted directly or indirectly by climate change. Cascade effects that could occur include crop failures, increased production costs, decreased farmer income, and rising seasonal unemployment rates [4,5]. Despite this, farmers are not overly concerned about climate change due to poor institutional capacity, a lack of local knowledge, and inadequate awareness of the challenges [6]. To deal with the growing threat that climate change poses to farmers, adaptation measures must be developed. Due to the consequences of climate change, the most vulnerable communities are already having trouble establishing secure and

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successful livelihoods [7]. Uncertainties caused by climate change can be identified, handled, and utilized to guide agricultural decision-making. has the capacity to understand, keep track of, and foresee climate variations, farmers may compare alternative management strategies and put past experiences into context to make informed decisions. This might enable individuals to maximize their gains in prosperous years and lessen their losses in difficult ones. Farmers may use inputs and technology more efficiently and with less uncertainty by using climate information. Having a better understanding of the climate can also help agriculture withstand climatic shocks. It can help increase climate resilience and reduce climate hazards. For instance, farmers might choose which crops to sow when they are aware of the impending wet season. In addition to posing a threat to national food security, climate change will also affect farmers' wellbeing. Considering the study that was done [8], climate change has made 62,365 hectares of Surakarta's land vulnerable to flooding and 41,704 hectares to drought. Each planting season, poor harvests cost farmers 207 billion IDR in losses.

Because it can affect how well the economy performs [9,10,11], increasing the roles of social capital in communities is one method of reducing the effects of climate change [12,13]. According to certain research, social capital refers to the standards and trust that allow members of a community to behave as a unit [14;15]. Grootaert and Bastelaer [16] developed the concept of "cognitive social capital". Numerous studies have shown connections between the management of natural resources and social capital. Consider the possibility that social capital might influence collective action in either a positive or negative way [17]. According to [18], people can collaborate to manage natural resources by using social capital.

Changes in farming methods, such as adopting new agricultural technology and innovations, may improve farmers' livelihoods [19, 20, 21]. Social networks, including friends and family, may have an impact on farmers' attitudes on adapting to climate change [22], increase their understanding of adaptation [23], improve their ability to foresee future risks and damages brought on by climate change and to manage their readiness to pay for adaptation expenditures [24]. Utilizing social capital while constructing new plantations and educating farmers about cutting-edge technology as a consequence were suggested by the Indonesian Climate Change Sectoral Roadmap (ICCSR).

Tabel 1. References

Independent Variables	Sign	References
Age	+	Rondhi et al., [25] Aydogdu et al., [26] Quedraogo et al.,[27] Tsigkou&Klonaris, [28]
Gender	+	Novikova et al., [29] Quedraogo et al., [27] Mutaqin et al., [30] Shee et al., [31]
Education	+	Saptutyningsih &Sujud, [32] Shee et al., [31] Banna et al., [33] Novikova et al., [29] Suryanto et al., [34] Rondhi et al [25] Amegnaglo et al., [35]
Income	+	Banna et al., [33] Novikoba et al., [29] Suyanto et al., [34] Aydogdu et al., [26]
Land area	+	Shee et al., [31] Aydogdu et al., [26] Amegnaglo., [35]
Length of work	-	Saptutyningsih &S Sujud, [32]
Participation in community	+	Priyatno et al., [36] Hidayat &Suryanto [37]

Dependent variable: WTP for climate change adaptation

Numerous studies have discovered connections between the management of natural resources and social capital. For instance, [17] argues that social capital affects collective behavior, either favorably or unfavorably, and [18] suggest that collaboration on resource management may be facilitated by social capital. The success or failure of attempts to manage forests in order to mitigate climate change in China is heavily influenced by social capital. Lack of social capital is associated with ineffective forest management [19]. Greeks' willingness to pay extra for higher-quality water is influenced by their social capital as well [20]. However, research into how social capital affects farmer behavior didn't yield any firm conclusions.

To close this information gap, this study investigates how farmers adapt to climate change and the advantages of social capital. We carried out the research on tobacco farmers in Temanggung, Indonesia, who are anticipated to experience negative effects from climate change [21]. With the aid of a logistic regression model, we looked at how sociodemographic traits and social capital affected farmers' willingness to pay for climate change adaptation in the agricultural sector. This study deepens our comprehension of the topic by emphasizing the part social capital plays in climate change adaptation.

2 Methodology

2.1. Study site

This study was carried out in Temanggung, Indonesia, where the tobacco farming industry is significantly impacted by climate change. Due to the district's poor agricultural yield, food security was under danger [38]. Climate change has made the province's agricultural areas more vulnerable to drought, floods, and insect infestation [39]. The productivity and selling price of tobacco in Temanggung Regency in 2022 have decreased. This is due to reduced land and the influence of weather changes, where the lack of air entering the plants makes productivity in tobacco plants not optimal and the number of leaves decreases.

2.2. Survey design and administration

We conducted a survey of nearby farms to determine their willingness to help with the effort to adapt to climate change and the importance of social capital. They were questioned on whether they would be open to supporting an environmental tax in exchange for a specific monetary commitment to aid in the adaptation to climate change. Finding farmers who were devoted to battling climate change was the aim of this investigation. We gathered 20 well-known people for a focus group discussion to determine the benchmark. Farmers in Temanggung Regency were polled using the contingent value approach to ascertain their readiness to pay for climate change adaptation [40,41,42]. The contingent valuation's findings were employed as a stand-in for calculating the potential financial rewards for farmers that support climate change adaption. For the purpose of paying for an environmental tax referendum, the contingent valuation survey was developed. The question in our survey was: "Would you agree or disagree if the Indonesian government levied x amount of an environmental tax to carry out climate change adaptation?". In the double-bound study, farmers offered amounts ranging from IDR 12,000 (USD 0.78) to IDR 2,000 (USD 0.13), with the lowest offer. In actuality, this estimate did not accurately capture the overall research population's willingness to pay. As an alternative, this outcome illustrates to knowledgeable farmers the possible financial gain of climate change adaptation. The farmers who could afford it and wanted to participate in the adaptation were identified by this number. In order to do this, we questioned participants about their willingness to contribute IDR 12,000 (USD

0.78) per month for climate change adaptation. The benefit that farmers get if they are willing to pay a contribution of IDR 12,000 (USD 0.78) is to help farmers meet their needs for fertilizer, pesticides, and agricultural support tools to help and strengthen the growth and development of tobacco plants so that the tobacco plants remain strong and fertile even though they are affected by the negative impact of extreme climate change because the supply of fertilizers and pesticides is adequate. Apart from that, farmers also get other benefits by making these contributions. Farmers get financial assistance for tobacco marketing distribution because they feel at a loss and have less money when their crops are affected by climate change, and they also get knowledge and direction on how to overcome the problem of crop damage. Tobacco farmers need to be supported by technology and appropriate agricultural practices from agencies and people who are experts in their fields due to climate change. The chairman of each farmer group appointed in this case has the responsibility to collect or manage the contribution. More people are familiar with the idea of social capital because to earlier studies [43,44,45]. An illustration of a social capital trait is involvement in the neighborhood community. These traits have a strong foundation in Indonesian society and culture.

There are four sections to the final survey questionnaire (appendix). Mapped in Part A are the sociodemographic traits of the farmers (for example, age, sex, education, income, duration of employment, and land area). Part B reveals social capital (belief, involvement of the community, and the proportion of relatives living outside the hamlet). Part C describes farmers' adaptation techniques, while Part D reveals the farmer's willingness to contribute IDR 12,000 (USD 0.78) each month to climate change adaptation.

Table 2. Descriptive statistics of the survey participants (n = 270).

Variables	Mean	Std.
Willingness to pay for climate change adaptation (IDR)	0.82	0.38
Age of household head (year)	48.15	10.00
Gender of household head (1 male; 0:female)	0.67	0.46
Education of the household head (years)	7.95	2.42
Income of household head per month (IDR)	1.3970	2.87197
Land square (m^2)	1.8171	721.56477
Years as farmers (years)	22.68	11.02
Household participation in community (1: yes, 0: no)	0.91	0.27

Std: Standard deviation; IDR: Indonesian rupiah

There were three sections in the final survey questionnaire. The questionnaire's first component outlined sociodemographic information about the farmers, including their gender, age, number of years of education, level of income, and awareness of climate change. The farmers' assets were listed in the second section by land square and years of farming. Community involvement was one of the social capital criteria covered in the third segment. The participation of households in the community is one aspect of social capital.

2.3 Data Analysis

We looked into how farmers' social capital and desire to participate in climate change adaptation correlated using a logistic model [46]. The dependent variable in the model is the willingness of the farmers, where 1 denotes agreement and 0 denotes disagreement. The model includes independent variables for sociodemographic data, possessions, and social capital.

The basic logit estimate model looks something like this:

$$Log_e = \left[\frac{\{p(y=1)|x_1 \ldots x_p\}}{\{1\text{-}p(y=1|x_1 \ldots x_p\}}\right] = Log_e \left[\frac{\pi}{1\text{-}\pi}\right] = \alpha + \beta_1 x_1 + \ldots + \beta_p x_{p1} = \alpha + \sum_{j=1}^{p} \beta_j x_j \quad (1)$$

a conditional probability where is present of the form P(Y = 1| X1... Xp).

The term "logit analysis" also refers to the analytical procedure explained here. The logit transformation of the aforementioned log odd. The logistic function was as follows:

$$\langle P(Y=1|X_1 \ldots X_p) \rangle = \frac{exp\left(\alpha + \sum_{j=1}^{p} \beta_j x_j\right)}{1 + exp\left(\alpha + \sum_{j=1}^{p} \beta_j x_j\right)} \quad (2)$$

Table 3. The definitions of explanatory variables

Categories	Variables
Willingness to pay for climate change adaptation	Support for regular payments for coping with climate change (1: yes; 0: otherwise)
Sociodemographic characteristics	Age of household head (year)
	Head of household gender (male: 1, female: 0)
	Education of the household head (years)
	Income of household head per month (IDR)
Asset characteristic	Land area (m^2)
	Length of working (years)
Social capital characteristic	Participation of a household in the community (1: affirmative, 0: otherwise)
	Trust (1: trust; 0: otherwise)
	Family outside village (1: yes; 0: otherwise)

This might also be altered to:

$$\langle P(Y=1|X_1 \ldots X_p) \rangle = \frac{1}{1 + exp\left(-\alpha - \sum_{j=1}^{p} \beta_j x_j\right)} \quad (3)$$

The likelihood of a non-response is:

$$P = (Y=0|X_1 \ldots X_p) = 1\text{-}p(Y=1|X_1 \ldots X_p) = \frac{1}{1 + exp\left(-\alpha - \sum_{j=1}^{p} \beta_j x_j\right)} \quad (4)$$

Y is equivalent to 0 (or no) in all other circumstances. The following predictors are used to generate the logistic regression equation for the log odds of support for adaptation to climate change:

$$log\left[\frac{p}{1\text{-}p}\right] = b_0 + b_i x_j + \varepsilon_t \quad (5)$$

The possibility that farmers will decide to accept climate change can be reflected by the log equation, which also shows a log-odd ratio. The general pattern of the farmers' behavior is revealed by the statistical significance and parameter recommendations [47].

3 Results and Discussion

The study's results showed that 82.2% of participants (n = 222) were willing to provide a certain amount of money towards climate change adaptation, while 17.8% (n = 48) were not. Social capital characteristics significantly influenced people's likelihood to support the

government tax intended to aid in climate change adaptation (Table 4). Age, gender, income, and the area of the land were sociodemographic characteristics that had positive and substantial effects, but education and the number of years spent farming did not. As they get older, farmers favor climate change adaptation more. The willingness to pay is more influenced by male sex farmers. As their money rises, so does their willingness to participate. Additionally, if they own more land, farmers will be more likely to pay for climate change adaptation because it will increase their revenue and agricultural productivity.

One of the farm asset characteristics that had some influence on how supportive farmers were of adaptation to climate change was farm size. The higher the possibility that farmers will join, the larger the farm. Farmers with more experience are more strongly encouraged to be flexible.

Table 4. Regression results

Variables	Odd ratio (S.E)
Sociodemographic	
Age	0.116*** (.031)
Gender	2.219** (.359)
Education	1.187 (.088)
Income	1.000** (.000)
Assets	
Land Area	1.001** (.000)
Length of work	0.960 (.029)
Social capital	
Participate to community	3.590** (.560)
Trust	1.517 (.496)
Family outside village	1.189 (.356)
Constant	-9.336 (1.966)
Nagelkerke R Square	.254

***significant at α = 1%; **significant at α = 5%; *significant at α = 10%
Dependent variable: willingness to pay for climate change adaptation

Based on the findings of the partial significance test in Table 4. The results show that out of the six independent variables, five have an effect on tobacco growers' willingness to pay for climate change. These variables are Age, Gender, Income and Land Area and Participate to community.

According to the regression analysis, the age variable has a significance level of 1% and a significance value of 0.000. Therefore, we may infer that age significantly influences tobacco growers' willingness to spend money on climate change adaptation. The age variable has an odds ratio of 1.116. Conclusion: Respondents with a willingness to pay of IDR

12,000.00 (USD 0.78) have 1.116 times more opportunity when they are older than those who are relatively younger. According to the results of the regression analysis, the gender variable has a significant value of 0.026 at a level of 5%. Therefore, it may be concluded that gender significantly affects tobacco growers' desire to pay for climate change adaptation. The gender variable has an odds ratio of 2.219. The likelihood of responders with a willingness to pay IDR 12,000.00 (USD 0.78) being positive for male sex is therefore 2.219 times higher than for female sex.

The findings of the binary logistic regression show that the level of education has a significant probability of 0.052, which is higher than the significance level at the 10% level, showing that there is no discernable relationship between education level and tobacco growers' willingness to pay for climate change adaptation. According to the findings of the regression analysis, the income variable's significant value at a level of 5% is 0.026. We might infer from this that tobacco producers' willingness to spend for climate change adaptation is significantly influenced by money. Income is the variable with a 1,000-odds ratio. Conclusion: When respondents' income grows, they have a one-time higher opportunity with a willingness to pay of IDR12,000.00 (USD 0.78).

The results of the regression analysis indicate that, at a 1% level of significance, the variable land area has a significance value of 0.023. It may be concluded that the size of the land area has a significant impact on how much tobacco growers are ready to invest in adaptation to climate change. The odds ratio for the land area variable is 1.000. It is obvious that as the land area increases, the likelihood that respondents will have IDR 12,000.00 (USD 0.78) to spend increases. The binary logistic regression results show that the length of work variable has a significant probability of 0.156, which is higher than the level of significance at the 10% level, leading one to argue that it has no impact on the willingness of tobacco growers to pay for climate change adaptation.

According to the results of the regression analysis, the community engagement variable is statistically significant at a level of 5% and has a significant value of 0.023. It is evident that tobacco growers' willingness to invest in climate change adaptation is significantly influenced by community engagement. The odds ratio value for the gender variable is 3.590. It can be concluded that the chance of respondents with a positive willingness to pay of IDR 12,000.00 (USD 0.78) participating in the community is 3.590 times greater than that of those who do not participate in the community at all. The trust and family that they have outside of their community have no discernible impact on how willing they are to pay for climate change adaptation.

This study demonstrates how social capital, as measured by community involvement, positively and significantly influences farmers' support for the study's central thesis: the significance of social capital on farmers' willingness to pay for assistance with climate change adaptation. Participation in farmer organizations is probably going to raise farmers' understanding of the importance of mitigation to halt additional climate change damage. These results demonstrate the assertion [48] showed the amount of crop loss caused by climate change is considerably reduced when farmers participate in farmer organizations. Participating in the community can help one better understand modern farming techniques, how to sow crops, how to deal with droughts, and what may be done to lessen the consequences of climate change. The farmer community frequently acts as a conduit between farmers generally and the appropriate governmental institutions. Usually, these outside services and aid are channeled via the community.

4 Conclusion

In this study, we examine the connection between social capital and farmers' support for climate change adaptation. In Temanggung, Indonesia, farmers were questioned. This region

is experiencing an increase in rainfall due to climate change. According to the report, 82.2% of these farmers are willing to pay for help with climate change adaptation. Farmers who are active in their communities or society are more inclined to provide this help. The contribution of climate conditions is also impacted by asset characteristics. According to research, farmers tend to be older, more educated, and those with clear land ownership, as opposed to farmers who are tenant farmers or younger farmers with less education. Policy-wise, it is essential to provide all farmers with the knowledge they require to use the appropriate agricultural technologies and practices to adapt to climate change. Projects and initiatives aimed at enhancing farmers' comprehension of climate impacts will contribute in the development of the managerial skills necessary to deal with climate risk processes.

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