ARTICLE

Environmental Conservation Based on Community Empowerment

Case Study in Toba Caldera UNESCO Global Geopark

Bonataon Maruli Timothy Vincent Simandjorang [1], **Fransiskus Xaverius Candra Gunawan** [2], **Asinkritus Ngongo Lalu Manu Mesa** [3], **Tini Apriani** [4], **Melati Ayuning Pranasari** [5], **Imam Radianto Anwar Setia Putra** [6], **Suci Emilia Fitri** [7]

[1, 4, 5, 6, 7]National Research and Innovation Agency

[2, 3]Regional Research and Development Agency of East Sumba Regency

✉ vincent.simandjorang@gmail.com

Abstract: Toba Caldera UNESCO Global Geopark (TCUGG) has not only geological phenomena of international geological significance value but also has outstanding universal value by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The establishment of TCUGG as a national priority and the Lake Toba Authority Agency is a serious commitment from the government to develop this region. Although it is now a super-priority tourism destination, over the last six decades, the water level of Lake Toba has decreased significantly by 2.4 cm per year from 1957 to 2016. The environmental quality index shows a decline from year to year, and environmental conditions of Lake Toba are already very severe due to various factors. The government and local communities are still running independently for the conservation agenda. This empirical research uses a mixed method of sequential explanation. The main objective of the research is to analyze the determinants of local people's choices to participate in conservation activities in TCUGG. From the research results, the significant factors that determine the local communities' participation in conservation activities are water availability, incentives, suitability of seeds, trust level for the initiator, and the success rate of previous conservation. Society does not need promises or rhetoric, especially for those who have participated before and experienced low success rates. Application of reward and punishment as an incentive for the community to participate in conservation activities and to further encourage their motivation. The main key is to serve the needs of the community in conservation practices.

Keywords: environmental conservation; community empowerment; Toba Caldera Geopark.

Simandjorang, Gunawan, Mesa, Apriani, Pranasari, Putra, & Fitri. (2022). Jurnal Bina Praja, 14(3), 517-527

517

1. Introduction

Toba Caldera UNESCO Global Geopark (TCUGG) is the result of the eruption of the Toba Supervolcano thousand years ago, which has ecological, socio-cultural, economic, educational, science, tourism, and natural beauty values as well as biodiversity for life. As one of the strategic assets for Indonesia and the world, TCUGG has experienced various pressures for decades, both caused by natural factors and caused by various human activities. The declining environmental quality of TCUGG that continues to occur is further strengthened by the 2012 environmental quality index (EQI) at 60.75. Environmental conditions are increasingly worrying, with a drastic decline of 13.73 points from 2011, which was at 74.5. The land cover as part of the index also describes the very worrying condition of TCUGG forestry, which is 30.7 (Environmental Agency of North Sumatra Province, 2013).

According to the 2009 Agreement on Forest Use, the forest area in the Lake Toba Catchment Area is 143,840,32 hectares (ha), or 51% of the catchment area. The forest area in the catchment area tends to decrease from year to year, becoming 57,604.88 ha (15.27%) (Kementerian Lingkungan Hidup Republik Indonesia, 2014). Over the last six decades, the water level of Lake Toba has decreased significantly by 2.4 cm/year from 1957 to 2016, with a surface water level of 903 meters above sea level (Irwandi et al., 2021). The main driver that contributes to the decline in water quality in Lake Toba is the over-loading of nutrients from aquaculture, livestock manure, and domestic wastewater, which contribute to water quality degradation (World Bank Group, 2018).

TCUGG forest recharges surface and underground water, a water source to Lake Toba, Dairi, Asahan to Aceh. Therefore, it is necessary to maintain, and reforestation is necessary (SWP et al., 1989). In particular, the Tele Forest is also an heirloom for the Batak people that contains historical and cultural values, the struggle of the National Hero, King Sisingamangaraja XII, and saves biodiversity in the Tele Forest, one of which is the endemic flower of the Batak Orchid named Hartina. Lake Toba has the potential of up to 2,200 Mega Watts (MW), and only about 750 MW has been managed to drive the Asahan PLTA and support the aluminum production of PT Inalum in Kuala Tanjung and is still small allocated for electricity needs for the people in North Sumatra (Simandjorang, 2010).

Forest and land rehabilitation is carried out in collaboration with various parties, both government and private sectors, including tree planting around the catchment area; one million trees will be planted in the entire area of Lake Toba. The determination of TCUGG as a national priority and the establishment of the Lake Toba Authority Agency (BPODT) is a serious commitment from the government to develop Lake Toba. Various obstacles and problems, especially regarding the coordination of activities. As a result, the impact of conservation efforts becomes very small or even completely invisible. In addition, the nature of the activity tends to crash the program which indicates the absence of a continuous/sustainable program planning and implementation (Sinamo, 2001).

Community empowerment is key in environmental development agenda. However, Fatimah (2016) found that community participation in supporting the development agenda in TCUGG is still low. Local communities are only involved in the program implementation stage, and not all communities are involved in planning development programs. The government and local communities are still running independently, so there is no harmonization between the government and local communities. The low community participation cannot be separated from the absence of socialization from the government. Cooperation between the government and local communities is needed to encourage local community participation in realizing sustainable TCUGG.

Many project activities fail because the implementation is still mostly a top-down approach, not involving the community in planning so that the community does not participate in maintaining and supporting the implementation of activities. Improvement of TCUGG is absolute as an effort to improve the sustainability of the

area as well as increase tourism which has been declining since 1997, which in turn will improve the welfare of the community (Simanihuruk, 2005). Without community participation, it is very difficult to expect beauty and greenery to be possible. The involvement of local communities, especially indigenous peoples, is very important (Karokaro, 2018).

It is well known that human activities impact the environment, particularly the balance of nature, and cause damage to the environment. The damage and decline in the quality of the environment have an impact on human life (Tietenberg & Lewis, 2018). There is a relationship between economic activity and air quality. Health problems caused by high levels of air pollution cause costs to society. Health problems will reduce the effectiveness of production activities (Resosudarmo & Thorbecke, 1996).

Conservation is needed to create a cool, fresh, comfortable, and healthy environment. However, the reforestation actions that are carried out do not produce maximum benefits, with many factors causing the implementation of reforestation to be not on target (Rubiantoro & Haryanto, 2013). There are several community motivations in participating in conservation, including: (1) conservation to increase the ecology of the area, (2) reforestation to add to the aesthetics of the area, (3) reforestation to add economic value, (4) reforestation to support government programs/other initiators.

The success of conservation with community involvement is also influenced by several factors, such as equity factors in several aspects such as access, finance, gender, ethnicity, social strata, employment, and others (Klein et al., 2015). Socio-economic and political context determinants can influence this justice itself. Aspect of effective leadership is very important in determining the success of a conservation program, with four key characteristics, namely: (a) motivating others; (b) building a common vision; (c) effective communication; and (d) building partnerships (Straka et al., 2018).

The conservation paradigm shift has also developed at the micro implications, including (a) direct benefits and access for resource use; (b) conservation business opportunities that are not always synonymous with "cost center activity" but become a "business plan for conservation"; (c) accommodative and adaptive to local values in area management; (d) changes in management techniques with a persuasive, participatory, collaborative approach (Iskandar, 2009).

The nature of rural development so far has not touched on participatory development. The existence of a "culture of silence" or a culture of silence where village communities tend to have no voice, no access, and no participation (Organisation internationale du travail et al., 1991). This is a failure of the government and other supporting institutions that make the community weak in building initiatives and participating. The forestry sectoral participation model as a pattern of social/community forestry needs to be put forward, not traditional forestry, namely by providing stimulation, and technical guidance for the community.

Jara-Rojas et al. (2013) examined the impact of variables on natural, social, human, and financial resources on the application of water conservation and soil conservation in Chile and South America. The results show that land size, production system, access to finance, and government incentives are important variables in promoting conservation. Program design should include incentives to increase effectiveness. Devi (2013) analyzed the economic value of conservation and the factors influencing the chances of conservation adoption in Padaawas Village and Barusari Village, Pasirwangi District, West Java. With the logit regression model, it is found that if the farmer's age, income, and slope steepness increase, the chances of farmers adopting conservation increase.

Rubiantoro and Haryanto (2013) studied the forms of community involvement in reforestation in dense residential areas in Serengan Village, Surakarta City. The community carries out reforestation activities with various motives, including adding ecological value aesthetic value, obtaining economic benefits, as well as reasons to support government programs. Moges and Taye (2017) analyzed the determinants

of farmers' perceptions of adopting land and water conservation in Ankasha District, Ethiopia, Africa which. Overall, this study shows that the perception of farmers to participate in conservation is highly determined by socio-economic, institutional, attitude, and biophysical factors. A better understanding of the constraints that affect farmers' perceptions is essential when designing and implementing conservation.

Hasibuan et al. (2017) formulated a study on socio-economic variables that determine the success of biodiversity conservation in the national parks of Mount Halimun Salak, Ujung Kulon, and Mount Ciremai. The results of the study showing that the determinants of the success of biodiversity conservation are: (1) the decrease in the number of individual species in religious and customary systems, (2) the increase in the rate of encroachment in age and distance; (3) the increase in the theft of natural resources is the control of private land; (4) the increase in violation of regulations is the responsibility of the family; and (5) positive interactions are age and distance. Habanyati et al. (2020) compiled an analysis of the factors contributing to promoting community conservation in Petauke, Zambia, Africa. The results show that conservation practices are associated with high farmer demands, lack of incentives, transportation for supporting infrastructure, and perceived poor local leadership. Furthermore, research shows that the factors that contribute to the increased likelihood of not adopting conservation are lack of transportation, lack of adequate knowledge, location, and lack of incentives.

Based on the literature review, we can consider there are three main factors categorization according to their characteristics that encourage local communities to care for and participate in conservation, namely: (a) household characteristics, such as age factor, dependency rates, income, and the education level; (b) land characteristics, such as land area, ownership status, topography, access related to time and distance to location, infrastructures such as water availability and road access; (c) characteristics of the conservation program offered by the initiator, taking into account factors such as monetary incentives provided, suitability of seeds, expected benefits, views of the community as well as the level of their assessment of the initiator of conservation activities, and the level of success of the community in the conservation activities that were followed previously.

In order to increase the effectiveness of conservation activities in TCUGG, it is necessary to analyze the key success factors local community to participate in conservation activities in TCUGG. This research attempts to answer questions about the factors that determine the perception of local communities to participate in conservation activities TCUGG. The research questions are as follows: (1) what are the factors that determine the perception of local communities to participate in conservation activities in the TCUGG?; and (2) how is the influence of the factors that determine the perception of local communities to participate in conservation activities in the TCUGG? This research will be an important addition to the academic literature that is closely related to the factors that determine the perception of local communities to participate in conservation activities and empirically has implications for the formulation of appropriate policies for all stakeholders, both government and non-government.

2. Methods

This empirical research uses a mixed method, where quantitative research includes statistical modeling of the determinants of local people's choices to participate in conservation activities in TCUGG. Qualitative research includes investigation, understanding, and explanation of these determinants. The sequential explanatory method is used to support this research, where the research in the first stage uses quantitative methods and in the second stage uses qualitative methods so that the results of quantitative research will be more in-depth and meaningful (Creswell, 2013). This research was conducted in Samosir Regency. The data used in this study are cross-section data. The source of data comes from primary data and secondary

data. Primary data is obtained from questionnaires, direct interviews with respondents (community) in January 2022, and field observations. The informants in the interview were participants in filling out the questionnaire by choosing based on considerations of gender representation and experiences in conservation activities.

This study used a sample of 115 households representing villages in Pusuk Buhit Geosite. In analyzing the empirical modeling in this study, the analytical tools that can be used are econometric tools, namely multiple regression analysis techniques of various types and forms (Ethridge, 2004). This study uses data analysis techniques with qualitative response regression models to analyze the influence of the factors that are the determinants of the qualitative dependent variable, namely the perception of local communities to participate or not participate in conservation activities in TCUGG. Multiple regression analysis with qualitative information also complements data analysis techniques that use independent/explanatory variables that are qualitative, in addition to using quantitative variables (Gujarati & Porter, 2009; Wooldridge, 2019).

This study uses the probit model as a type of regression where the dependent variable can take only two values to analyze data and empirical modeling, which examines the choice of local communities to participate or not participate in conservation activities in TCUGG by showing the probability between 0 (not participating) and 1 (participating). The term probit (short for probability unit) was introduced in the 1930s by Chester Bliss. The probit regression model in this study is as follows:

$$P(Y = 1 \mid X_k = 1,2,...,13) = \Phi(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 +$$
$$\beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \beta_{12} X_{12} + \beta_{13} X_{13})$$

The hypothesis and measurement indicators formulated in the study is in Table 1 as follows partially based on the formulations obtained from literature review both theoretical and empirical.

Table 1. Research Hypothesis

Variable	Influence Hypothesis and Interpretation
A. Dependent Variable	
Community's choice to participate in conservation activities (Y)	
B. Independent Variables	
1. Household Factors	
a. Age (X1)	negative (—): negative quadratic function/inverted-U shape: If age increases, people tend to choose to participate in conservation activities; and as people get older, people tend to choose not to participate in conservation activities
b. Number of family (X2)	positive (+): If the number of dependents in the family increases, the community tends to choose to participate; and vice versa (v.v.)
c. Income per month (X3)	(+): positive quadratic function/ U: If the income level is low, then people tend to choose not to participate; and as income levels increase, people tend to choose to participate
d. Education level (X4)	(+): If the level of education is higher, the community tends to choose to participate; and v.v.
2. Land Factors	
a. Unused land (X5)	(+): If there is a lot of unused land, the community tends to choose to participate; and v.v.
b. Land ownership status (X6)	(+): If the land is their own, then the community tends to choose to participate; and v.v.
c. Topography (X7)	(—): If the level of land steepness is high, then the community tends to choose not to participate; and v.v.
d. Travel time to land location (X8)	(—): If the travel time to the land location is taking lot of times, then the community tends to choose not to participate; and v.v.
e. Availability of water at the site (X9)	(+): If water is available, the community tends to choose to participate; and v.v.
3. Characteristics of Conservation Programs Offered by the Initiators	
a. Fiscal Incentives (X10)	(+): If the amount of fiscal incentive given is large, then the community tends to choose to participate; and v.v.
b. Suitability of the seeds given (X11)	(+): If the seeds given are in accordance with the wishes of the community, then the community tends to choose to participate; and v.v.
c. Trust level for the initiator (X12)	(+): If the assessment from the community for the initiator is good, then the community tends to choose to participate; and v.v.
d. Previous conservation success rate (X13)	(+): If the success rate of conservation followed by the community previously was high, then the community would tend to choose to participate; and v.v.

3. Results and Discussion

Of the 115 people in the Pusuk Buhit area who were sampled in this study, 38 people were dominated by their 40's age (40–49) and 25 people were in their 30's (30–39) and 25 people in their 50's (50–59). as many as 19 people. The proportion of gender in this study was 89 men and 26 women. The education level of the respondents was 59 high school graduates, 20 elementary school graduates, 19 junior high school graduates, 12 bachelor degrees, four diploma graduates, and one master's education level.

The income class Rp dominates the average monthly household income of the 115 people in this study. 1 million as many as 52 people. Twenty-five people then answered under Rp1 million. The income class is Rp2 million, and as many as 21 people. Income above Rp3 million amounted to 17 people. The number of dependents in the family varied, with the most dependents being 1 (30 respondents) and 4 (21 respondents). And ten respondents who have several dependents of more than six people. The occupation is dominated by farmers, as many as 85 people. In addition, the respondent's occupations are as many as 11 entrepreneurs, seven civil servants, and others such as students, honorary employees, retirees, and village officials, including one village chief.

Four respondents have complete access to TV, radio, cellphone, and the internet. And the majority already have at least two information and communication media, such as television and cell phones. This study found that respondents had at least one mode of transportation, especially 71 families owned and used motorbikes. Only 20 respondents answered that they did not have any mode of transportation. The rest of the respondents have more than two modes of transportation other than motorcycles, such as cars, trucks, and beko.

A total of 101 respondents answered that they had participated in conservation activities before, and 14 said they had never participated. The organization of activities also varies among the government and non-governmental organizations (NGOs), and some are based on their initiative. A group of community respondents also participated in conservation activities for the last time in the 1970s and 1980s, which were sourced from the government (forestry service). However, most respondents participated in conservation activities, the last time being in the millennial era.

Types of trees planted include coffee, fruit (petai, durian, mango, avocado, avocado, banana, palm sugar, cloves, duku, dog fruit, guava, guava, soursop, lamtoro, petai china, eucalyptus, areca nut, rambutan, woods (jabon, African teak, mahogany, trembesi, sengon, eucalyptus, ingul, meranti, pine, fir, mindi, banyan, sampinur), and also endemic plants. In terms of the amount planted, it varies from tens to hundreds, and even some plant as many as 5,000 trees. Conservation activities are carried out on own land and customary land (ulayat), and some use government-owned land with land topography that varies from steep and normal. Access to conservation activities is still in the form of dirt roads and footpaths.

From the aspect of the success of conservation activities, respondents gave varied answers, where 48 respondents had previously participated in conservation activities stating that the growth rate was below 50%. In contrast, the rest is evenly distributed at 60%, 70%, and 80% to 90%. Nine respondents stated that their success was perfect (100%). The aspect of seed suitability was also a concern in this study, where 62 respondents who had previously participated in conservation activities stated that the seeds given were in line with expectations above 90%. Only 20 respondents stated that the type of seed provided was not as expected, below 50%.

In terms of usefulness, 29 respondents who have participated in previous conservation activities answered that in addition to providing sustainable natural benefits, they also provide additional income by converting unproductive land into a land that can support monthly household income. Additional monthly income varies from hundreds of thousands of rupiah to millions. There are only two respondents who did not feel any benefit from the conservation activities that were followed

previously. Meanwhile, from the level of satisfaction with the initiator of the following conservation activities, in general, respondents were satisfied with the activity, where 55 respondents rated this activity above a score of 70. Meanwhile, there were only 26 respondents who rated it below 60.

The estimation results of the empirical model from the analysis of the determinants of local people's perceptions to participate in conservation activities in TCUGG with a case study in Pusuk Buhit Geosite, Samosir Regency through the probit regression model in Table 2.

Table 2. Probit Regression Model Processing Results

Dependent Variable (Y_Conservation)			
	Coefficient	z-statistic	Prob. z
Constant (C)	− 1.632	− 1.278	0.20
Independent Variables:			
X_{1a}_Age	0.027	0.456	0.65
X_{1b}_Age^2	− 0.001	− 0.534	0.59
X_2_Dependency	0.008	0.094	0.93
X_{3a}_Income	− 0.084	− 0.273	0.78
X_{3b}_Income^2	0.040	1.016	0.31
X_4_Education	0.022	0.170	0.86
X_5_Unused Land	0.014	0.832	0.41
X_6_Ownership	0.124	0.422	0.67
X_7_Topography	− 0.010	− 1.167	0.24
X_8_Travel time	− 0.004	− 0.759	0.45
X_9_Water**	0.619	2.114	0.03
X_{10}_Incentives*	0.065	1.603	0.10
X_{11}_Seeds***	0.012	2.600	0.01
X_{12}_Trust*	0.012	1.647	0.09
X_{13}_Success rate***	0.015	2.443	0.01
McFadden R^2	0.174 (17.4%)		

***, **, *: significant at alpha level (α) 1% (***), 5% (**), 10% (*)

The effect of household characteristics on the community's choice to participate in conservation activities starting with the age of the head of the family (X1) has a negative effect on the choice to participate in conservation activities, with a marginal effect value of 0.001. If age increases, the community tends to choose to participate in conservation activities, and as people get older, people tend to choose not to participate in conservation activities. From 57 respondents who answered the choice to participate in conservation activities, dominated by the '30s to 50's age group, which is the golden age for work and still has enough energy to carry out extra activities such as conservation. Likewise, 58 respondents chose not to participate in the '30s to '50s age group. Likewise, with some uniqueness where age is not an obstacle to participation in conservation activities, eight respondents have retired or are elderly, choosing to be involved in conservation activities. As in the results of an in-depth interview with a respondent, who stated that he was very interested in participating in conservation activities considering that in his old age, he wanted to continue to be active and get natural freshness as well as additional income.

The number of family dependents (X2) positively influences the choice to participate in conservation activities, with a marginal effect value of 0.008. That is, if the number of dependents in the family increases, the community tends to choose to participate. A large number of dependents encourages a group of respondents to choose to participate in conservation activities related to the desire to earn income as well as investment and savings in the future. A large enough family member can sustain conservation activities, according to an interview with a respondent with nine dependents in his family. However, some other field findings were that a group of

Simandjorang, Gunawan, Mesa, Apriani, Pranasari, Putra, & Fitri. (2022). Jurnal Bina Praja, 14(3), 517-527

523

respondents with a small number of dependents chose not to participate due to the absence of assistance in carrying out conservation activities.

Monthly income level (X3) positively affects the choice to participate in conservation activities, with a marginal effect value of 0.040. That is, if the income level is low, then people tend to choose not to participate, and as income levels increase, people tend to choose to participate. The low level of income affects a group of respondents, 47 people with income below 2 million rupiahs, to participate in conservation activities expected to boost the income faucet for their families. But on the other hand, symmetrically based on income groups, there is an option not to participate in conservation activities. One of the things mentioned by the respondent mentioned several factors that encourage him not to participate in conditions of low average monthly income, such as climate uncertainty and limited capital support.

Education level (X4) positively affects the choice to participate in conservation activities, with a marginal effect value of 0.022. That is, if the level of education is higher, the community tends to choose to participate. The level of education plays an important role in making decisions about the choice to join a conservation program. With the education level dominated by high school graduates, the respondents have wisdom in choosing the one that suits their needs. Likewise, eight respondents hold a bachelor's degree, and one holds a master's degree. A respondent in his interview stated that the desire to participate in conservation activities is more driven by the importance of natural welfare, considering the level of pollution is getting higher, coupled with forest coverless tree stands. A healthy nature will provide mental health, mind, and income.

Furthermore, the influence of land characteristics on the community's choice to participate in conservation activities is looked at in the aspect of spacious land (X5), which positively influences the choice to participate in conservation activities, with a marginal effect value of 0.014. That is, if there are a lot of unused land, then the community tends to choose to participate. The availability of unused land also encourages community participation, both in the area of 0.5 ha to more than 1 ha. With the availability of land, the community can be involved in conservation activities that can turn unused land into productive land, as stated by a respondent who is very fond of conservation activities and is ready to prepare his vast unused land for planting trees.

Land ownership status (X6) positively influences the choice to participate in conservation activities, with a marginal effect value of 0.124. That is, if the land is their own, then the community tends to choose to participate. However, a respondent who works as an entrepreneur said in an interview that land still owned by his family (ulayat) is still an obstacle for him, and he has to wait for a decision from his extended family. Respondents who do not own private land will participate in conservation activities if there is family certainty and legal certainty (government land).

The topography (X7) has a negative effect on the choice to participate in conservation activities, with a marginal effect value of 0.010. If the level of land steepness is high, the community tends to choose not to participate. The increasingly steep topography of the land also influences community decisions, especially with the road access condition still limited by dirt roads and footpaths. Even though it has an area of 3 hectares of unused land, a respondent is very difficult to participate in with very steep conditions. Several interesting phenomena were found, such as a group of community respondents who chose not to participate even though they had sloping land, and some people chose to participate even though the land condition was steep. Travel time to land location (X8) has a negative effect on the choice to participate in conservation activities, with a marginal effect value of 0.004. If the travel time to the land location takes much time, the community tends to choose not to participate. The long travel time to the land location makes some respondents choose not to participate in conservation activities. Thus, a respondent who only had elementary education in his interview said that his difficulty with the steep location and only available footpath access made the situation even more difficult. However, difficult

infrastructure conditions and the long journey to the location are not significant for all respondents. A respondent with a junior high school education stated that it is difficult to get to the location by motorbike, even though it takes 1 hour.

Availability of water (X9) positively influences the choice to participate in conservation activities, with a marginal effect value of 0.619. This means that if water is available at the location of the land to be planted, the community tends to choose to participate. This is in line with the hypothesis formulated previously and is statistically significant explanatory. Water is one of the important elements in life, including agriculture, plantation, and conservation. Therefore, the community tends to see the availability of natural and artificial water resources as one of the keys to the success of conservation activities were 45 respondents stated that they participated in conservation activities if water was available, and 24 respondents stated that they did not participate in conservation activities if water not available. From 115 respondents, information was obtained that 36 respondents did not have a water source at all, while the rest there were natural water sources and there were also artificial water sources from drums, plastic ponds, ponds, and other media.

And the last factor is the effect of the characteristics of conservation programs offered by the initiator, such as incentives in the form of money (X10), which positively influences the choice to participate in conservation activities, with a marginal effect value of 0.065. That is, if the amount of monetary incentive given is large, then the community tends to choose to participate. This is in line with the hypothesis formulated previously and is statistically a significant explanatory variable. Money incentives are one of the driving factors for a group of respondents. The more available incentives in the form of money and the larger amount will encourage community involvement. This was conveyed by a respondent who works as an entrepreneur. He mentioned the need for financial incentives to support the treatment process in the future, including the cost of postage at the start of planting. The support the community expects varies from providing seeds, fertilizers, supporting equipment (hoes, tripe machines, herbicides), assistance from experts, transportation support, water, and ponds to the hope of financial assistance. Community respondents are evenly divided into two equal groups: those who do not need financial support and need money.

The suitability of seeds (X11) positively affects the choice to participate in conservation activities, with a marginal effect value of 0.012. That is, if the seeds are given according to the wishes of the community, then the community tends to choose to participate. This is in line with the hypothesis formulated previously and is statistically a significant explanatory variable. Seedlings became a significant explanatory factor in this study, where a group of respondents stated the need for the suitability of seeds to encourage them to participate in conservation activities. The suitability of the seeds according to demand and needs is an important factor in conservation activities. People are more aware of their requests according to their interests and experiences, as stated by a respondent who wants superior seeds. She conveyed the experience that occurred when the initiator from the government provided sengon and mahogany seeds in 2010, and the results were less than optimal because they were attacked by plant diseases such as tumor rust on sengon and pests on mahogany. Community respondents also want the type of seed to be determined by themselves with a variety of seeds according to their needs, both types of perennials, fruits, and so on. The following are the various types of seeds desired according to the answers and interviews with respondents: coffee, petai, durian, mango, avocado, mahogany, trembesi, sengon, chocolate, banana, jengkol, duku, pine, ingul, eucalyptus, candlenut, meranti , teak, aloes, frankincense, cloves, mangosteen, sugar palm, endemic Batak, banyan, Chinese bamboo, lime, jackfruit, guava, mindi, areca nut, fir, sampinur, breadfruit, sapodilla, suren.

The trust level for the initiator (X12) positively affects the choice to participate in conservation activities, with a marginal effect value of 0.012. That is, if the trust in the initiator is good, then the community tends to choose to participate, and vice versa. If the initiator's evaluation is bad, the community tends to choose not to

participate. This aligns with the hypothesis formulated previously and is statistically a significant explanatory variable. Leading by example is key to encouraging community involvement in conservation activities. A respondent who works as a village official said that stakeholders must change the position or role they have played so far. From those who like to govern and command, they change to those who like to serve, from those who are always close to power to be helpful towards being flexible, collaborative, and dialogical. From slogans to pragmatic, realistic ways of working that can be practiced and can provide benefits based on the community's real needs in conservation. Thus, the community will automatically want to participate in the offered activities. The community's assessment of the initiator is one factor that attracts them to participate. And based on a survey, 84% of respondents stated that exemplary service and transparency are important in conservation activities.

Previous conservation success rate (X13) positively influences the choice to participate in conservation activities, with a marginal effect value of 0.015. That is, if the success rate of conservation followed by the previous community is high, then the community tends to choose to participate. This aligns with the previously formulated hypothesis and is a statistically significant explanatory variable. The level of success in previous participation also influences involvement in conservation activities. From the aspect of the success of conservation activities, respondents gave varied answers, where 48 respondents had previously participated in conservation activities stating that the growth rate was below 50%.

In contrast, the rest is evenly distributed at 60%, 70%, and 80% to 90%. Nine respondents stated that their success was perfect (100%). This certainly affects participation in the conservation activities offered next. This was conveyed by a respondent who was previously disappointed because the success rate was only 30% due to the seed's mismatch with expectations and the low quality. Another respondent, who works as a civil servant and is 41 years old, is very passionate about conservation because of his previous success in planting Mahogany and encouraging the government and church to be proactive.

4. Conclusion

From the results of research and studies conducted, it is obtained the influence of the key factors that determine the local communities to participate in conservation activities in Toba Caldera UNESCO Global Geopark (TCUGG) can be grouped into two main factors as follows: (1) the factors that influence be a significant determinant, namely the availability of water, incentives, suitability of seeds, trust level for the initiator, and the success rate of previous conservation; and (2) factors that have not become significant determinants, namely the number of dependents, income level, education level, unused land area, land ownership status, topography, and duration of travel time to the land.

Suggestions and policy recommendations as quick wins that encourage local community involvement in the future in conservation in TCUGG are as follows: (a) the need for infrastructure such as water supply to support conservation activities; (b) reconsidering the support of fiscal incentives, in addition to other support in the form of seeds, fertilizers, supporting equipment (hoe, tripe machine, herbicide, beko); (c) provide seeds that are in suitable with the needs of the community with high quality and pest resistance; (d) exemplary, service and transparency from the initiator. Society does not need promises or rhetoric, and (e) the application of reward and punishment as an incentive for the community to participate in conservation activities and to further encourage their motivation.

References

Creswell, J. W. (2013). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications, Incorporated.

Devi, D. A. (2013). *Analisis Nilai Ekonomi Konservasi dan Faktor-faktor yang Mempengaruhi Peluang Adopsi Konservasi Usahatani Kentang Dataran Tinggi di Kecamatan Pasirwangi Kabupaten Garut* [Undergraduate Thesis, Bogor Agricultural University]. http://repository.ipb.ac.id/handle/123456789/63070

Environmental Agency of North Sumatra Province. (2013). *Lake Toba Environmental Quality Index 2012*. Environmental Agency of North Sumatra Province.

Ethridge, D. E. (2004). *Research Methodology in Applied Economics*. Wiley.

Fatimah, S. (2016). *Partisipasi Masyarakat dalam Pembangunan Sektor Pariwisata Geopark Kaldera Toba (Studi tentang Rendahnya Partisipasi Masyarakat dalam Pembangunan Sektor Pariwisata Geopark Kaldera Toba di Desa Sianjur Mula Mula, Kecamatan Sianjur Mula Mula, Kabupaten Samosir, Provinsi Sumatera Utara)* [Undergraduate Thesis, Universitas Gadjah Mada]. http://etd.repository.ugm.ac.id/penelitian/detail/96486

Gujarati, D. N., & Porter, D. C. (2009). *Basic Econometrics*. McGraw-Hill Education.

Habanyati, E. J., Nyanga, P. H., & Umar, B. B. (2020). Factors Contributing to Disadoption of Conservation Agriculture Among Smallholder Farmers in Petauke, Zambia. *Kasetsart Journal of Social Sciences, 41*(1), 91–96. https://so04.tci-thaijo.org/index.php/kjss/article/view/229980

Hasibuan, S. H., Sunkar, A., & Santosa, Y. (2017). Identification of Determinant Socio-Economic Variables for the Success of Biodiversity Conservation. *Media Konservasi, 22*(2), 156–163. https://doi.org/10.29244/medkon.22.2.156-163

Irwandi, H., Rosid, M. S., & Mart, T. (2021). The Effects of ENSO, Climate Change and Human Activities on the Water Level of Lake Toba, Indonesia: A Critical Literature Review. *Geoscience Letters, 8*(1), 21. https://doi.org/10.1186/s40562-021-00191-x

Iskandar, J. (2009). *Keterlibatan Masyarakat Lokal dalam Upaya Konservasi*.

Jara-Rojas, R., Bravo-Ureta, B. E., Engler, A., & Díaz, J. (2013). An Analysis of the Joint Adoption of Water Conservation and Soil Conservation in Central Chile. *Land Use Policy, 32*, 292–301. https://doi.org/10.1016/j.landusepol.2012.11.001

Karokaro, A. S. (2018, May 30). *Nasib Danau Toba, Antara Investasi Pariwisata dan Penyelamatan Lingkungan*. Mongabay.co.id. https://www.mongabay.co.id/2018/05/30/nasib-danau-toba-antara-investasi-pariwisata-dan-penyelamatan-lingkungan-bagian-1/

Kementerian Lingkungan Hidup Republik Indonesia. (2014). *Gerakan Penyelamatan Danau (GERMADAN) Toba*. Kementerian Lingkungan Hidup Republik Indonesia.

Klein, C., McKinnon, M. C., Wright, B. T., Possingham, H. P., & Halpern, B. S. (2015). Social Equity and the Probability of Success of Biodiversity Conservation. *Global Environmental Change, 35*, 299–306. https://doi.org/10.1016/j.gloenvcha.2015.09.007

Moges, D. M., & Taye, A. A. (2017). Determinants of Farmers' Perception to Invest in Soil and Water Conservation Technologies in the North-Western Highlands of Ethiopia. *International Soil and Water Conservation Research, 5*(1), 56–61. https://doi.org/10.1016/j.iswcr.2017.02.003

Organisation internationale du travail, Oakley, P., & World Employment Programme. (1991). *Projects with People: The Practice of Participation in Rural Development*. International Labour Organization.

Resosudarmo, B. P., & Thorbecke, E. (1996). The Impact of Environmental Policies on Household Incomes for Different Socio-Economic Classes: The Case of Air Pollutants in Indonesia. *Ecological Economics, 17*(2), 83–94. https://doi.org/10.1016/0921-8009(95)00113-1

Rubiantoro, E. A., & Haryanto, R. (2013). Bentuk Keterlibatan Masyarakat dalam Upaya Penghijauan pada Kawasan Hunian Padat di Kelurahan Serengan—Kota Surakarta. *Jurnal Pembangunan Wilayah dan Kota, 9*(4), 416–428. https://doi.org/10.14710/pwk.v9i4.6679

Simandjorang, W. E. (2010). *Pembangunan Regional: Studi Kasus Perspektif Kawasan Industri Kuala Tanjung*. Penerbit Universitas Indonesia.

Simanihuruk, M. (2005). Pendekatan Partisipatif dalam Perencanaan Konservasi Lingkungan di DTA Danau Toba. *Jurnal Wawasan, 11*(2), 47–54.

Sinamo, J. (2001). *The Future of Lake Toba*. Lake Toba Heritage Foundation.

Straka, T. M., Bal, P., Corrigan, C., Di Fonzo, M. M. I., & Butt, N. (2018). Conservation Leadership Must Account for Cultural Differences. *Journal for Nature Conservation, 43*, 111–116. https://doi.org/10.1016/j.jnc.2018.03.003

SWP, H. D., Dai, J., Hidayat, A., AH, Y., Sumulyadi, H. Y., S., H., Buurman, P., & Balsem, T. (1989). *Explanatory Booklet of the Land Unit and Soil Map of the Sidikalang Sheet, Sumatra*. Center for Soil Research, Agency for Agricultural Research and Development.

Tietenberg, T., & Lewis, L. (2018). *Environmental and Natural Resource Economics* (11th ed.). Routledge. https://doi.org/10.4324/9781315208343

Wooldridge, J. M. (2019). *Introductory Econometrics: A Modern Approach*. Cengage Learning.

World Bank Group. (2018). *Improving the Water Quality of Lake Toba, Indonesia*. World Bank. https://doi.org/10.1596/32196