

Assessing social capital in community forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia

BISMA YOGA HERDANANTA¹, NAILA MAULIDA IBRIZA¹, WIAN AYU WARDHA'ADLINA¹, MUHAMMAD NUR SULTON¹, SUGIYARTO², SUGENG BUDIHARTA³, AHMAD DWI SETYAWAN^{1,4,*}

¹Department of Environmental Science, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57126, Central Java, Indonesia. Tel./fax.: +62-271-663375, *email: volatileoils@gmail.com

²Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Sebelas Maret. Jl. Ir. Sutami 36A Surakarta 57126, Central Java, Indonesia

³Purwodadi Botanic Gardens, Research Center for Ecology and Ethnobiology, National Research and Innovation Agency. Jl. Surabaya-Malang Km. 65, Pasuruan 67163, East Java, Indonesia

⁴Biodiversity Research Group, Universitas Sebelas Maret. Jl. Ir. Sutami 36A, Surakarta 57126, Central Java, Indonesia

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Abstract. Herdananta BY, Ibriza NM, Wardha'adlina WA, Sulton MN, Sugiyarto, Budiharta S, Setyawan AD. 2024. Assessing social capital in community forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia. *Asian J Ethnobiol* 7: 50-60. Community-based Forest Management (CFM) offers more effective protection of forest resources with a decentralized approach to ownership and management, as well as the establishment of autonomous local institutions that provide adequate incentives for the parties involved. The community manages natural resources through mutual use agreements, which lead to the concept of social capital as a solution to overcome collective problems. The study aims to evaluate the state of social capital in community forest management in Kalibawang Sub-district, Wonosobo, Central Java, Indonesia and identify the determinants that influence it as recommendations for improvement to policymakers. Data collection was conducted in March 2024 with research methods included interviews, surveys with questionnaires based on The Social Capital Assessment Tool (SCAT) and the Social Capital Integrated Questionnaire (SC-IQ) and Focus Group Discussion (FGD) discussions with local communities. The results showed that social capital in the studied area was significantly influenced by various variables, such as the role of forest farmer groups, access to information, community knowledge, non-formal education, and forestry extension activities. Consequently, the average level of social capital is obtained at 36.91 with a moderate category. Additionally, the analysis of concern community reveals a high classification, with an average score of 8.39. Increased social capital can be reflected in a higher density and diversity of social ties, as well as greater access to resources and stronger trust among group members. The recommendations of this study emphasize the importance of government in encouraging community participation in CFM management, reducing mistrust and conflict with government agencies, and strengthening social capital essential for sustainable forest management.

Keywords: Agroforestry, CFM, social capital, sustainability, the role of forest farmer groups

INTRODUCTION

Sustainable development is based on three main pillars, namely economic, social, and ecological aspects. These three aspects are interrelated and have an important role in promoting sustainable development, as conveyed at the World Summit in 2015. In the context of forest management, the economic, social, and ecological dimensions have an inseparable causal relationship to achieve sustainability (Sukwika and Fransisca 2021). Community-based Forest Management (CFM) is a promising idea which can lead to the protection and sustainable utilization of forests through decentralization of ownership and management (Ranjan 2018). CFM creates local institutions that are autonomous and have adequate respect for those involved. This approach is particularly emerging in developing countries that may not have adequate infrastructure and monitoring capabilities to protect forests.

Caballero (2015) state that studies on CFM institutions must be based on various aspects such as institutional changes, political frameworks, legal regulations, property

rights, governance mechanisms, user participation, and policy making. This includes forest management systems on local community land, as well as state forests in the form of collaborative management (Asmin et al. 2019). In many regions, forest communities have organized themselves to protect, sustainably manage and, in some cases, restore local forests by creating groups or associations (Dharmika et al. 2022). The focus of social forest management initiatives have evolved from merely resolving ecological constraints related to trees and forests to more broadly by incorporating socio-economic constraints, local institutional constraints, and most recently, government policy constraints (Ahammad et al. 2023). From the perspectives of socio-economic, institutional and governance, the management of forest resources by communities arises when there is a mutual use agreement among its members. This agreement can occur because of regular and continuous interaction between community members in the use of these resources. To understand the structure, relationship and interaction in community-based forest management, the concept of social

capital developed in social sciences can be used to support decision-making (Sabet and Khaksar 2024).

The concept of social capital began to develop from the understanding that a society needs collective actions and cooperations to overcome its problems (Engbers et al. 2017). This idea was introduced by Lyda Judson in the early 20th century, although the term of "social capital" only became known in academia in the late 1980s. Pierre Bourdieu explains that economic, cultural, and social capital is convertible (Pylypenko et al. 2023). Economic capital can take the form of money; cultural capital, such as education, can also be economic capital; and social capital can generate material benefits (Pret et al. 2016). Structural social capital includes various forms of social organization, such as networks, roles, rules, and procedures, while cognitive social capital refers to norms, values, attitudes, and beliefs that are jointly held (Claridge 2018). The existence of shared values and norms, shared rules and responsibilities, and relationships built on trust and mutual benefit all play an important role in strengthening cooperation and supporting collective action, both in social interaction and decision-making (Prayitno et al. 2024).

The development of social capital in community-based forest management in Kalibawang Sub-district, Wonosobo, Central Java, Indonesia hinges on the intricate interplay of shared values, norms, and trust among its inhabitants (Prayitno et al. 2024). According to data from the Disdukcapil Wonosobo (2023), the population of Kalibawang Sub-district in 2022 reached 29,082 people, with the majority of their livelihoods are sourced by farming on forest land. In this regard, forest sustainability and the need for livelihoods are critical to maintaining a balance between environmental conservation and local communities' economic needs. In Kalibawang Sub-district, the implementation of sustainable community-based forest management is imperative for maintaining forest sustainability and improving the welfare of the Kalibawang community (Wiyono et al. 2020). Forest management in Kalibawang is

based on community forestry principles, which might require a different approach compared to, for example industrial forestry or national park (Syapriallah and Sapriani 2014). In Kalibawang, forest management is focused on rural communities that are typically involved in subsistence agriculture, and the sustainable forest management practices are new to them. The establishment and management of community forests entails the formation of community forestry associations, which coordinate, monitor, and advise community forest committees on how to successfully implement their activities (Palmolina 2015). The purpose of this study is to assess social capital in community-based forest management in Kalibawang Sub-district, Wonosobo, and determine the factors affecting it. These determinants can be used as recommendations to improve forest management in the studied area wheret local policymakers can adopt.

MATERIALS AND METHODS

Study area

This research was conducted in four villages in Kalibawang Sub-district, Wonosobo District, Central Java Province, Indonesia (Figure 1). The four villages are Mergolangu ($7^{\circ}30'48.661''\text{S}$, $109^{\circ}53'11.789''\text{E}$), Depok ($7^{\circ}29'54.805''\text{S}$, $109^{\circ}54'21.341''\text{E}$), Dempel ($7^{\circ}30'36.655''\text{S}$, $109^{\circ}55'19.556''\text{E}$), and Karangsembung ($7^{\circ}30'11.876''\text{S}$, $109^{\circ}55'35.976''\text{E}$). The elevation in Kalibawang ranges from 549 to 984 meters above sea level, and the area is characterized by hilly terrain with many hills (Shiddieqy et al. 2023). The sub-district has an extent of 4.78 thousand hectares, accounting for 4.86% of the total area of Wonosobo District. The average land slope in Kalibawang Sub-district ranges from 10 to 40%. The average temperature is 22°C with average rainfall of 2.200 mm/years (BPS 2023).

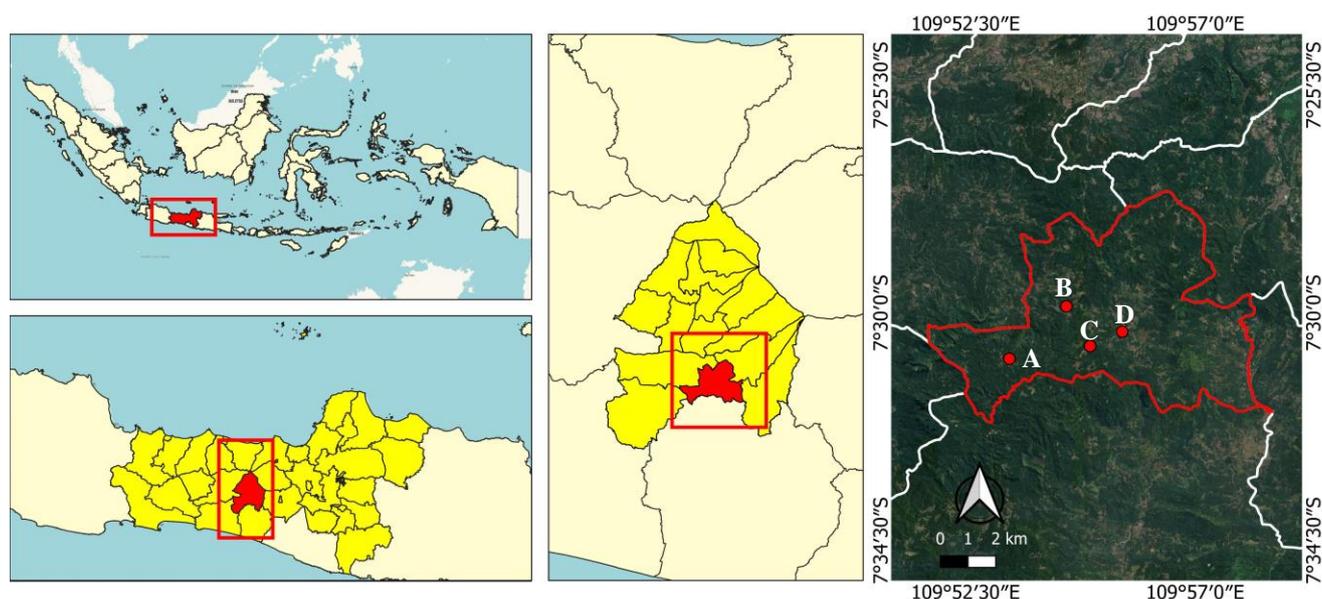


Figure 1. Study area of Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia. A. Mergolangu, B. Depok, C. Dempel, and D. Karangsembung

Data collection

Data collection was carried out in March 2024 through field observations/surveys and in-depth interviews, as well as literature review, especially for plant diversity, soil and climate conditions. Primary data were collected through interviews and surveys using structured questionnaires. The questionnaire was prepared based on Grootaert et al. (2004). The Social Capital Assessment Tool (SCAT) and the Social Capital Integrated Questionnaire (SC-IQ) were used to assess social capital, which is a concept that refers to the networks, norms, and trust that exist between individuals and within communities. Kalibawang Sub-district consisted of 9829 households and the questionnaire was targeted to the head of households who are the members of forest farmer group. The sample number is obtained using the Slovin formula and a simple random sampling technique with a 10% margin of error due to the population's homogeneous characteristics (Lawadi et al. 2023). The data was compiled by collecting samples from 100 community forest farmer households, which were obtained based on:

$$n = N / (1 + Ne^2)$$

Where:

- n = Sample size
- N = Population size
- e = Acceptable margin of error

In addition to respondent surveys and interviews, the data in this study was also obtained through Focus Group Discussions (FGDs) involving the community, which aimed to understand community's perspective about managing forests and gain direct insight into their challenges, needs, and aspirations related to forest management. FGD is an effective method for gathering

qualitative data in various research contexts, including health services, disaster management, and community development (Onwuegbuzie and Frels 2015). FGDs also provide opportunities for the participants to share knowledge and experience, which can increase the depth of analysis and understanding of the study. The FGD process was carried out using discussion guidelines that have been systematically prepared to ensure the completeness of the information obtained and direct the discussion on aspects relevant to the research objectives. Following that, the data obtained from the FGD was critically and holistically analyzed to gain a comprehensive understanding of community perspectives on forest management.

Analytical framework

The study was conducted using quantitative descriptive analysis with questionnaires to determine individual characteristics, knowledge about CFM, external factors, and elements of social capital (Duong et al. 2020). The scoring was then derived from the survey results and analyzed using the interval value formula as presented below:

$$\text{Interval value} = \frac{\text{Difference between the highest total score and the lowest total score}}{\text{Class number}}$$

Individual characteristics, knowledge of CFM, and external factors were evaluated based on three categories: low, moderate, and high, with each score being 1 for low, 2 for moderate, and 3 for high (Lee et al. 2017).

Social capital, as a variable (Y), included trust (Y1), social networks (Y2), social norms (Y3), proactive actions (Y4), and concern (Y5) (Figure 2).

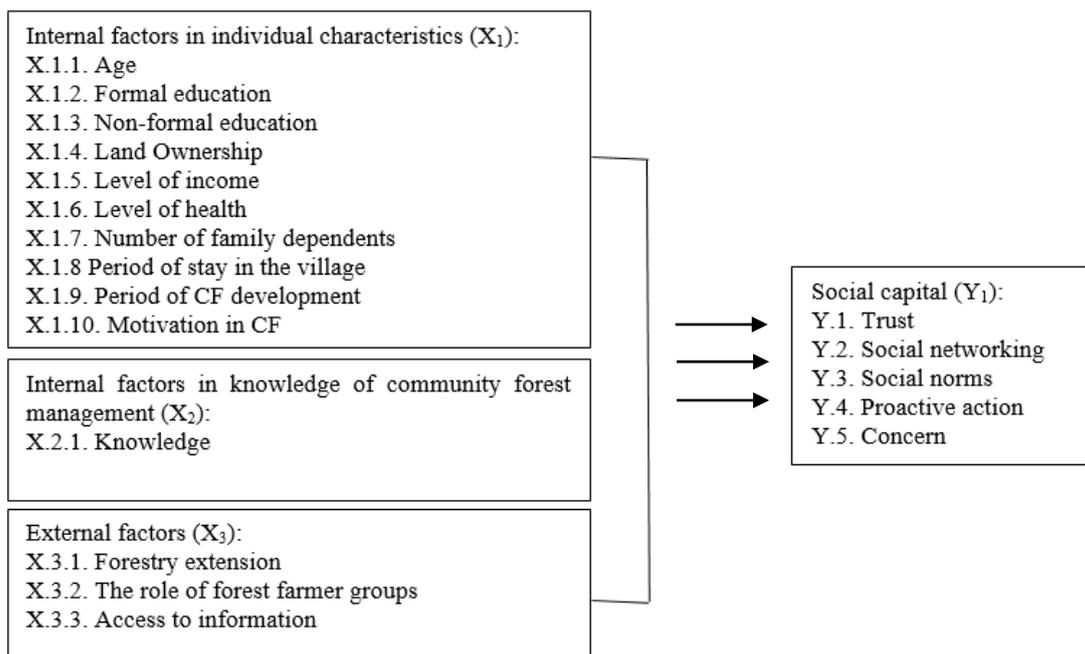


Figure 2. Analytical framework of the research with respective code of each factor

Trust levels were measured by the Forestry Service trust in community leaders, farmer groups, and extension services. Social networks were measured by the number of community groups followed, motivation to join the group, willingness to participate in the group, respondents' interaction with other members, and intensity of attendance at group meetings. Proactive action was measured by the experience and participation in resolving community conflicts, social norms were measured by the degree of difference in groups and the number of conflicts between community members, while concern was measured by the attitudes that show concern, solidarity, and empathy for community members and the surrounding environment. The influencing factors were made up of internal factors consisting of individual characteristics (X1) and knowledge of community forest management (X2) and external factors (X3). Internal factors in individual characteristics included age, formal education, non-formal education, land ownership, level of income, level of health, number of family dependents, period of stay, period of land ownership, period of community forest development, and motivation in community forest (Table 1).

Internal factors in knowledge of community forest management included understanding intercropping systems, their benefits, and CFM's technical capabilities. External factors included forestry extension activities, the role of respondents in community groups, and access to information. The variable of forestry extension activities was measured by the benefits felt by the respondents from the extension activities. The role of the farmer group included the knowledge and skills gained through the activities of the farmer group. Access to information refers to the level of respondents' access to information received about forestry.

Data analysis

We used SPSS Statistics 25 to analyze the data. We conducted multiple linear regressions to determine the influence of social capital on internal and external factors in CFM in Kalibawang Sub-district, Wonosobo District, Indonesia. Regression results can be used as a determining

factor to increase social capital in the study area.

RESULTS AND DISCUSSION

Status of community forest management

The forest area studied in Kalibawang Sub-district, Wonosobo District is a community-based forest management with the land is owned by Perhutani (Indonesian Forest State Enterprise). The legal status of this forest is designated as production forest, managed collaboratively between Perhutani and the local community, in accordance with the prevailing laws and regulations in Indonesia. Studies conducted in four villages show that the majority of communities implement an agroforestry system locally known as a "tumpangsari". This term refers to a planting pattern that utilizes various types of plants simultaneously in one field. This system has proven to be an adaptation strategy for the majority of people who work as farmers either as landowners, land tenants, or agricultural workers. The main commodity production in this system is focused on food and vegetable crops, following ecological principles that allow sustainable land optimization (Lalican 2018).

The majority of plants in Kalibawang Sub-district are woody and tree species, such as *sengon* (*Albizia chinensis*), *pinus* (*Pinus merkusii*), *durian* (*Durio zibethinus*), avocado (*Persea americana*), mahogany (*Swietenia mahagoni*), and teak (*Tectona grandis*). The selection of these plants is due to a variety of factors, such as good soil conditions, that allow woody plants to grow with necessary nutrients (Wang et al. 2021; Negari et al. 2023). In addition, water availability is an important factor for woody plants since lack of water can reduce plant growth and productivity (Barry et al. 2016). Another factor that can affect woody plant growth in Kalibawang Sub-district is high soil moisture (Emmyzar 2020). Intercropping plants in Kalibawang are various types of annual plants that can be planted and harvested within one year (Figure 3), such as food crops and feed crops (Darma and Angka 2020).



Figure 3. Intercropping system of forest management in Kalibawang Sub-district, Wonosobo District, Central Java, Indonesia

Common food crops grown in Kalibawang Sub-district are rice, cassava, and corn. Fruit plants are also widely cultivated, such as bananas, mangosteen (*Garcinia mangostana*), durian, avocados, and cocoa (*Theobroma cacao*). Some food plants, such as cassava, are intercropped with woody plants, such as pine. Pine can be a growing medium and fertilizer for cassava plants (Pranamulya et al. 2013). Although pine leaves have allelopathic potential, research also indicates that when processed properly, pine leaves can be used as compost. Through proper composting processes, allelopathic compounds can be broken down, thus the end product can enhance soil fertility and provide nutrients for plants (Anwar et al. 2019). In addition, cocoa is grown together with corn and various kinds of horticultural crops. We also noted that, in addition to growing food and medicinal crops, the community of Kalibawang implement silvopastoral to support goat livestock commodities by utilizing the lower area of woody plants as a place for grass development.

Demographic profiles

Intercropping systems have been shown to have a significant impact on local communities in terms of socio-economic status. The result indicates that more than half of the respondents chose intercropping farming because of higher profits (87%). However, the average annual income of some respondents (34%) is low (<700,000 IDR) because

the majority of Kalibawang people have a land area below 0.8 ha (82%) (Table 1). In the context of community forest management, intercropping systems are seen as a way to promote sustainable forest management and improve community welfare (Kailola et al. 2023). The success of this system, however, depends on a variety of factors, including the level of social capital in the community. According to interviews with respondents in Kalibawang Sub-district, the level of community trust in four villages in the study area was moderate.

For the respondent, the economic condition of the agriculture sector is crucial. Community forests represent a farming business of high economic value and provide farmers with opportunities for additional income. Based on the result of the survey, farmer's average annual income from the community forest business is around 700,000-12,700,000 IDR (60%), with average land ownership of 0.8 ha (82%), and average number of dependents of 0-3 (73%). The demographic profile of the Kalibawang community underscores the significance of agriculture in their livelihoods. Furthermore, based on the survey, it is evident that the majority of working individuals in Kalibawang are productive farmers with age between 19 and 45 years old comprised 56% of the surveyed population (Table 1). This demographic composition not only highlights the community's reliance on agriculture but also suggests a potential receptiveness towards agroforestry practice in Kalibawang.

Table 1. Individual characteristics of respondents in Kalibawang, Wonosobo District, Indonesia

No.	Variable (Code)	Category	Score	Frequency	%
1	Age (X.1.1)	a. Less productive : > 60 years old	1. Low	0	0
		b. Quite productive : 45 - 60 years old	2. Moderate	44	44
		c. Productive : < 45 or 19 - 45 years old	3. High	56	56
2	Formal education (X.1.2)	a. Elementary	1. Low	40	40
		b. Middle school	2. Moderate	28	28
		c. High school/university	3. High	32	32
3	Non-Formal education (X.1.3)	a. Never	1. Low	93	93
		b. Some : 1-2 times	2. Moderate	3	3
		c. Often : > 3 times	3. High	4	4
4	Land ownership (X.1.4)	a. Narrow : 0. 8 ha	1. Low	82	82
		b. Quite wide : 0. 8 - 2. 9 ha	2. Moderate	15	15
		c. Wide : > 2. 9 ha	3. High	3	3
5	Level of income (X.1.5)	a. < 700,000 IDR	1. Low	34	34
		b. 700,000 – 12,700,000 IDR	2. Moderate	60	60
		c. > 12,000,000 IDR	3. High	6	6
6	Level of health (X.1.6)	a. Bad : > 20 days	1. Low	1	1
		b. Health enough : 10 - 20 days	2. Moderate	1	1
		c. Healthy : < 10 days	3. High	98	98
7	Number of family dependents (X.1.7)	a. 0 - 3	1. Low	73	73
		b. 4 - 8	2. Moderate	0	0
		c. >9	3. High	27	27
8	Period of stay in the village (X.1.8)	a. Short : < 29 years	1. Low	10	10
		b. Quite long : 29 - 53 years	2. Moderate	64	64
		c. Long : > 53 years	3. High	26	26
9	Period of CF development (X.1.9)	a. Short : < 21 years	1. Low	39	39
		b. Quite long : 21 - 40 years	2. Moderate	28	28
		c. Long : > 40 years	3. High	33	33
10	Motivation in CF (X.1.10)	a. Encouragement from the outside	1. Low	6	6
		b. Own desire because of higher profits	2. Moderate	87	87
		c. Own desire because of concern for forest	3. High	7	7

Table 2. Evaluation of individual characteristics in Kalibawang, Wonosobo District, Indonesia

Individual characteristics	Score	Average	Category
Age	230	2.3 ≈ 2	2 Moderate
Formal education	170	1.7 ≈ 2	2 Moderate
Non-formal education	101	1.01 ≈ 1	1 Low
Land ownership	111	1.11 ≈ 1	1 Low
Level of income	157	1.57 ≈ 2	2 Moderate
Level of health	267	2.67 ≈ 3	3 High
Number of family dependents	140	1.4 ≈ 1	1 Low
Period of stay in the village	195	1.95 ≈ 2	2 Moderate
Period of CF development	170	1.7 ≈ 2	2 Moderate
Motivation in CF	182	1.82 ≈ 2	2 Moderate
Total	1723	17.23	Moderate

Note: “≈” means rounding to the nearest number

Table 3. Community knowledge in community forest management in Kalibawang, Wonosobo District, Indonesia

Knowledge (code)	Total score interval	Category level	Freq.	%
Knowledge (X.2.1)	8-13	Low	3	3
	14-19	Moderate	25	25
	20-24	High	72	72
Total			100	100

Table 4. Evaluation of community forest management knowledge in Kalibawang, Wonosobo District, Indonesia

Knowledge of community forest management	Score	Average	Category
Knowledge	1,879	18.79	Moderate

Table 2 is the result of the evaluation of individual characteristics, in which there are ten categories in individual assessment. Age has score of 230 with an average of 2, indicating a moderate category. Formal education reaches the score of 170 with an average of 2, which is also included in the moderate category. Non-formal education achieves 101 with an average of 1 in the low category. Land tenure has score of 111 with an average of 1, making it a low category. With an average of 2, the income level reaches 157, including in the moderate category. The health level receives the highest score (267 with an average of 3) and fell into the high category. The number of family dependants has score 140 with an average of 1, falling into the low category. Length of stay obtains a score of 195, with an average of 2 in the moderate category. The duration of CF implementation receives a score of 170 with an average of 2, also included in the moderate category. Motivation in CF gets a score of 182 with an average of 2, including the moderate category. The overall total is 1,723, with an average of 17.23 in the moderately dominant category. The income inequality index is a statistical measure that describes how much income differs between individuals or groups in a population. In their study, Negi et al. (2018) found that the income of the local community fluctuates in the range

between 0.31 and 0.54. The index's average is estimated at 0.39, with an uncertainty level of approximately 0.05 SD. This suggests that income is largely unevenly distributed among members of the community studied, with significant variation from the mean value. Based on research by Kailola et al. (2023), the income earned by respondents ranged from 739,591.83 IDR to 2,112,127.66 IDR per month. In terms of length of stay, respondents have settled in their villages over a period of 20 to 79 years, indicating that they have had a depth of experience in the environment. The results showed that the community has a strong understanding of the socio-cultural conditions and biophysical landscape in their area (Dako et al. 2019).

Table 3 explains the level of community knowledge on forest management, which is divided into three categories, namely low, moderate, and high. Based on the total number of respondents, 3% fall into the low category, with interval scores between 8 and 13, while 25% of respondents fall into the moderate category, with interval scores between 14 and 19, and 72% fall into the high category, with interval scores between 20 and 24. In their research, Lee et al. (2017) divided community knowledge into two categories, namely conceptual and procedural. The overall total shows that community knowledge is in the high category, with the acquisition of procedural knowledge scores in the moderate category and conceptual knowledge in the high category.

Table 4 shows the results of the evaluation measuring the community's level of knowledge about forest management, with a total score of 1,879 and an average score of 18.79, indicating that the community is at a moderate level of knowledge about forest management. This moderate level of knowledge in the community is influenced by several factors, namely the effectiveness of the extension program, access to information, and the level of community participation in environmental conservation activities. Interestingly, in a study conducted by Kailola et al. (2023), community knowledge was categorized as high. This success can be attributed to sustained efforts by tribal chiefs or traditional leaders in disseminating knowledge, as well as strict sanctions on those who violate existing forest management norms. Thus, the direct intervention of such local leaders plays an important role in improving community understanding and adherence to sustainable practices in forest management.

Table 5 explains the external factors that affect forest management which are classified into three categories, namely low, moderate, and high. The influencing external factors include forest expansion activities, the role of farmer groups, and access to information. Forest expansion activities in the low category (intervals of 2-3) consist of 39 respondents; while in the moderate category (intervals of 3-4) are 44 respondents; and in the high category (intervals of 5-6) are 17 respondents. Then, regarding the role of forest farmer groups, there are 2 respondents in the low category with an interval of 8-13; 30 respondents in the moderate category with an interval of 14-18; and 68 respondents are in the high category with an interval of 19-24. Regarding access to information, there are 30 respondents in the low category, with an interval of 2-3; 62 respondents are in the moderate category, with an interval of 3-4; and 8

respondents are in the high category, with an interval of 5-6. Lee et al. (2017) found that local communities were not actively involved in the development and participation in extension programs. In addition, they also recognized the importance of the role of forest farmer groups and the availability of access to information at a sufficient level.

Table 6 displays the results of the external factors evaluated based on three criteria. First, forestry extension activities obtain a score of 388 with an average of 3.88, which puts them in the medium category. The moderate score of forestry extension activities is influenced by several factors, such as the method and scope of extension, the quality of the material delivered, and the interaction between extension staff and the community. The role of forest farmer groups falls into the high category, with a score of 1,978 and an average of 19.78. Factors contributing to this high score include the group's ability to manage resources sustainably, the community's active participation in conservation projects, and solid partnerships with government and non-government organizations. Access to information results in score of 369 with an average of 3.69, also falling into the medium category. This is influenced by several factors, including government policies related to information transparency. Overall, the total score obtained is 2,735, with an average of 27.35, which is dominated by the moderate category. According to the research findings of Kailola et al. (2023), the social network element shows an overall score of 23.06, which falls into the high category. However, the study also highlighted some villages that scored low, ranging from 20.68 to 22.22. This is due to barriers to building institutional cooperation, which in turn hinders communication.

Table 7 is an evaluation of social capital in forest management, showing that the group element has a score of 1,112, with an average of 11.12 (low) and a range of high-lowest scores of 21-7. The trust element has a score of 589, with an average of 5.89 (moderate) and a high-low score range of 9-3. Proactive element has a score of 554, with an average of 5.54 (moderate) and a range of high-low scores of 9-3. The social norms element has a score of 597, with an average of 5.97 (moderate) and a range of high-low scores of 9-3. The concern element has a score of 839, with an average of 8.39 (high) and a high-low score range of 10-3. The overall total score is 3,691, with an average score of 36.91 (high) and a range of high-lowest scores of 58-19 for all elements evaluated. Kailola et al. (2023) found that the analysis of the level of trust in the community showed a moderate level with an average value of 32.57. The findings also reveal a high level of trust in various entities, such as family, neighbors, friends, groups, individuals from the same tribe, religious leaders, community leaders, and written rules. However, trust in the district government, provincial government, and written rules is low. Furthermore, the analysis of the community's concern reveals a high classification, with an average score of 8.39. This finding confirms that communities still attach importance to concern that prioritize values such as awareness, commitment, knowledge of unwritten rules, and compliance with regulations in the forestry context.

Table 5. External factors that affect forest management in Kalibawang, Wonosobo District, Indonesia

External factors (code)	Total score interval	Category level	Freq.	%
Forest extension activity (X.3.1)	2-3	Low	39	39
	3-4	Moderate	44	44
	5-6	High	17	17
Total			100	100
Role of forest farmer groups (X.3.2)	8-13	Low	2	2
	14-18	Moderate	30	30
	19-24	High	68	68
Total			100	100
Access to information (X.3.3)	2-3	Low	30	30
	3-4	Moderate	62	62
	5-6	High	8	8
Total			100	100

Table 6. Evaluation of external factors that affect forest management in Kalibawang, Wonosobo District, Indonesia

External factors	Score	Average	Category
Forest extension activity	388	3.88	Moderate
Role of forest farmer groups	1978	19.78	High
Access to information	369	3.69	Moderate
Total	2735	27.35	Moderate

Table 7. Evaluation of social capital in forest management in Kalibawang, Wonosobo District, Indonesia

Social capital elements (code)	Score	Average	Max.-min. score	Category
Group (Y.1)	1112	11.12	21-7	Low
Trust (Y.2)	589	5.89	9-3	Moderate
Proactive (Y.3)	554	5.54	9-3	Moderate
Social Norm (Y.4)	597	5.97	9-3	Moderate
Concern (Y.5)	839	8.39	10-3	High
Total	3691	36.91	58-19	Moderate

Key determinants of social capital

The results of our investigation show the impact of internal and external factors on the level of social capital in a community. This capital plays an important role in achieving the sustainable development goals of society, including sustainable CFM. Based on multiple linear regression analysis, we found that social capital in Model 1 is 66.1%, which was influenced by the variable role of forest farmer groups (Table 8). Other variables, such as formal education and the CFM development period, do not show significant value. Therefore, individuals who join farmer groups are likely to have a deeper understanding of CFM management than those who do not. In addition, Model 2 shows that 73% of social capital is significantly influenced by the role of farmers, forest groups, and access to information (Table 8).

Table 8. Estimation results for the impact of independent variables on social capital from three regression models

Variable	Model I	Model II	Model III	Model IV	Model V
Constant	8.292 (0.000)***	9.196 (0.000)***	4.9*** (0.000)	5.14*** (0.000)	4.954*** (0.000)
Age					0.585 (0.560)
Formal Education	0.406 (0.686)				
Non Formal Education				-2.872*** (0.005)	-2.871*** (0.005)
Land ownership			-1.443 (0.152)		
Level of income		1.145 (0.255)			
Level of health					-1.162 (0.248)
Number of family dependents					1.608 (0.111)
Period of stay				-1.13 (0.262)	
Period of CF development	1.174 (0.243)				
Motivation in CF development					-0.86 (0.392)
Community knowledge			2.636** (0.01)	3.192*** (0.002)	3.181*** (0.002)
Forestry extension activity					-2.406** (0.018)
The role of forest farmer group	13.927*** (0.000)	10.418*** (0.000)	10.439*** (0.000)	10.788*** (0.000)	10.786*** (0.000)
Access to information		5.085*** (0.000)	5.365*** (0.000)	6.135*** (0.000)	6.718*** (0.000)
Adj. R	0.661	0.73	0.745	0.763	0.774

Other variables, such as income level, do not show a significant value. This shows that the role of farmer groups in obtaining information is very large in the implementation of CFM, thus affecting several factors, such as their economies individually. The delivery of information about agriculture still uses oral media, so misunderstandings often occur in interpreting the information, and the sources of information cannot be reached by all members of farmer groups. This implies that information systems in the agricultural sector are very important for farmers (Sentono 2022).

In model III, social capital of 74.5% is obtained, with significant variables being the role of farmer forest groups, access to information, and people's knowledge of CFM (Table 8). This shows that farmer groups' involvement in training and associations resulted in the development of very broad knowledge in the community about CFM management. Furthermore, in Model IV, social capital is 76.3%, which was significantly influenced by variables such as the role of the farmer forest group, access to information, people's knowledge, and non-formal education. This proves that the existence of non-formal education for each individual can increase the significance of CFM management, which will be shared with other communities by utilizing farmer groups to increase their community knowledge. In Model V, variables that significantly affect social capital as much as 77.4% are the role of farmer forest groups, access to information, people's knowledge, non-formal education, and forestry extension activities. The change in the forest management paradigm in Indonesia has now provided more space for the community, in line with the government's goal of improving welfare while preserving forests through the Social Forestry Programme (Rachmawan et al. 2021). The role of the government in implementing community empowerment by conducting regular counseling is to increase public knowledge about CFM management and make it easier for them to obtain information.

Discussion

Our research investigates factors that have a significant impact on the formation of social capital, which is a valuable asset in natural resource management, particularly in the context of community forestry. Some of the key factors we identified include the vital role of forest farmer groups, access to information, community knowledge levels, non-formal education, and forestry extension activities. Social capital itself includes networks, trust norms, cooperation, and reciprocal exchanges among individuals and groups. Forest farmer groups not only serve as a place to exchange information but also as a center for learning, collaboration, production and processing facilities, and support service providers for their members. They can collaborate to improve soil conservation, introduce new technologies, and provide training on new practices, as shown by a study conducted by Ville et al. (2016). Research by Wuysang (2014) shows that social networks are considered very important by the majority of farmer groups in the formation of social capital. Access to information is also an important aspect, as it enables more informed decision-making and more effective participation in the group (Johnson 2007). Non-formal education can also be an effective alternative for improving individual skills, such as training, workshops, courses, and so on. Through such programs, communities can stimulate the growth of social capital by creating opportunities to interact and build relationships (Shahid et al. 2022). Such programs can help reinforce a sense of belonging and shared values, which in turn can strengthen social networks and increase trust among community members (Igaune et al. 2016). Developing social capital, therefore, necessitates attention to these factors as well as collaborative efforts from various community actors. Investments in farmer groups, access to information, non-formal education, and forestry extension activities can be effective strategies for strengthening social capital and promoting sustainable natural resource management. Synergies between these factors can bring significant benefits to community development and environmental conservation.

According to research conducted by Gorriz-Mifsud et al. (2017), social networks have a very significant role in facilitating collaboration. In today's digital era, social networks have become key to increasing the community's potential through empowerment activities that aim to increase knowledge and skills both individually and in groups. These knowledge and skills are considered to be very important in the context of community development. The study conducted by Auer et al. (2020) also emphasizes that knowledge and skills gained through social networks can strengthen social capital, which in turn supports further learning and development. This social capital is a valuable asset for advancing communities and expanding collaborative networks. Not only that, community knowledge about forestry also has a significant impact on environmental knowledge and pro-environmental behavior. Research by Wan and Du (2022) showed that social capital facilitates pro-environmental behavior. Research has shown that high levels of social participation and adherence to social norms increase the adoption of pro-environmental behaviors, both privately and publicly. Forestry extension activities are an effective way to provide communities with opportunities to socially interact, learn, and develop the skills and knowledge needed to strengthen social networks. Research by Savari and Khaleghi (2023) highlights that forestry extension activities have great potential to increase social capital by enriching environmental knowledge and encouraging pro-environmental behavior. In addition, in the context of environmental conservation, research by Dasanayaka and Matsuda (2022) emphasizes the importance of maintaining local wisdom related to forest management in the context of environmental conservation. This local wisdom is an important foundation in efforts to preserve natural resources and build harmonious relationships between humans and the environment. Overall, these studies demonstrate the important role of social networks in facilitating collaboration, enhancing knowledge and skills, and strengthening social capital for community development and environmental conservation. By effectively utilizing the potential of social networks, we can create a more knowledgeable, environmentally conscious, and empowered society.

We also compared the results of the influence of social capital on CFM management with other similar literature and found that the existence of farmer groups supported by local governments can provide more experience for each individual in CFM management. In addition, the ease of obtaining information about counseling and managing CFM greatly affects social capital. Community-based institutional mechanisms are needed to help farmers acquire information and business skills, market produce, and promote quality (Zerihun 2021). A study by Valenzuela et al. (2020) in the Philippines found that having more social capital means having more diverse and dense social ties, better access to resources, and stronger trust. This means that networks built by community group members through their work on government-led environmental projects allow for the creation of more networks, which in turn lead to more project participation and benefits, both directly and indirectly. This is also

supported by research conducted by Apipoonyanon et al. (2020) in Thailand, which states that future forest management approaches should emphasize the participatory needs of local communities, such as training programs, knowledge transfer, and information dissemination, thereby reducing mistrust and conflict between local community members and government agencies. In terms of government institutions, they also get support due to their ease of entering CFM to cooperate with the community in its management (Dako et al. 2019). Moreover, extension strategies, including field schools, exchange visits, and farmer training, are effective ways of disseminating needed information (Mukhlis et al. 2022). Research conducted by Ahmad et al. (2021) in Pakistan added that, apart from that, special focus must be given to strategies for developing community-based management, which includes trees and food plants in certain areas that can also be combined with livestock to produce products and services that will then be sold on the market at a higher selling price.

In conclusion, the results of the social capital analysis in Kalibawang Sub-district are classified as moderate. Significant determinants of the influence of social capital include forest farmer groups, access to information, and non-formal education, all of which play a role in improving community knowledge and skills, which in turn can strengthen community forest management capacity. This study's policy recommendations include expanding support for forest farmer groups, increasing information access, increasing non-formal education programs, and increasing community forest extension activities in Kalibawang Sub-district, Wonosobo.

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