ORIGINAL ARTICLE

Determinants of Participatory Forest Management Practices in the Northwestern Highlands of Ethiopia

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Abstract

Forest resources are fundamental in supporting the livelihoods of the people and the sustainability of biodiversity. However, these resources are overexploited in order to meet the increasing demand for food, shelter, and energy. Participatory forest management is a tool used to support the sustainable utilization of forest resources. Thus, the objective of this study was to examine the factors that determined the participatory forest management practices in the study area. The Alemsaga forest was chosen as a case study since it is in danger in its current state due to illegal cuttings and unrestricted grazing. The study employed a mixed research design where quantitative and qualitative approaches of data collection and analysis were implemented. Household heads from three rural kebeles were used as a target population, and the questionnaire survey was administered to randomly selected sample households. A binary logistic regression was employed to identify the major determinants of PFMP in the study area. The result shows that family size, education status, perception, forest income, and training have significant positive relations with household participation in forest management, whereas, demand for firewood and grazing, age, and change in office administration have significant negative relations with participation on forest management. Therefore, a key aspect in the sustainable use of natural resources is realizing the key determinant factors that influence forest management programs. This work can be perceived as a contribution to enlightening policymakers and practitioners about PFM practices and core factors that hampered the forest management effort.

Keywords: *Participation, Forest Management, Ethiopian Forest, Forest Ecosystem, Stakeholder Participation*

Introduction

Background

The livelihoods of most rural people in the world are inextricably linked to natural resources such as forests (Oldekop et al., 2020; Zenteno et al., 2013). However, currently, there are problems related to the environment, such as a lack of community awareness about the

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resources, land degradation, and deforestation. The over-extraction of both renewable and non-renewable natural resources is a series of issues throughout the globe, which is especially severe in the developing world as the lives of the people, directly and indirectly, depending on the existence of these resources (Ribot & Larson, 2013).

Before the 1990s, the majority of nations were dependent on the centralization approach to forest management which leads to high pressure for deforestation. In response to this challenge in the early 1990s, the idea of participatory forest management (PFM) came into practice and world leaders at the United Nations agreement (Brown, 2007). Participatory forest management has multiple benefits, including improving forest quality through sustainable forest management (Blomley et al., 2008); diversifying and improving income sources, asset building and supply of subsistence forest products (Ha et al., 2014; Tadesse et al., 2017; and forest management at the community level contributes to accountable natural resource management (Hajjar & Oldekop 2018).

Forest resource degradation has become the most serious and acute problem during the second half of the 20th century (UNDP, 2012). Deforestation is highly associated with population growth, and the area that was previously unpopulated has become inhabited by a large number of people who engage in substantial farming operations (Winberg, 2010). According to Teketay's (2001) estimates, Ethiopia's forest area coverage has decreased from 40% in the 1920s to 2.7% in the 1990s, with an estimated 150,000–200,000 hectares of high forest lost each year. Over the years, the forest sector has been faced many mismanagement challenges due to the lack of government support (FAO, 2010). Ethiopia is rich in the flora of tropical Africa and this situation enables Ethiopia to be considered the center of origin for plant species diversity (Tolera et al., 2008). One of the possible solutions is participatory forest management which was introduced around the mid-1990s by non-governmental organizations (Gobeze et al., 2009). The intent was to prevent deforestation and to bring better social and economic outcomes compared with the former centralized command-and-control resource management approach. The practice of PFM is now being embraced in many parts of the country. However, the problem of deforestation continues and there are no systematic assessments made on evaluating the determinant factors affecting the performance of the system.

Alemsaga forest is one of the forest areas found in the South Gonder Zone of Amhara regional state. According to Masresha et al. (2015), the number of plant species in the Almsaga Forest is about 124, and its variety is higher than in some dry Afromontane forests of Ethiopia, such as the Menagesha-Suba Forest, with 82 species. Even though it contains a diverse range of species, the forest has recently been subjected to exploitation, which has hampered the long-term performance of forest species diversity, area coverage, and ecosystem services.. Researchers conducted different studies about participatory forest management in different parts of Ethiopia and other countries. For instance, Deressa (2014) conducted research on practices and challenge of participatory forest management in West Shewa. Alemtsehay (2010) had dealt with determinant factors for a successful establishment of participatory forest management: A Comparative Study of Goba and Dello Districts, Girma and Zegeye (2017) conducted research on farmer's participation in participatory forest management and factors affecting its performance in Sodo Zuriya District, Wolaita Zone. Similarly, Tesfaye (2015) studied on Ethiopian Orthodox church in forest conservation practice and the current status of woody plant species diversity in Debre Libanos.

All the above and other studies illustrate that the role of community participation is vital

in enhancing forest conservation and management effort and promoting sustainable forest management through PFM approach. Likewise, Getinet et.al, (2015) also investigated the status and species diversity in Alemsaga forest. However, as the researcher`s knowledge is concerned no study conducted specifically on Determinants of participatory forest management practices in Alemsaga forest. Hence, in order to fill the gap and get relevant information on participatory forest management, the researcher is motivated to conduct this research in Alemsaga forest.

Conceptual Framework

The conceptual framework in Figure 1 is developed based on Teshome, (2015); Engida & Mengistu (2013); and Ofoegbu et al. (2017), suggest that the explanatory variables that determine the level of participation in participatory forest management are explained. These variables could be internal as well as external. These include i) socio-economic variables (demand for grazing, demand for firewood, forest income, and level of education); ii) psychological attributes (community perception on PFM); iii) institutional variables related to staff turnover and change of office administration; and iv) demographic variables (age, family size and gender). These factors can influence the level of community participation in forest management. The graphical presentation of the conceptual framework is given below.

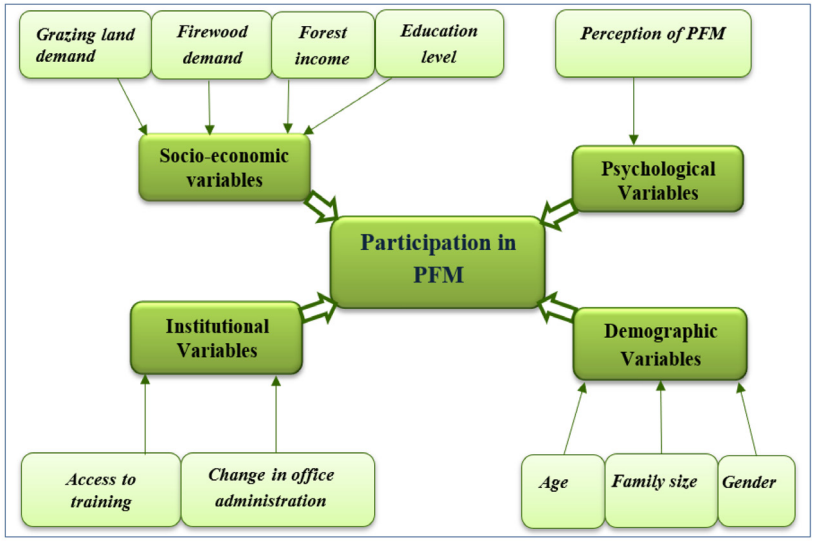

Figure 1. Conceptual framework; factors determining participation in PFM

Materials and Methods

Description of the study area

The Alemsaga forest is found in the South Gondar zone of the Amhara Region. The forest lies between 11° 54' 0" – 11° 57' 0" N and 37° 55' 30" – 37° 57'0" E with elevation ranges from 2077 to 2547 meters above sea level (Figure 2). The forest shares the boundaries of

Farta and Fogera woreda. It covers an area of 729 hectares, including plantations around the edges of the forest,of this, 181 hectares are covered by Fogera woreda and the remaining 548 hectares by Farta woreda. The forest is bordered in the north by Koleye kebele, in the south by Denegorese, in the east by Koleye, and in the west by Alemberzuriya kebele. The livelihood of the local community in the study area is dependent on a mixed farming system. A mixed farming system (i.e., crop production and livestock rearing) represents the major source of livelihood for the local community.

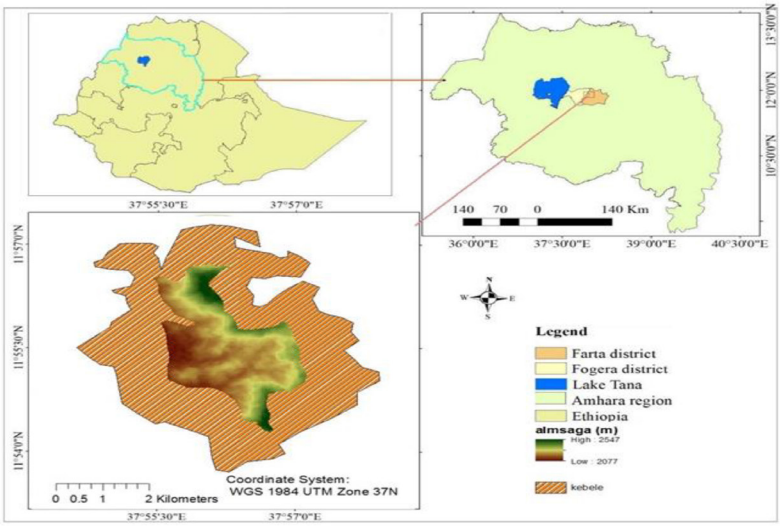

Figure 2. Location map of the Alemsaga forest

Research design

This study used a mixed research method (both qualitative and quantitative) methods as it minimizes some of the limitations of using a single method (Creswell, 2014). Consequently, a qualitative approach was used for analyzing the qualitative data gathered through an interview and field observation, whereas a quantitative approach was used to analyze the quantitative data collected through questionnaires about practices of participatory forest management.

The study area and kebeles were selected purposively while household heads (respondents) were selected randomly among three rural kebeles because the system gives equal chance for each household and which enhance to get more representative data. The three kebeles were selected purposively because of their special proximity to the study site. The forest is confined to Fogera and Farta woredas of the South Gondar zone, two rural kebele from Farta (Koleye and Denegorese) and one rural kebele from Fogera (Alemberzuriya kebele) were used for sampling.

Sampling procedure and sample size

Systematic random sampling was applied to draw sample respondents from each kebele based on lists of household heads at the respective administrators arranged in localities

called "Gots". This sampling technique gives each household head in the study area an equal chance, which improves the ability to obtain more representative data. The sample size of respondents was taken by considering the number of household heads in each kebele. The sample size of the study was 336 (Table 1), which was determined by using the sample size determination formula developed by Kothari (2004) (Eq. 1).

$$n = \frac{Z^2 * P * Q * N}{e^2(\mathrm{N} - 1) + Z^2 * \mathrm{P} * \mathrm{Q}} \quad (1)$$

Where, n = sample size Z = value standard variation at 95% confidence level (1.96), P = sample proportion of the study is unknown (0.5) Q= 1 – P, N = number of total household heads and e = the estimated true value in this study (0.05).

Finally, the total sample size obtained was distributed into three rural kebele proportionally on basis of their total household heads.

Table 1. Number of sample households in each selected kebele

Sample kebele	Total number of households	Sample proportion (%)	Sample unit
Koleye koleye	692	26	87
Dengorse	855	32	107
Alemberzuriya	1136	42	142
Total	2683	100	336

Data Sources and Types

Primary data sources have the advantage of providing detailed information and high accuracy, and they are more closely related to the problem under study. The primary data sources for this study were data obtained from a questionnaires survey (quantitative) while interviews and field observations are qualitative.

The study also employed secondary data sources as it has the advantage of saving cost and time. It supports the reliability and accuracy of primary data sources and was obtained from Farta woreda environmental protection office (FWEPO), Fogera woreda natural resource conservation office (FWNRCO), and journals that were related to PFM systems. Moreover, governmental office documents relevant to the study were also reviewed.

Data Collection Methods and Instruments

Household survey: The researcher obtained statistically useful information concerning practices of participatory forest management through relevant items prepared using questionnaires. Therefore, a questionnaire survey was used to collect data from randomly selected sample household heads, and the questionnaire was not self-administered. Instead, each question was asked by research assistants, and responses were filled in the relevant spaces in the questionnaire.

Key informant interviews (KII): an in-depth information obtained from key informants through face-to-face interaction. The data gathered from key informants is qualitative and

describes the practices of PFM in the study area. Natural resource management experts were included in the interview.

Field observation: Information about the current condition of the Almsaga forest, the practical activities of the local communities on forest management, and whether community members are using the forest, for example, for grazing and firewood, during field observation was recorded using checklists. Both field observation and KII were used to validate the data obtained from questionnaire survey and fill the gap of data that was bot be completed using survey called data triangulation.

Data analysis

The profile of the household was analyzed by using descriptive statistics, and the factors that administer household participation in PFM using inferential statistics, such as binary logistic regression.

Logistic regression with binary variables

Binary logistic regression model was employed to identify the determinants of the dependent variable, participation (Tabachnick et al., 2007; Gujarati, 2019). In this model, yi represents the dependent variable, participation, which equals 1 if the respondent participates in PFM and 0 if not. The probability of household participation in PFM, Pr (yi = 1), is a joint probability likelihood function assessed at Xib, where Xi is a host of explanatory variables and β is the coefficient of the predictor variable explaining the change in the dependent variable as a result of a unit change in an explanatory variable. As indicated in table 2, the explanatory or independent variables include Sex (SEX); age of the household (AGE); number of family members (FAMILY SIZE); educational level (EDUCATION STATUS); Forest income (FORES_INCOM); demand for grazing land (GRAZING); demand for firewood (FIREWOOD); household perception (HOUSEHOLD PERSEPTION); access to training (TRAINING); change in responsible administration office (CHANGE_OFFICE_EX). The estimation form of the logistic transformation of the probability of participants' opinions in favor of participation in PFM Pr(Yi = 1) can be represented as:

$$\Pr(yi = 1) = \frac{\exp(Xib)}{1 + \exp(xip)} \quad (2)$$

The above equation can be reduced to:

$$\Pr(yi=1)=B_0+B_1 X\_i+B_2 X_2+B_i X_i \quad (3)$$

Where: P is the probability of the presence of the characteristic of interest, participation. B is the coefficient of the predictor variables and is estimated from calibration data using the maximum likelihood technique. X is a host of explanatory variables

Table 2. Measurement of the variables and their expected sign

Variable	Measurement	Characteristics of variables	Expected sign-on participation
Dependent variables			
Participatory forest management (P)	Yes/No		
Independent variables			
AGE	Years	Continuous	-
SEX	Male/female	Categorical	
FAMILY SIZE	Number	Continuous	-
EDUCATION STATUS	Literate /illiterate	Categorical	-
HOUSEHOLD PERCEPTION	Yes/No	Categorical	+
CHANGE_OFFICE_EX	Yes/No	Categorical	-
TRAINING	Yes/No	Categorical	+
GRAZING	Yes/No	Categorical	-
FORES_INCOM	Yes/No	Categorical	+
TRAINING	Yes/No	continuous	+

Results and Discussion

Demographic characteristics of the sample households

From the 336 randomly selected households, 72.2% were male and 27.8% were female (Table S1). Even though there is male dominance, it is possible to observe that there is an effort to involve both males and females in forest management practices. The maximum and minimum ages of the respondent households were 69 and 25, respectively. The family size ranged from 2 to 10. The educational level of the household was 44.3% literate, and the remaining 55.6% illiterate (Table S1).

Of all the ten independent variables hypothesized to affect the participation of households in PFM, about nine variables were significant, to determine the participation of households in participatory forest management. The following section describes the detail of each significant variables (Table 3).

AGE: age is an important determinant factor in households' decision to participate in PFM. The binary logistic regression result showed that age has a negative B coefficient and is significant at a 5% probability level (Table 3). This implies that an increase in the age of the household decreases participation in PFM activities because, unlike the older group, the youth have an interest in participating in conserving the forest because they have high labor power to manage the forest. Based on the result of the odds ratio, other variables being constant, a unit increase in a household's age would decrease the interest in participation by a factor of 0.936 compared to the reference category of the younger age group (Table 3). Similarly, research done in Iran by Faham et al. (2008) indicates that the level of community participation in replanting and developing forest areas decrease with the increase in the age of the forest residents. A similar study done by Smith (2010) indicates that age is the major factor in influencing and clarifying participation levels in forestry activities among various age groups, and youth were willing to participate better than elders. However, unlike this finding, the study conducted by Taddese et. al. (2018) and Amenu et al. (2022) showed that older people can acquire more knowledge

and experience and are expected to influence more decisions in forest management than younger people as the young people had mobile nature of searching other jobs.

FAMILY SIZE: the binary logistic regression result showed that family size is positive and significant at a 1% probability level ($p<0.01$). This indicates that households with a large number of family sizes tended to participate in participatory forest management activities (Table 3). A unit increase in family size increases the probability of participation in forest management by 44.4%. This is most likely due to more demand for forest resources for household consumption compared to households' having small members. Households with small size are less impacted as they are heavily engaged in farm activities even in the off-seasons. Similar findings were reported that the greater family size contributes to a positive response to PFM. It has been noted that households with large family sizes have extra opportunities to work with community forest management initiatives (Engda, 2013).

Table 3. Regression result of the determinant variables and participation in PFM

Explanatory variables	B	S.E.	Wald	Sig.	Exp(B)
SEX	-.245	.531	.213	.645ns	.783
AGE	-.066	.030	5.005	.025**	.936
FAMILY SIZE	.444	.163	7.402	.007*	1.559
EDUCATIONAL STATUS	1.803	.450	16.073	.000*	6.065
HOUSEHOLD PER-CEPTION	2.266	1.114	4.136	.042**	9.638
FORES_INCOM	3.134	.517	36.689	.000*	22.969
GRAZING	-.935	.462	4.095	.043**	.393
FIREWOOD	-2.369	.789	9.017	.003*	.094
CHANGE_OFFICE_ EX	-1.339	.442	9.203	.002*	.262
TRAINING	.993	.494	4.051	.044**	2.700
Constant	-24.744	6319.551	.000	.997	.000
Note: *significant at 1% level of significance, ** significant at 5% significance level, ns=not					

Based on the result of the odds ratio, other variables being constant, an increase in the number of household sizes would increase the interest of participation by a factor of 1.559 compared to the reference category that has a small family size. The major reason is that large family members have a greater demand for forest products such as firewood, cutting grass, and other activities due to their free labor compared to the small family size. Thus, family size affects the decision to participate in being engaged or not in participatory forest management. Similarly, the studies of Taddese et al. (2018) ; Getachew and Tafere (2013) and Engda and Mengistu (2013) indicated that an increase in family size could increase the probability of forest users' levels of participation than their counterparts with small family members. Households having more working labor contribute more time for forest management practices as they have greater demand for firewood and other undergrowing resources.

EDUCATION STATUS: The binary logistic regression result revealed a significant positive relationship between educational status and participation in PFM at a 1% level of significance (Table 3). The odd ratio result showed that a unit increase in educational status increased the participation in PFM by a factor of 6.065 compared with illiteracy,

other variables being constant. Similarly, another study conducted by Gujarati (2019), Jatana et al. (2017) and Tesfaye et al. (2012) concluded that the level of forest resident participation in forest management activities increases as their level of formal education increases. In contrast to the findings of this study, Tacconi (2007) found that there was no association between level of education and participation in the use and management of forest resources because adjacent communities have equal access to forest resources regardless of their educational level.

HOUSEHOLD PERCEPTION on PFM: As can be seen from table 3, perception and participation in PFM have a positive relationship and are statistically significant at a 5% level of significance. Other variables being constant, households who perceive the importance of participatory forest management are more likely to participate than those who are not aware of it by an odds ratio of 9.638 (Table 3). When communities are perceived to be involved in forestry projects, they become motivated and feel it is their responsibility to sustainably conserve and manage forest resources. This finding is similar to that of Garekae et al. (2020), who found that there is a need to involve local communities in decision-making because communities need to control any activity that needs to influence their lives. Similarly, Iddi (2010) argues that the community should be granted rights, responsibilities, and power so that they can effectively participate in forest conservation and management initiatives. His study further indicated that failure to give the community equal rights as other partners negatively influences their motivation and reduces their participation in forest conservation efforts.

FORES_INCOM: Table 3 indicates that forest income and participation had a positive relationship, and it is statistically significant at a 1% level of significance. When there is a unit increase in forest income, the participation of households in PFM increases by the factor of 22.963, other variables being constant. Households who get benefits from forest management activities are more likely to participate in participatory forest management programs than those who do not get them. Similarly, the findings of Faham et al. (2008) and Jatana and Paulos (2017) indicated that forest income is one of the factors influencing individual decisions about whether or not to participate in management, and that it has a positive impact on household decisions to participate.

FIREWOOD: the regression result showed that the demand for firewood by the community has a negative relationship with participation in PFM and is significant at a 1% level of significance. The odd ratio result indicates that those households who have a high demand for firewood are less likely to participate than those who have a low demand by a factor of 0.094. Because most of them want to utilize the forest resource as firewood illegally. There are two ways that households exploit the forest as a supply of firewood. The majority of families use firewood for cooking food and lighting at night. However, several households relied on the sale of firewood as a source of income. According to studies, the largest portion of the total forest income was made up of firewood (Asfaw et al., 2013). For the disadvantaged households headed by women, forest income was particularly significant. Despite that, PFM was designed to improve forest productivity and enhance environmental sustainability; unknowingly the community, particularly the poor, is reluctant to adopt the program. This action reduced the effectiveness of PFM strategies in the area. In addition, there are restrictions imposed on commercializing forest product in the form of charcoal as forest resources are illegally harvested. These practices further discourage community participation in PFM.

GRAZING: as observed in Table 3, the result showed that the demand for grazing by the community has a negative relationship with participation in PFM and is significant at a

5% level of significance. The binary logistic regression result showed that those with high demand for grazing are less likely to participate than those who have low demand by a factor of 0.393. The reason behind this is that they graze their livestock in the forest area illegally, as observed during the study site visit, and most households use free grazing illegally.

TRAINING: access to training and experience-sharing has a significant positive influence on the household's decision on participation in forest management activities. As can be seen from table 3, the result of training has a positive relationship with participation in PFM and is significant at a 5% level of significance. Therefore, the regression result showed that other things were constant: the training increased household participation in forest management also increased by a factor of 2.700. Studies by Maraga et al. (2010) identified the existence of collaborations between the local people's participation and their awareness of natural resource-related problems. Furthermore, Kajima et al. (2020) found that awareness of the aim of management affects the level of participation in forest management. Having a greater understanding of Individuals inspired them to participate in forest management given being aware of the social and economic impacts of deforestation. The appropriate communication platform should be provided for farmers to share opinions on better agricultural production methods and problems and possible solutions including other income-generating activities through training, is crucial to effectively manage and increase forest cover.

CHANGE_OFFICE_EX: It indicates that the change in the office that administers Alemsaga forest in different years and also the forest expert turnover was some of the factors that affected the PFM of Alemsaga forest. The binary logistic regression result showed that the change of office administration and expert with household participation in PFM has a negative relationship and is statistically significant at a 1% level of significance by the odd ratio of 0.267, other variables being constant (Table 3). An interview of Farta and Fogera woreda environmental protection and natural resource conservation experts revealed that one of the major factors that affected PFM has been the change of an office that administers the forest. In addition, the changing of experts and their experience does little with the work, and there is no follow-up and training from the institutional office, so its cumulative effect hinders the effectiveness of PFM in the Alemsaga forest.

Conclusion

Forest resources are life-supporting systems, especially for rural households. Currently, there is a large gap between the demand and supply of these resources for fuelwood and construction with the increasing population. Therefore, there is a need for an adaptive management approach. In the study area, PFM was used as an approach for the sustainable utilization of forest resources. However, the effective implementation of this approch was determined by household participation. The study indicates that PFM was largely determined by family size, educational status, forest income, training, demand for firewood and grazing, age, perception, and high expert turnover. Moreover, the researcher also concludes the interview and observation results. The field observation result indicates that illegal cutting of firewood and uncontrolled grazing are significant problems of forest degradation.

Generally, the result showed that participatory forest management continue to be developed by strengthening the administrative structure of forest management groups in order to empower members in decision-making process and fair benefit sharing among households for increasing the success of participatory forest management system. Hence,

in order to improve the existing system of PFM implementation, the Farta and Fogera woreda environmental protection offices and natural resource management departments should work on the effective implementation of PFM with full attention and the support from decision makers at all levels. This could be through provision of awareness creation programs, access to alternative sources of income for youths and unemployees, and documentation to reduce the loss of progress reports among expert turnover. In addition, reducing forest resource degradation through the provision of alternative sources of energy and technologies that can eliminate people's pressure on the forest resources.. Encouraging the local community to plant trees at farm yards owned by individuals outside the forest area has a paramount benefit in producing household managed woodlots.

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Conflict of interest

The author declares that there is no conflict of interest.

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Ethical approval

Ethical approval was not declared since the study does not involve human and animal life.

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