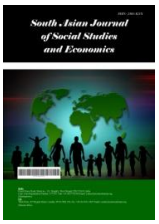

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Assessing the Role of Gender in Identifying and Prioritizing Local Ecosystem Services of Trees in Croplands

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Authors' contributions

This work was carried out in collaboration with both authors. Author TT designed the study, performed the statistical analysis, wrote the protocol and wrote the first and second draft of the manuscript. Author GE managed some analyses and editing parts of the study. Both authors read and approved the final manuscript.

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ABSTRACT

The overall objective of the study was to assess and compare the role of gender in identifying and prioritizing the ecosystem services of trees in croplands. The research was carried out in croplands and species inventory in each cropland was conducted during field observations of every tree species by interviewing the local farmers and/or villagers. A questionnaire containing both close-ended and open-ended questions were designed to collect information about the role of gender in identifying and prioritizing the ecosystem services supplied by each tree species in croplands based on local communities. A total of 15 ecosystem services were identified from trees in croplands by both men and women. The number and type of ecosystem services identified by men and women were different. The differences could be due to different access and benefits from ecosystem services. As a result, their perception and knowledge of ecosystem services could also

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vary. After identification of each ecosystem service, a paired two-tail t-test was conducted whether the list of individual score values given to each local ecosystem services identified by both men and women were the same or not. The statistical result of the paired t-test showed that the score values of all the ecosystem services that are only identified by both men and women were not statistically significant. This can imply that the commonly identified ecosystem services have more or less similar importance to men and women. The findings in this research demonstrate that ecosystem services identification might cause gender biases on women due to neglected control and access to the ecosystem services of trees in croplands which in turn could have an impact on tree resource management, conservation, and development interventions. Therefore, integrating women in ecosystem service access and control can help build various experiences of gender and balanced institutions which can aid collective and effective tree and forest resource management and to maximize the benefits for all beneficiaries of the ecosystem services.

Keywords: Ecosystem services; gender; trees in croplands; beneficiaries; tree management.

1. INTRODUCTION

1.1 Background

Trees in croplands are defined as separate and minor groups of trees and/or individual scattered trees that are grown in farmlands [1]. Trees in croplands are scattered trees which are found in agricultural lands including fruit trees. In this study, trees in croplands can be explained as naturally grown or planted trees in croplands which are kept by local beneficiaries excluding commercial plantation trees such as palm oil, cacao, and teak plantations [2]. Trees in croplands provide a variety of ecosystem services to indigenous beneficiaries or communities. Ecosystems of trees in croplands provide similar ecosystem services as forests although the supply of ecosystem services differs in terms of quantity and value [3].

Ecosystem services are advantages of an ecosystem to people in which most of the benefits are critical to our survival such as climate regulation, air purification, and crop pollination [4,5]. The idea of ecosystem services has become a useful concept for integrating into decision-making and ecosystem-related values into decision making. This concept has gained broad attention as one of the main steps to understand and value the importance of ecosystem service providers to beneficiaries [6].

Various ecosystems of the world offer an enormous variety of goods and services. The valuable commodities that natural ecosystems provide include; edible plants and animals, medicinal products, and materials for construction or clothing [7]. These are also the goods and services delivered by the ecosystem to the society. Ecosystem services offer the basis for the valuation of the ecosystem. The supply of ecosystem services varies over time and space [4]. The beneficiaries of the ecosystem services also have varying awareness and choice on the supplied ecosystem services.

The insight and selection of ecosystem services can also differ by the preference of gender. The experience and utilization of ecosystem services can also be perceived differently by men and women as they can have divergent social and cultural backgrounds. Therefore, the participation of gender has an important advantage to gather and identify various ecosystem services and understand prioritization differences [8]. The Sustainable Development Goals (SDGs) target to mobilize efforts to end poverty, discriminations, inequalities, and minimize climate change with inclusive participation [9]. It also takes gendered considerations for attaining its objectives. As a result, inclusive insights on gender and ecosystem service relations are crucial.

Involving gender and their indigenous knowledge in identifying and prioritizing the specific types of trees in croplands and their ecosystem services can reveal the score value of the ecosystem services and understand the role of the trees to local livelihood benefits [2]. Identifying and ranking of ecosystem services with gender inclusion can help to prioritize the ecosystem service providers based on the services they provide and therefore, for better planning and management of the ecosystems to gain the maximum possible benefit [10].

Gender has been emerging as the main research and policy focus in the past decades. However, gender issues have not gained an equal focus on environmental and natural resource management and utilization even though gender

considerations are required in research and conservation organizations. Gender is rarely included and serious gaps in natural resource management and ecosystem services studies [8]. As a result, this study is aimed; 1) To assess the role of gender in identifying the ecosystem services of trees in croplands, 2) To compare the role of gender in prioritizing the ecosystem services of trees in croplands.

2. METHODS

2.1 Study Area

The research was carried out in croplands around Nkasiem village, in the Goaso district in Ghana, West Africa. It is located between latitudes of 24° 10' 00" N-24° 50' 00" N and longitudes of 11° 31' 00" E-11° 63' 00" E. The study area covered a total area of 621 ha. Of this total study area, 147 ha of croplands were used for the inventory of trees in croplands. The major crops in the study area include plantain, cassava, ginger and cacao, and some maize, pepper, and rice. In addition to the cultivated crops, there are several trees inside and at the boundaries of croplands retained by local beneficiaries. The location and map of the study area within Ghana and Goaso and the location of croplands and trees within the study area are shown in Fig. 1.

2.2 Inventory of Tree Species in Croplands

The species inventory was conducted during field observations of every tree species in croplands by interviewing the local farmers or villagers and through a fieldwork assistant from Kwame Nkrumah University of Science and Technology with good knowledge of tree species. The local names of each tree in croplands were identified by the local farmers and a field assistant. The scientific name of each tree in croplands was identified through the help of the field assistant and Goaso forest district office experts, and by searching the internet [11].

2.3 Identification of Ecosystem Services

A questionnaire containing both close-ended and open-ended questions were designed. The purpose of the questionnaire was to collect information about the role of gender in identifying and prioritizing the ecosystem services supplied by each tree species in croplands and frequency of each ecosystem service based on local communities. Ecosystem services provided by each tree in croplands of the study area were identified through an interview with the local beneficiaries during the fieldwork.

The interviewees who are local farmers and reside in and around the croplands were selected purposely to get better information about the ecosystem services of trees in croplands. Most of the interviewees were asked during an inventory of trees in croplands on the field on a random basis considering gender as a main factor. Some respondents who retain trees in their croplands were asked at the village purposively and randomly. Photos of trees in croplands were used to interviewees who cannot join in the field to collect data about ecosystem services and ranking of the ecosystem services supplied by trees in croplands.

The number of diverse ecosystem services supplied by each tree in croplands was analyzed in Excel 2016 and SPSS 20 based on the list of ecosystem services identified by respondents for each tree in croplands. The analysis was conducted to identify the diversity and prevalence of ecosystem services and to define the level of multi-functionality tree species to respondents in the study area.

2.4 Prioritizing of Ecosystem Services

After identifying the ecosystem services of each tree in croplands from the local beneficiaries, different categories of farmers/interviewees including gender, age, and education level were asked to order the ecosystem services based on their importance to respondents. Each ecosystem service provided by each tree in croplands is scored on basis of 1, 2 and 3 meaning; 1= fairly important, 2= important, 3= Very important by men and women. Based on the score values the average score value of each ecosystem service of tree in croplands calculated. However, the average score value does not consider the multi-functionality of ecosystem services provided by each tree in croplands. Therefore, for better evaluation and comparison among trees in croplands and considering the multi-functionality of tree in croplands, the average score of ecosystem services was multiplied by the number of ecosystem services provided by each tree in croplands to get the total score value of trees in croplands assigned by men and women. Therefore, the total score values were assigned to each tree in croplands of the same species in

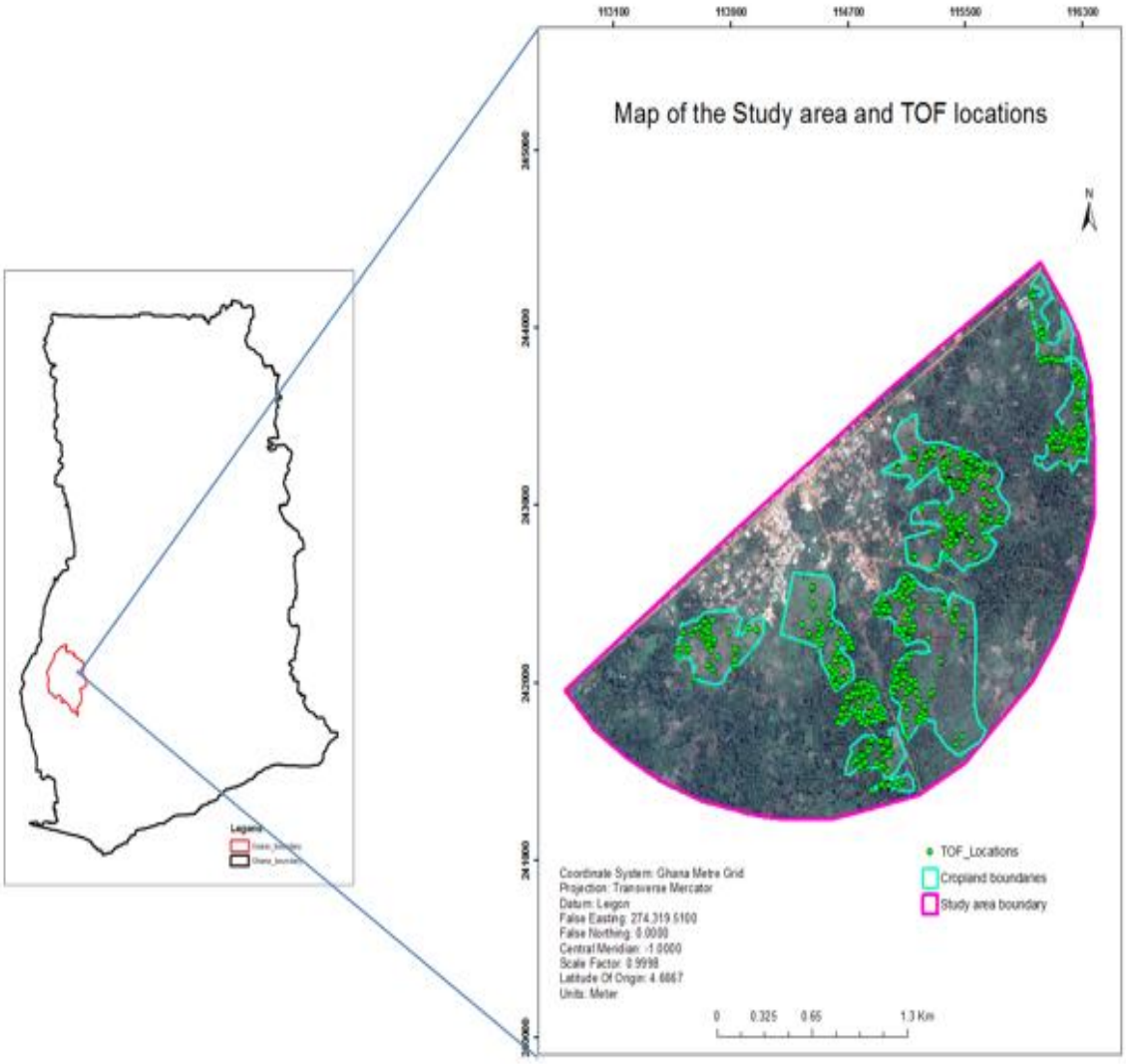

Fig. 1. The location of the study area within Ghana and Goaso, and location of croplands and trees within the study area

the study area. A paired two-tail t-test was conducted on whether the list of individual average score values given to each ecosystem service by men and women respondents was the same or not. The data analysis was done using a pivot table in Excel 2016 and SPSS 20.

3. RESULTS

3.1 Respondents Characteristics

Thirty-seven local beneficiaries were interviewed to gather information about the supply of ecosystem service by each tree in croplands, the score value of each ecosystem service and frequency of each ecosystem service used. Different gender, age, education level and the village of respondents were taken into consideration to gather diverse and better information. 46% of the respondents were women whereas the rest 54% were men. The characteristics of the respondents in the study area are shown in Fig. 2.

The study was mainly carried out in Nkasiem village. As a result, most of the respondents were selected from this village as shown in the Fig. 2.

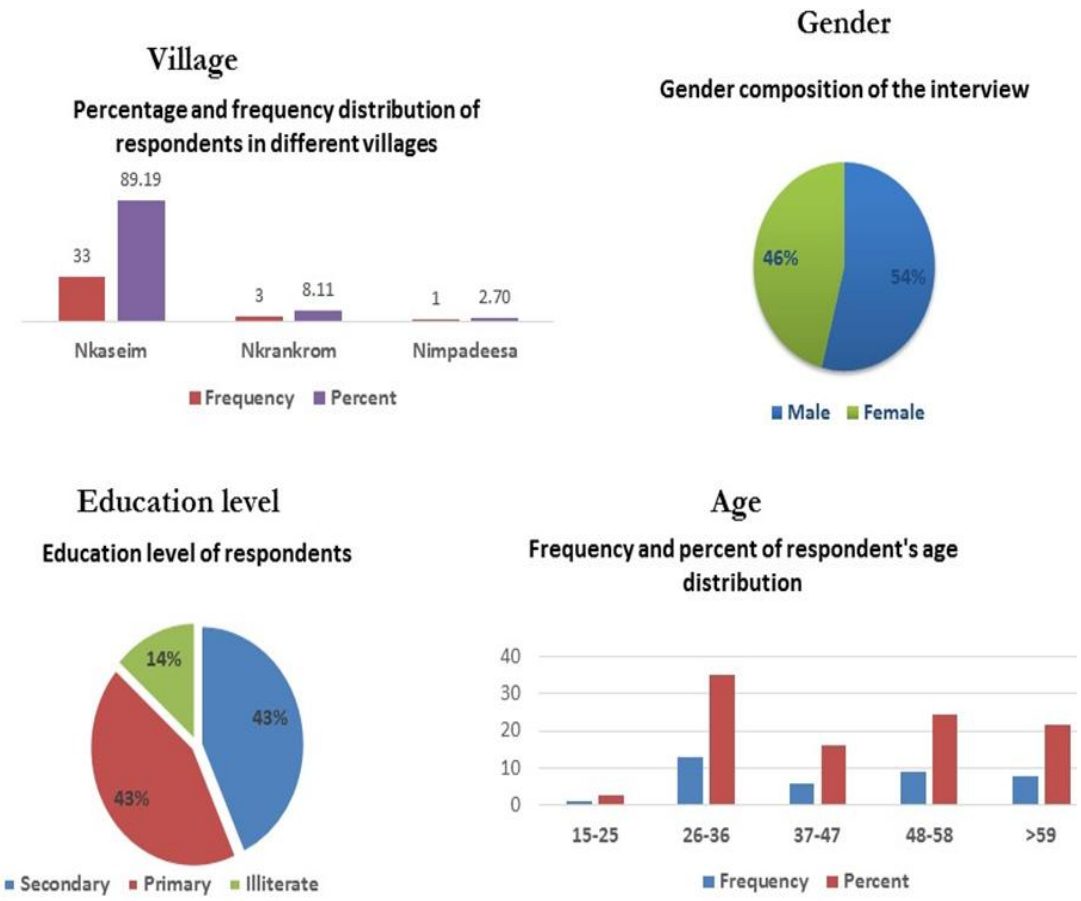

Fig. 2. Characteristics of respondents

Table 1. List of ecosystem services from different tree species in the study area and gender differences in identification of ecosystem services

Male	Female
Boundary	Charcoal
Climbing of yam tree	Food
Food	Fuel wood
Fuel Wood	Medicine
Habitat to other important species	Rainfall Regulatior
Medicine	Shade
Pollination of cacoa plants	Soil conservation
Rainfall regulation	Soil fertility
Shade	Timber
Soil conservation	
Soil fertility	
Timber	
Water accumulation for other crops	
Wind abatement	

3.2 Gender and Identification of Ecosystem Services of Trees in Croplands

A total of 50 different tree species and 15 different ecosystem services supplied by different tree species in croplands were identified by the interviewees. The ecosystem services identified by men and women were different in terms of number and some of the ecosystem services were exceptionally identified by men or women. Fourteen ecosystem services were identified by men out of the total 15 ecosystem services in which six of the fourteen ecosystem services were exceptionally identified by men. Nine out of the 15 ecosystem services were identified by women with a single unique ecosystem service that is not identified by men. The following table shows the list of identified ecosystem services from different tree species and gender differences in the identification of ecosystem services.

As can be vividly seen from the table above, charcoal was uniquely identified by women whereas boundary, climbing for yam tree, habitat to other important species, pollination of cacao plants, water accumulation for other crops and wind abatement were exceptionally identified by men. The frequency of men and women in the identification of ecosystem services is shown in the Fig. 3.

3.3 Gender and Prioritization of Ecosystem Services of Trees in Croplands

The local ecosystem services supplied by trees in croplands were given a score value based on their importance to the respondents. The score value of the 15 ecosystem services supplied by trees in croplands was calculated based on the average score values. A paired two-tail t-test was conducted on whether the list of individual scores given by men and women to each local ecosystem service was the same between men and women respondents. The equal list of count scores given by women and men to each ecosystem service were compared. The comparison between men and women scores is performed for each ecosystem service that is only identified by both men and women (Table 2). Shade, timber, food, fuelwood, medicine, soil conservation, soil fertility, and rainfall regulation are the ecosystem services identified by both men and women. The statistical result of the paired t-test shows that the score values of all

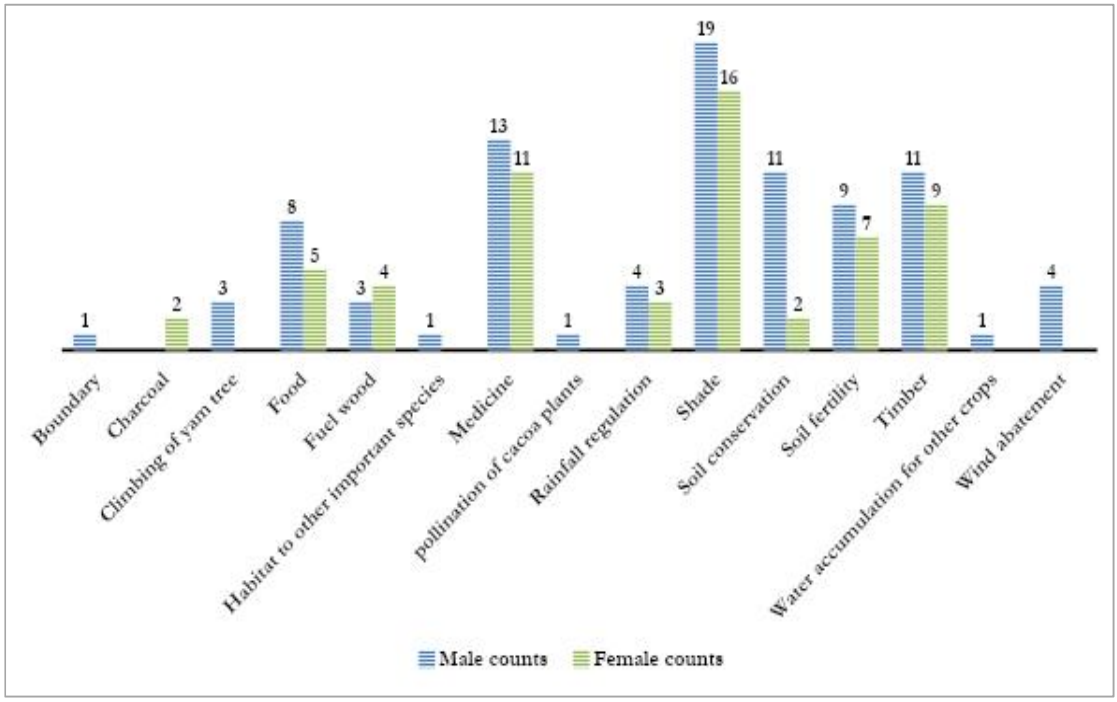

Fig. 3. Frequency of men and women per each local ecosystem service

Table 2. Paired two-sample t-test of gender score values of ecosystem services

TOF ecosystem services	Women (average score value)	Men (average score value)	T-Value	*P*-Value
Food	2.40	1.78	2.78	0.305
Fuelwood	2.00	1.80	4.30	0.625
Medicine	1.93	2.08	2.28	0.277
Rainfall regulation	1.67	1.83	4.30	0.578
Shade	2.72	2.76	2.13	0.164
Soil conservation	2.00	1.79	12.71	0.5
Soil fertility	1.63	1.80	2.45	0.356
Timber	1.93	1.77	2.31	0.782

the ecosystem services are not statistically significant between men and women. As can be seen in (Table 1) the t-statistic is less than the t critical two tail and the P-value is much greater than 0.05 (at 95% confidence interval) for all ecosystem services. This shows that there is no significant difference between the score values assigned to ecosystem services by men and women.

4. DISCUSSION

4.1 Gender and Identification Ecosystem Services of Trees in Croplands

Fifteen ecosystem species from fifty different tree species in croplands were identified by men and women. The number of ecosystem services identified by women was different from that of men. 9 of the 15 ecosystem services were identified by men whereas 14 of the 15 ecosystem services were identified by women. The fewer number of ecosystem services identified by women could be directly or indirectly related to the less accessible and/or benefit from the ecosystem services provided by trees in croplands than men [12,8]. This implies that men can have more exposure, access and benefit from the ecosystem services over women. This can also be related to gender differences in resource dependence especially those with a low income and dependent on tree resources which are also discussed in [13].

Some of the ecosystem services were exceptionally identified by men or women only and others were identified commonly. One ecosystem service (charcoal) was uniquely identified by women whereas 6 ecosystem services (boundary, climbing for yam tree, habitat to other important species, pollination of cacao plants, water accumulation for other crops and wind abatement) were exceptionally identified by men. This reveals that including both men and women in the identification and assessment of ecosystem services can reveal new and hidden ecosystem services as explained in [14]. Some and less visible ecosystem services that are solely identified by women can play an important role in assisting household livelihoods [8].

The other 8 ecosystem services (food, fuelwood, medicine, rainfall regulation, shade, soil conservation, soil fertility, timber) were commonly identified by both men and women. This could be related to that both men and women share and get access to the commonly identified ecosystem services and awareness creation might be conducted by experts to local beneficiaries on the ecosystem services especially on the rainfall regulation services [9]. Both men and women may also have interaction with trees in their croplands regularly in a similar way and the selected respondents all engage in farming with trees in their cropland. This could be different from other stakeholders in other areas [15].

4.2 Gender and Prioritization of Ecosystem Services of Trees in Croplands

The ecosystem services identified by both men and women only were prioritized based on the level of importance to the respondents by assigning score values to each ecosystem services. The gender difference of the respondents was a key determinant factor for prioritizing the ecosystem service benefits as very important, important and fairly important. Prioritization of ecosystem services can be done using monetary and other indicators [16]. However, it is challenging to valuing ecosystem services that have no material or monetary benefits as explained in [17]. As a result, using score or ranking methods can help to get the level of importance (value) for ecosystem services [2].

A paired two-tail t-test was conducted on whether the list of individual score values given to each local ecosystem services identified by both men and women was the same or not. The statistical result of the paired t-test showed that the score values of all the ecosystem services that are only identified by both men and women were not statistically significant. This can imply that the commonly identified ecosystem services have more or less similar importance to men and women and both can have more or less similar dependence, access, and benefit to and from ecosystem services of trees in croplands. However, some studies reveal that women have less access and greater dependence on ecosystem services than men [12]. In the developing world, women have key responsibility for the collection of fuelwood, water and in preparing and providing meals for the household. Nevertheless, women lack access to and control of the ecosystems and their respective ecosystem services. As a result, women are discriminated against in using or benefiting from ecosystem services [8,12,9].

The gender differences in prioritization of ecosystem services could arise due to many

intersecting factors such as socioeconomic status, age, culture, and access to information and educational backgrounds [9].

4.3 Implications of Gender-based Ecosystem Service Assessment

This study revealed that while both men and women have common knowledge and preferences, they have also differences in the identification and prioritization of ecosystem services of trees in croplands. This difference is relevant in policy-making, planning and managing tree and forest ecosystems for livelihood benefits and climate change adaptation.

Gender variances in preferences and perceptions of tree ecosystem services in croplands could be necessary for managing natural resources. It can help in building various experiences of gender and balanced institutions which can aid collective and effective tree and forest resource management. It could also help to incorporate women's decision making and preparing rules and norms on the use of ecosystems and to reduce the discriminated resource control and access by men.

5. CONCLUSION

In this study, gender-based identification and prioritization of the supply of provisioning and regulating ecosystem services for local beneficiaries by trees in croplands was carried out. Trees in croplands provide different ecosystem services for the beneficiaries. Most of the ecosystem services were identified by men than women. Some ecosystem services from trees in croplands were exceptionally identified either by men or women. However, their prioritization of the commonly identified ecosystem services does not have a significant difference.

The findings in this research demonstrate that ecosystem services identification might cause gender biases on women. This could be due to neglected control and access to the ecosystem services of trees in croplands which in turn could have an impact on tree resource management, conservation, and development interventions.

Therefore, integrating women in ecosystem service access and control can help build various experiences of gender and balanced institutions which can aid collective and effective tree and forest resource management and to maximize the benefits for all beneficiaries of the ecosystem services.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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