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Assistance of Sustainable Forest Management through Strengthening of Human and Social Capital in Arjuna Mount East Java Community Matheus Nugroho1*, Yustinus Budi Hermanto2, Hind Hussein Obaid3, Majdy Kasheem4 1Universitas Yudharta Pasuruan, Indonesia, 2Universitas Katolik Darma Cendika, Indonesia, 3University of Baghdad, Iraq, 4University of Zawia, Libya *Coresponding author: mtnugroho@gmail.com Received: 19 October 2024 Revised: 19 November 2024 Accepted: 27 November 2024 Abstract This study is part of a community service project aimed at examining the role of human and social capital in the sustainable forest management of Mount Arjuna East Java. The objective of the community service initiative is to empower local communities around the forest to actively participate in forest conservation efforts. The study employs a descriptive method with a survey technique to gather factual data from the research area, which includes the spring areas around Mount Arjuna in East Java, Indonesia. The study population consists of communities from three villages: Leduk, Jatiarjo, and Dayurejo, located in Pasuruan, East Java. Data were collected from respondents through questionnaires and analyzed using Structural Equation Modeling (SEM) to understand the general responses regarding community participation in forest preservation. The results indicate that the human capital of the community, particularly education level and employment, contributes significantly to the success of sustainable forest development. Additionally, social characteristics such as mutual- cooperation and kinship within the community play a vital role in supporting long-term forest management. This community service initiative aims to strengthen both human and social capital to foster a sustainable forest management approach based on local wisdom and community-driven efforts. Keywords: human capital; social capital; forest management Soeropati with CC BY-SA license. Copyright © 2024, the author(s) Introduction Forests, as ecosystems, are basic functional units in ecology, comprising organisms and their biotic and abiotic environments, all of which interact and influence each other (Odum, 1993). These elements, whether living or non-living, form an interconnected system that cannot function in isolation. The relationships between these elements provide essential functions and benefits, supporting human needs across primary, secondary, and tertiary levels. Sustainable forest management, therefore, requires a holistic approach where these interdependencies are recognized and nurtured. A sustainable forest is one that maintains its ecological and economic functions. The ecological function ensures that the forest supports balanced interactions among all its components, while the economic function guarantees that the forest provides resources without crossing critical thresholds that would result in irreversible damage (Safei & Tsani, 2016). Healthy forests exhibit several characteristics, including: (1) adequate vegetation cover, (2) well-maintained hydrological cycles, (3) soil fertility preservation, (4) balanced interactions between biotic and abiotic components, and (5) successful ecological succession (Kolb et al., 1995). In tropical forests, vegetation cover helps prevent flooding by reducing surface runoff and increasing groundwater infiltration, enhancing water storage and reducing flood risks by 10-40% (Mondry, 2023) . The preservation of forests is intrinsically linked to the growth and development of surrounding communities. Issues such as reduced agricultural land, population growth around forests, and the transformation of protected forests into production forests or tourist destinations pose challenges to forest sustainability. Additionally, increased industrial expansion and the growing demands of local communities have intensified the extraction of forest resources, including water, flora, and fauna, often leading to unsustainable practices. The 2005 Forest Research Assessment (FRA) identified several factors contributing to forest damage, including fires, pests, diseases, and human-induced pressures (Geneva, 2006). Monitoring data from USAID and the Kaliandra Environmentalists Foundation (2008) revealed significant forest degradation in the Arjuna Mount region. The decline in water flow from springs, particularly in sub-watershed areas, is closely linked to the degradation of recharge areas, which have been severely impacted by land conversion, forest fires, and resource exploitation, resulting in soil erosion and increased sedimentation. The communities living around forests play a critical role in the success of forest conservation efforts. Human capital, defined as the knowledge, skills, and capabilities of individuals within the community, is essential for empowering local institutions. Every institution is created with the vision of improving human welfare, and human

capital is a strategic factor in fostering institutional and community development. Social capital, which includes social relations, trust, adherence to local norms, solidarity, and community engagement, further strengthens the collective response to forest conservation and management. Through community service initiatives, we aim to strengthen both human and social capital within the local communities of Mount Arjuna. By focusing on local empowerment, these initiatives seek to foster a deeper sense of responsibility toward sustainable forest management. The ability of the community to collaborate effectively, based on shared goals and mutual support, is essential for the long-term sustainability of the forest. Strengthening social capital through cooperation and trust enables communities to respond collectively to environmental challenges and enhance the resilience of their ecosystems. In the context of community service, this study examines the importance of human and social capital in the sustainable development of forests in the Mount Arjuna region of East Java. By focusing on local communities in the villages of Leduk, Jatiarjo, and Dayurejo, the goal is to empower them through participatory approaches that enhance their capacity to manage natural resources sustainably. This approach involves not just educating the community about sustainable practices, but also reinforcing social ties and cooperation, which are essential for the success of conservation efforts. Human capital development, such as increasing access to education and improving livelihood opportunities, contributes directly to the community's ability to manage forest resources effectively. Simultaneously, strengthening social capital, particularly through the cultivation of trust, mutual cooperation, and solidarity, creates a supportive environment for collective action. These initiatives help to build a resilient and knowledgeable community capable of sustaining forest conservation efforts over time. Based on the challenges and opportunities outlined above, it is crucial to explore the impact of human and social capital on sustainable forest management in the Mount Arjuna region. Through community service initiatives aimed at strengthening these forms of capital, local communities are empowered to take an active role in the preservation of their natural environment. The synergy between human capital development and social capital enhancement offers a comprehensive approach to ensuring the sustainability of forest ecosystems, benefiting both the environment and the livelihoods of the surrounding communities. Method This study employs a descriptive method with a survey approach, forming an integral part of the community service process. This approach was selected as it provides a clear depiction of community participation in sustainable forest management through the strengthening of human and social capital, which is central to the community service activities conducted around the spring areas of Mount Arjuna, Pasuruan, East Java, Indonesia. The aim of this study is to explore the causal relationship between two or more variables. In the context of this community service initiative, the research variables are divided into two types of relationships: 1. Independent (exogenous) variables. These include factors that support the success of sustainable forest management and community empowerment through the strengthening of human and social capital. 2. Dependent (endogenous) variables. These focus on the level of community participation in forest conservation and the preservation of natural resources around Mount Arjuna. The selection of these variables is based on empirical conditions observed in the field, including the current state of the forests around Mount Arjuna and the socio-economic characteristics of the surrounding communities. Additionally, theoretical frameworks that emphasize the importance of community empowerment in the context of sustainable forest management further inform the choice of research variables. To collect data, a survey technique was employed through the distribution of questionnaires to the local community residing in three villages around Mount Arjuna: Leduk, Jatiarjo, and Dayurejo. Respondents were selected from community members directly involved in forest management and conservation activities. The data obtained from the questionnaires were analyzed using Structural Equation Modeling (SEM) to explore the relationships between the research variables, specifically: 1. Human capital (such as education level and employment), 2. Social capital (such as mutual-cooperation and kinship relationships), and their influence on community participation in forest conservation. This analysis aims to provide a general overview of the community's responses to sustainable forest management activities conducted as part of the community service initiative. Results and Discussion Human capital 100% 19,5 17,2 13,3 14,8 20,5 80% 39,5 60% 38,1 38,1 39 34,7 40% 22,4 25,7 28,6 25,2 24,8 20% 13,8 11,9 8,6 11,9 13,3 0% 6,2 7,1 8,6 8,6 6,7 human economy social institutional infrastructure resources STS TS RR S SS Figure 1. Respondents' perceptions of community empowerment Note: STS : strongly disagree TS : disagree RR : Doubtful S : Agree SS : strongly agree The profile of human resource empowerment in the communities of Leduk, Jatiarjo and Dayurejo Villages was: (1) the minimum education level of junior secondary schools; (2) most of the main work of the farming community; (3) there were jobs as breeders and fisheries; (4) there were people who have a side business, besides being farmers and breeders. The response of 210 respondents to the profile of human resources, in Figure 1. shows that human capital was a determinant of the success of community empowerment for the preservation of the Arjuna mount forest, because 57.6% of respondents said they strongly agreed and agreed. Figure 1. describes respondents' perceptions of empowerment in Leduk, Jatiarjo and Dayurejo villages. Social Capital The social profile of empowering the people of Leduk, Jatiarjo and Dayurejo villages was: (1) mutual cooperation activities were still being carried out in Leduk or Jatiarjo and Dayurejo villages; (2) most of the residents actively and voluntarily participate in mutual cooperation activities in the community; (3) the culture of social activities such as helping each other at death ceremonies, sick people, marriages and being hit by calamities still exist in the community; (4) most residents know that there was a revegetation program for the Arjuna mount forest; (5) community leaders (indigenous leaders, community leaders, hamlet and village heads, heads of neighborhood) participate actively in forest rehabilitation. The perception of 210 respondents to the social profile of empowering the people of Leduk, Jatiarjo and Dayurejo villages, in Figure 1. shows that the social capital of Leduk, Jatiarjo and Dayurejo villages was a determinant of the success of community empowerment for revegetation of the Arjuna mount forest, because almost 52.3% of respondents agreed and strongly agree. Forest Preservation Plant species The profile of Arjuna mount forest plant species, namely: (1) the current vegetation condition of Arjuna mount forest plants, was better compared to 10 years ago; (2) the amount of vegetation of Arjuna's mount forest plants was currently increasing, and the source of the spring continues to flow; (3) the variety of plant species in the forests of Arjuna mount was currently increasing; (4) tree species planted in the forests of Arjuna mount were native plants of the forest; (5) what names of tree species planted in the forests of Arjuna mount include bamboo, kaliandra tree, rattan, banyan, sono tree, mahogany, rengas tree, kesambi tee, trengguli, tamarind trees. The perception of 210 respondents towards the profile of Arjuna mount forest plant species towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 18.2% of respondents expressed strongly agree, 40.9% of respondents stated agree, 23.3% of respondents expressed doubt, 10.9% of respondents stated disagree and 6.7% of respondents stated strongly disagree. Based on these data the revegetation plant species of Arjuna mount forest influence the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 59.1% of respondents stated strongly agree and agree. Figure 2. explain the responses of respondents about the revegetation plant species of Arjuna mount forest. Note: STS TS RR S SS 100% 90% 18,2 80% 70% 60% 40,9 50% 40% 30% 23,3 20% 10% 10,9 0% 6,7 15,3 16,7 40,9 41,4 17,6 17,6 40 39 25,7 12,4 5,7 21,9 14,3 5,7 21,9 15,7 4,8 24,3 12,9 6,2 plant species nursery fertilization planting plant care STS TS RR S SS Figure 2. Respondents perception of revegetation of Arjuna S : strongly disagree : disagree : doubtful : agree : strongly agree Nursery Profile of forest nursery plants in Arjuna mount, namely: (1) community members around the forest were involved and provide plant seeds for the preservation of Arjuna mount forest; (2) tree seedlings planted in the forests of Arjuna mount, originating from certified nurseries; (3) the height of the initial tree seedlings planted in the Arjuna mount forest was a minimum of 2 meters; (4) seed nursery function, before planting in Arjuna mount forest was quality and uniform seedlings and (5) the estimated price of seedlings for each tree with a height of 2 meters was around IDR 20,000 to IDR 25,000. The perception of 210 respondents to the profile of the Arjuna mount forest plant nursery towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 15.3% of respondents expressed strongly agree, 40.9% of respondents stated agree, 25.7% of respondents expressed doubt, 12.4% of respondents stated disagree and 5.7% of respondents stated strongly disagree. Based on these data, revealing that the nursery of Arjuna mount forest revegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 56.2% of respondents stated strongly agree and agree. Figure 2. explain the responses of respondents about the nursery of the Arjuna mount revegetation plant. Fertilization The profile of Arjuna mount forest plant fertilization includes: (1) plant fertilization was carried out by community farmers from the villages of Leduk, Jatiarjo and Dayurejo; (2) the purpose of fertilizing plants was to meet the adequacy of soil nutrients, and plant growth could be optimally optimized; (3) fertilizing the plants was done at the beginning of planting, and continuously every 3 months,

until the age of the plants was 3 years; (4) the type of fertilizer given to fertilizing plants was inorganic fertilizer (nitrogen, phosphorus and potassium) and organic (manure); (5) nitrogen, phosphorus and potassium fertilization method for each plant was fertilizing by circling around the plant. The perception of 210 respondents towards the profile of Arjuna mount forest plant fertilization towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 16.7% of respondents expressed strongly agree, 41.4% of respondents stated agree, 21.9% of respondents expressed doubt, 15.7% of respondents stated disagree and 4.8% of respondents stated strongly disagree. Based on these data, revealing the fertilization of Arjuna mount forest vegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 58.1% of respondents agreed and strongly agreed. Figure 2. explain the responses of respondents about the fertilization of Arjuna mount forest revegetation plants. Planting Profile of Arjuna mount forest tree planting includes: (1) managing the forest together with the government, applying strict regulations to the lawbreakers of forest destruction and actively involved in tree planting activities and caring for them were a number of forest management activities, so that they could continue to benefit humans and their environment; (2) The village government makes village regulations for forest management; (3) tree planting, width and distance between trees, greatly affect plant growth; (4) spacing and number of trees planted in forest revegetation was 3 meters x 3 meters (300 trees/ha); (5) a simple procedure for planting trees was to make holes and plant tree seeds in an upright position, as deep as 3 cm from the neck of the root, and cover the soil again. The perception of 210 respondents to the profile of Arjuna mount forest planting on the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 17.6% of respondents expressed strongly agree, 40% of respondents stated agree, 21.9% of respondents expressed doubt, 15.7% of respondents stated disagree and 4.8% of respondents stated strongly disagree. Based on these data stated the planting of Arjuna mount forest trees influence the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 57.6% of respondents agreed and strongly agreed. Figure 2. explain the responses of respondents about the planting of Arjuna mount forest trees. Plant Care The profile of Arjuna's mount forest care includes: (1) care was needed to maintain the plants so they were not damaged after planting; (2) maintenance activities include: cleaning plants from grass, weeding plants, making firebreaks during the dry season, reporting treatment results to forest village community institutions once every 1 month, and then evaluating them; (3) the duration of plant maintenance was carried out once a week, for 3 years after planting; (4) the plant maintenance process was also carried out monitoring activities, which include direct growth checking, which was done every 3 months; (5) caring for plants includes prevention of plant diseases, fertilizing and administering drugs, weeding from weeds, providing water during the dry season and protecting plants from natural and human damage. The perception of 210 respondents towards the care profile of Arjuna mount forest plants towards the preservation of the spring water source of Lajer, Dawuan, Sumberkuning and Watupereng, in Figure 3. shows that 17.6% of respondents stated strongly agree, 39% of respondents agreed, 24.3% respondents expressed doubt, 12.9% of respondents expressed disagreement and 6.2% of respondents stated strongly disagree. Based on these data, revealing the maintenance of Arjuna mount forest vegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 56.5% of respondents said they agree and strongly agree. Figure 2. explains the respondent's response to the maintenance of Arjuna mount forest revegetation plants. Discussion Human Capital The constraints of human resources related to the empowerment of communities in Leduk, Jatiarjo and Dayurejo Villages were the level of education of the community as farmers in general was junior high school and elementary school. The survey results showed that there were 7 formal education institutions, 10 elementary schools, 4 junior high schools, non formal, 2 pursuit packages C and 3 Islamic boarding schools. There are 361 active members in women's organizations, 178 youth organizations, and professional organizations such as 69 people. Based on these data, the community was conditioned to develop dryland agriculture as the basis of their livelihood, and some do livestock business. The lack of knowledge and skills of the community around the forest, so that people use the forest as their main source of income, this has resulted in them doing things that are actually a factor in forest destruction. The level of community education has a significant effect on community empowerment and forest revegetation. (Adekola & Mbalisi, 2015), explained that the education of rural communities regarding forest conservation has a significant influence on preventing damage to forest ecosystems. The successes that have been carried out in the development of human resources in Leduk, Jatiarjo and Dayurejo villages include: (1) the formation of a group discussion of communities around the source of water; (2) an environmental school was held once a week, every Sunday by the Cempaka Foundation; (3) livestock skills training activities and (4) tourism service business development, the Arjuna mount forest area has high tourism potential. Based on the results of surveys and socialization in group discussions, the 2 objectives to be implemented in human resource empowerment in Leduk, Jatiarjo and Dayurejo villages were: (1) increasing knowledge and changing attitudes of the community, towards the revegetation movement of the Arjuna mount forest and (2) the environmental school model, which implements education on forest conservation and biodiversity through a local competency-based curriculum by the Cempaka foundation. According to [9], knowledge can be influenced by formal education factors. Knowledge was very closely related to education, where it was expected that with higher education, then the person will be more knowledgeable. Social Capital Constraints on cultural and social conditions related to the empowerment of communities in Leduk, Jatiarjo and Dayurejo Villages are beginning to decline in values and norms as well as patterns of social interaction in regulating the daily lives of community members, because more and more industries were penetrating several neighboring villages some of the people who previously farmed live within the norms of mutual cooperation, especially women who switched professions as individualized factory workers, and there was not enough time to contract with the surrounding community. The emergence of mutual trust between the community and Indonesian state forest company, so that forest management activities run independently without coordination. Adaptation of community-based forest management was also not optimal because of the weak socialization and exclusive approach. Indonesian state forest company's position was weak because people who have no land use the conditions of the reform era that often use coercion. Community empowerment requires the development of social capital on an ongoing basis, namely improving social relations, trust, and norms. The social relations in question include participation, cooperation, mutual care, and reciprocity. Trust and norms in social capital were considered as very important components because they support existing social relations. In this case it can be interpreted if there was no trust, then the existing social relations relationship cannot be said as social capital (Anggita, 2013). The successes that have been carried out in the social empowerment of communities in Leduk, Jatiarjo and Dayurejo villages include: (1) implementing forest resource conservation in accordance with the social characteristics of the forest communities; (2) increasing the social capital of forest village communities in accordance with local wisdom. Examples of activities that are routinely carried out every year were ritual social activities of thanksgiving, salvation of the community and preservation of springs in the villages of Dayurejo, Jatiarjo and Leduk. According to, revealing that communities around the forest still maintain elements of social capital such as the types of customs, culture, beliefs and rituals that were consistently maintained until now. The village community living around the forest has customary regulations in utilizing forest resources, these values or norms are mutually agreed and implemented, with the aim of forest resources remaining sustainable and they can continue to survive. Based on the results of surveys and socialization in group discussions, the objectives to be implemented in community social empowerment in Leduk, Jatiarjo and Dayurejo Villages were: increasing the active role of community social capital such as social/work networks, level of trust between people, adherence to norms, concern for fellow human beings and families and involved in community social activities in forest village community institutions, then forest management will be more effective in supporting conservation based on ecology, economics and social. (Fukuyama, 2002), explains that social capital was a value of trust that exists in a society. Forest Preservation Plant species Constraints of plant species conditions for revegetation of Arjuna mount forest were endemic plant species and spring water vegetation. (Doležal & Šrůtek, 2002), explained that the main indicator of forest revegetation through the restoration of degraded ecosystems was plant species. Selection of tree species to be planted was determined by three factors, namely: (1) the importance of natural species for revegetation, (2) the availability of seedlings and propagation, and (3) the location of revegetation to be carried out (Basyuni, 2002). Some of the successes that have been carried out in relation to Arjuna mount forest revegetation plant species preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs were the first stage revegetation activities at the Lajer spring with an area of 10 hectares, the number of plants 3000 trees, with a breakdown of plant species: 1000 bamboo (Dendrocalamus asper), 600 candlenut (

Aleurites moluccana), 400 kluwek (Pangium edule), 300 kluweh (Artocarpus communis), 100 banyan (Ficus benyamina), 500 durian (Durio sp) and 100 elo (Ficus glomerata). The second stage of revegetation of Arjuna mount forest in the area around the Dawuan spring was 15 hectares, the number of plants was 1500 trees, with details of plant species including petung bamboo (Dendroca-lamus asper) 300 trees, candlenut (Aleurities mollucana) 500 trees, banyan (Ficus benyamina) 50 trees, bendo (Artocarpus elasticus) 450 and ivory 200 trees. The third stage of revegetation of Arjuna mount forest in the area around the Sumberkuning springs, the area of revegetation area of 25 hectares, the number of plants of 5000 trees, with the details of the types of plants including mountain spruce (Casuarina junghuniana) 2000 trees, 300 trees kesek 300 trees, petung bamboo (Dendrocalamus asper) 500 trees, tutup (Mallocus moluccana) 200 trees, mlandingan (Leucaena glauca) 500 trees, kaliandra (Calliandra calothyrsus) 1000 trees and gmelina (Gmelina arbora) 500 trees. Revegetation of the fourth stage of Arjuna mount forest in the area around the Watupereng springs, the area of revegetation area of 46 hectares, the number of plants 8000 trees, with details of the types of plants including bamboo petung (Dendrocalamus asper) 1300 trees, banyan (Ficus sp) 500 trees, kluweh (Artocarpus communis) 180 trees, candlenut (Aleurities mollucana) 450 trees, matoa (Pometia pinnata) 820 trees, cloves (Syzygium aromaticum) 850 trees, soursop (Annona muricata) 800 trees, avocado (Persea americana) 1000 trees, durian (Durio sp) 1200 trees and coffee (Coffea sp) 900 trees. Based on the results of surveys and socialization in group discussions, the targets to be carried out related to the revegetation plant species of Arjuna mount forest preservation in 3 springs are springs that were Curahtangkil Dayurejo village), Puthukbunder Jatiarjo village and Talangwatu Leduk village, with a total revegetation area of 90 hectares, the number of plants 18000 trees, with details of the types of plants include: 1) Endemic plant species, namely: bendo (Artocarpus elasticus) 1000 trees, kluwek (Pangium edule) 1000 trees, breadfruit (Artocarpus altilis) 1000 trees, candlenut (Aleurites mollucanus) 1000 trees, gondang (Ficus variegate) 1000 trees 2) Species of spring water plants, namely: petung bamboo (Dendrocalamus sp) 2000 trees, aren (Arenga pinnata) 1000 trees, banyan (Ficus benyamina) 2000 trees, epek (Ficus elastica) 1000 trees 3) Fruit plant species, namely: avocado (Persea americana) 1500 trees, oranges (Citrus sp) 1000 trees, coffee (Coffea sp) 1000 trees, soursop (Annona muricata) 1500 trees, durian (Durio sp) 1000 trees and guava (Psidium guajava) 1000 trees. Plant Nursery The obstacle of plant nursery conditions for revegetation of Arjuna mount forest was that the quality of seedlings was not the same, so plants die in the first month of planting, plant seeds were unable to adapt to the environmental conditions in which they grow. In the first phase revegetation at the Lajer spring with an area of 10 hectares, the number of plants was 3000 trees, for 3 years the number of dead trees was 801 trees. In the second phase revegetation in the area around the Dawuan spring area of 15 hectares, the number of plants was 1500 trees, the number of trees that died over 3 years was 325 trees. In the third stage revegetation in the area around the Sumberkuning spring, the area of the revegetation area was 25 hectares, the number of plants was 5,000 trees, the number of trees that have died for 3 years was 697. In the fourth stage revegetation of Arjuna mount forest in the area around the Watupereng spring, revegetation area of 46 hectares, the number of plants 8000 trees, the number of trees that die during 1 year was 42 trees. Provision of quality plant seedlings could be done through seedbed, nursery first in the nursery before planting in the field intended to get good seedlings in terms of quantity and quality and could be planted at the right time too. High-quality plant seeds could only be obtained from seed sources that were built from the best selected individuals. It was expected that with the use of quality seeds, crop productivity will increase. The seed source of forest plants was an influential factor in improving the appearance of forest stands (Danu & Bramasto, 2004). Some of the successes that have been carried out related to plant nurseries for revegetation of Arjuna mount forest were the availability of plant seeds for revegetation in the area around the Lajer, Dawuan, Sumberkuning and Watupereng springs with an area of 90 hectares, and the number of plants of 17500 trees. The height of the initial tree seedlings planted was at least 2 meters. The price of seeds per tree with a height of 2 meters was IDR 18,000. Plant seeds that die due to disease pests or damaged by porcupine pests, then immediately replaced with other plants that were able to live with the environmental conditions in which they grow. Good quality disease-resistant seeds were affected by a variety of factors including: tree age, tree size, crowns, genetic factors, climate, soil fertility, stand density, pests and diseases, fruit maturity and handling processes ranging from downloading in the field to storage and distribution (Nath, 2013). Based on the results of the survey and socialization in the group discussion, the targets to be carried out in relation to the nursery of Arjuna mount forest revegetation were (1) providing quality seedlings from 18,000 trees; (2) tree seedlings consist of endemic plants, springs and fruit plants; (3) height of tree seedlings planted at least 2 meters. Fertilizing The obstacle of fertilizing plants for revegetation of Arjuna mount forest was the type of fertilizer that was given to plants that was not in accordance with the changing soil nutrient content, this was due to the loss of nutrients from forest damage or erosion. Fertilization was done if there was a lack of nutrients or growth was slow (Budiawan & Suprayogi, 2012). Fertilizers given to plants were organic fertilizer and inorganic fertilizer. Provision of organic fertilizer can improve soil structure, increase soil absorption of water, improve living conditions of soil microbes and as a food source for plants. Application of inorganic fertilizers could stimulate overall plant growth and important assistance in the formation of green leaves (Dewanto et al., 2013). Some of the successes that had been carried out related to plant fertilization for revegetation of Arjuna mount forest are providing nitrogen, phosphor and potassium organic fertilizer and inorganic manure for 17500 trees 3 times in 1 year for 3 years of care by small holder farmers. According to (Nath, 2013), fertilization was a very important way to improve crop productivity and soil quality. The use of organic fertilizers and inorganic fertilizers was the right way, not only to produce crop productivity but can maintain intensive plant production stability. Based on the results of surveys and socialization in group discussions, the target to be carried out by plant fertilization in the advanced forest revegetation program was to provide nitrogen, phosphor and potassium organic fertilizer and inorganic manure for 18000 trees 3 times in 1 year for 3 years of care by the cultivating farmers. Planting The obstacle of planting trees for revegetation of Arjuna mount forest was the size and the distance between plants was a factor that must be considered for plant growth, because the success of forest revegetation technically according to, was the regulation of light (light control) and selection of plant species. The width and distance between revegetation plants of Arjuna mount forest towards the preservation of Lajer, Dawuan, Sumberkuning and Watupereng springs were 10 meters x 10 meters (200 trees/ha). According to the Minister of Forestry Regulation Number P. 70/Forester Minister- II/2008 about technical guidelines for forest and land rehabilitation, explained in chapter IV. point 2. In general the number and distance of planting that was often used for revegetation was divided into several groups, namely: (1) spacing of 5 meters x 5 meters (400 trees/ha); (2) spacing of 5 meters x 2.5 meters (800 trees/ ha); (3) spacing of 3 meters x 3 meters (1,110 trees/ha); (4) spacing of 3 meters x 2 meters (1,666 trees/ha); plant spacing of 3 meters x 1 meter (3,333 trees/ha). Some of the successes that had been carried out related to planting for revegetation of Arjuna's mount forests were the implementation of revegetation around the area of the Lajer, Dawuan, Sumberkuning and Watupereng springs, a total area of 93 hectares and a total of 19,500 trees. This revegetation program was carried out by PT. Sorini Agro Asia Corporindo in collaboration with the Kaliandra Foundation, Cempaka and the people of the villages of Leduk, Jatiarjo and Dayurejo. Table 3. Arjuna mount forest revegetation to the springs preservation period 2014-2018 No Springs location Number of trees Area (hectares) the percentage of trees living 1 Lajer – Arjuna mount 3000 10 94% 2 Dawuan – Arjuna mount 1500 5 92% 3 Sumber Kuning – Arjuna mount 5000 25 4 Watu Pereng – Arjuna mount 6000 34 5 Watu Pereng – Arjuna mount 4000 19 86% 99% 99% 19500 93 Source: PT. Sorini Agro Asia Corporindo (Corporindo, 2017) Revegetation of forests I in 2014 Lajer springs area The first year of forest revegetation program began planting on February 27, 2014, with the purpose of improving the vegetation of around area of Lajer springs, by planting and maintaining plants for 3 years to keep the volume of water flowing and increasing, and preventing landslides and floods. Guidelines for revegetation of the Lajer spring water source area were government regulations number 43 of 2008, that revegetation was carried out thoroughly in groundwater basins which include recharge areas and groundwater discharge areas, through (1) protection and preservation of groundwater; (2) preservation of ground water; and (3) quality management and control of groundwater pollution. The decrease in spring discharge was caused by a reduction in protected areas or water catchment areas due to illegal deforestation and land conversion that results in critical land occurrence and a decline in the quality of water catchment areas. The result of revegetation phase I was to increase the vegetation cover of 10 hectares of land in the area around Lajer springs, with a total of 3000 trees. 3000 species of plants include: 1000 bamboo (Dendrocalamus asper), 600 pecan (Aleurites moluccana), 400 kluwek (Pangium edule), 300 kluweh (Artocarpus communis), 100 banyan (Ficus benyamina), 500 durian (Durio zibethinus) and 100 elo (Ficus glomerata). Intensive plant maintenance was carried out for 3 years, with 5

nurse farmers from the community around the forest. Based on verification results in each year shows that in the first year period of 2014 the percentage of living trees was 98%, in the second year of 2015 the percentage of living trees was 96% and in the third year 2016 the percentage of trees the life was 94%. Some factors that influence the percentage of the number of trees that live relatively stable are nurse farmers who directly replace dead plants with other plants, even though the plant species are different, so the number of trees was relatively close to a percentage. While other technical factors that affect the percentage of living trees are relatively stable, among others: (1) treatment of grass cleansing on plants, (2) weeding plants, (3) giving water to plants in the dry season, (3) making bulkhead burn, during the dry season, (4) routine evaluation of plant maintenance from farmers to NGOs, forest village community institutions, companies and the government every month, (5) corporate social responsibility programs for economic empowerment for nurse farmers. The results of verification for 3 years showed that the highest number of plant deaths occurred in durian plants reaching 98.8% (the initial number of plants 500 trees, which lived were 6 trees), the cause of death of durian trees (Durio zibethius) was eating animal Porcupines especially new stems who sprouted, so that the corrective action was to replace the types of plants that are resistant to porcupine pests such as jackfruit, mahogany, sengon buto, srampang balong and segawe plants. The dry season factor during August-November 2014, with temperatures above normal temperature (temperature 37-39OC), has the potential to cause forest fires. Forest revegetation II year 2015 Dawuan springs source area Based on the results of verification on February 23, 2015 shows that the area of forest rehabilitation in the second period in the area around the Dawuan spring was 15 hectares, with the number of plants was 1500 trees, data on types of plants include petung bamboo Petung (Dendroca-lamus asper) 300 trees, candlenut (Aleurities mollucana) 500 trees, banyan (Ficus benyamina) 50 trees, bendo (Artocarpus elasticus) 450 trees and Ivory tree 200 trees. The number of nurse farmers who directly carry out and care for plants was 3 people, each of whom receives 6 goats breeding assistance. Plant maintenance was scheduled every 1 week with the main goal of caring for and maintaining plant growth. 3 months after the initial planting, in April 2015 the nurse farmers carried out fertilization and planting dead plants. Based on the results of verification at the planting location around the Dawuan spring, it showed that up to May 30, 2015 the number of dead plants was 103 plants, and the nurse farmers immediately replaced with 140 new plants for planting. The total number of plants from verification in December 2016 was 1537 trees. Some types of plant replacement for revegetation include: spathodea (Spathodea campanulata) 20 trees, mahogany (Sweetenia mahagoni) 8 trees, srikaya (Annona squamosa) and jackfruit (Artocarpus heterophyllus) 5 trees. Dewanto et al. (2013), states that plant growth was influenced by soil factors, climate, microorganisms, competition by other organisms, and is also influenced by available organic substances, humidity and sunlight. Based on the results of the implementation of this second rehabilitation program, researchers measured and verified that Petung bamboo plants were very strong and resistant to be planted in critical areas and with little water, and able to hold water when the rainy season occurs. Based on the results of observations and measurements show that the number of plant deaths in the second stage rehabilitation program in the Dawuan springs, verification during the first year of 2015 the number of living trees was 1442 trees (96%), in the second year 2016 the number of living trees was 1404 trees (94%), and in the third year verification in April 2017 the number of trees that lived to be 1380 trees or 92% of the initial number of trees planted as many as 1500 trees. Forest revegetation III year 2016 Sumberkuning springs area The third stage of the forest revegetation program was held on March 29, 2016 with a location in the Sumberkuning springs area. The revegetation area was 25 hectares with a total of 5000 trees, with plants including mountain cypress (Casuarina junghuniana) 2000 trees, kesek 300 trees, petung bamboo (Dendrocalamus asper) 500 trees, tutup tree (Mallocus moluccana) 200 trees, mlandingan (Leucaena glauca) 500 trees, calliandra (Calliandra calothyrsus) 1000 trees and gmelina (Gmelina arbora) 500 trees. Sumberkuning spring was included in the area of Jatiarjo Village, Prigen Subdistrict, Pasuruan Regency, with different conditions compared to phase 1 and 2 revegetation activities (Lajer and Dawuan springs). The Sumberkuning spring was located at an altitude of 2,427 meters above sea level, and the forest area was under the management of the East Java Province forestry service. Community forest park of Raden Soerjo. The area was included in the conservation forest status, where there was a community allowed to do forest conservation but cannot take anything inside the forest area. The selection of forest rehabilitation sites in the Sumberkuning area was to protect upstream springs, which have been damaged by forest fires in November 2015, so that these forests need to be treated and protected from forest fires. If the water discharge in the area of the spring was reduced, then it has an impact on a number of springs under it. Based on the results of verification on March 29, 2016, the third period of forest revegetation area in Sumberkuning springs area were 25 hectares, with a total of 5000 trees. The results of planting verification for 2 years showed that in the first year the number of living plants was 4485 trees (90%) and 515 trees died. In the second year of verification in April 2017, the number of living plants was 4303 trees (86%) and the number of plants that died from 2017 to April 2017 was 697. The number of nurse farmers who were directly involved in the management of Sumberkuning springs forest rehabilitation in the program community empowerment was 5 people. Forest revegetation IV year 2017 Watu Pereng springs area The fourth stage of the forest rehabilitation program was carried out in the springs area of Watupereng, the Gumandar Sub-watershed (watershed) in Jatiarjo Village, Prigen District, Pasuruan Regency on February 21, 2017, with the theme "caring for the forest". The area of the forest rehabilitation area was 46 hectares, with the number of trees as many as 8,000 trees, this rehabilitation area was included in the protected forest of the Indonesian state forest company of west Lawang in plot 35. The types of trees planted include petung (Dendrocalamus asper), banyan (Ficus sp), kluweh (Artocarpus communis), pecan (Ale mollucana), matoa (Pometia pinnata), clove (Syzygium aromaticum), soursop (Annona muricata), avocado (Persea americana), durian (Durio Zibethinus) and coffee (Coffea canephora Pierre). By implementing this revegation program, Sorini Cargill had been conserving 4 springs (Lajer, Dawuan, Sumberkuning and Watupereng), with a total area of 83 hectares, and 17,500 trees planted and involving 28 forest nurse farmers in the form of a program to empower communities around the forest Through this sustainable forest rehabilitation program, the company was committed to carrying out the obligation to improve the rainwater catchment area that was upstream for water needs for all communities in Pasuruan Regency. The results of tree planting verification show that up to April 2017 the number of living trees was 7958 trees (99%). Based on survey results and socialization in group discussions, the target to be carried out with planting for the forest revegetation program was to carry out a revegetation program for the second period of 2019-2020 in the area around of springs the Dayurejo Sumbertangkil, Jatiarjo Puthukbunder and Leduk Talangwatu. The extent of revegetation was 90 hectares, the number of plants was 18000 trees. This revegetation program was carried out by PT. Sorini Agro Asia Corporindo, in collaboration with the Cempaka foundation, Indonesia state forest company, the Pasuruan Regency Environmental Service and the villagers of Dayurejo, Jatiarjo and Leduk. Some tree species planted include: (1) endemic plant species, namely: bendo (Artocarpus elasticus) 1000 trees, kluwek (Pangium edule) 1000 trees, breadfruit (Artocarpus altilis) 1000 trees, candlenut (Aleurites mollucanus) 1000 trees, gondang (Ficus variegate) 1000 trees; (2) springs plant species, namely: petung bamboo (Dendrocalamus sp) 2000 trees, sugar palm (Arenga pinnata) 1000 trees, banyan (Ficus benyamina) 2000 trees, epek (Ficus elastica) 1000 trees; (3) fruit plant species, namely: avocado (Persea americana) 1500 trees, orange (Citrus sp) 1000 trees, coffee (Coffea sp) 1000 trees, soursop (Annona muricata) 1500 trees, durian (Durio sp) 1000 trees and guava (Psidium guajava) 1000 trees. The purpose of this revegetation program was to improve the condition of forest cover in the area around 3 springs, covering 90 hectares on the slopes of Arjuna and Welirang mount through the concept of enrichment of productive plants that can be utilized by the community to improve the welfare of forest farmers. The location of the planting was in the area around the Dayurejo Sumbertangkil springs, Jatiarjo Puthukbunder and Leduk Talangwatu, all three villages are included in the Kedunglarangan Sub-watershed, which was part of the catchment area as an underground water source of PT. Sorini Agro Asia Corporindo. Plant care The obstacle of tree care for revegetation of Arjuna's mount forest was the growth of weeds or weeds around the plants, replacing and replacing dead plants, due to pests and plant diseases and damaged by animals. According to [18], care plays an important role in achieving successful planting. Maintenance activities include weeding from weeds, pests or the like that were wrapped around the plant, and from pioneers that rival the plants, and replanting if any plants die. In the treatment of plants, monitoring activities could also be carried out which includes verification of growth (plant survival), growth performance (growth performance), increment (growth increments) including height, diameter, volume and attack of pests and diseases. Some of the successes of plant maintenance that had been carried out for revegetation of Arjuna mount forest were funding of plant care for 5 nurse farmers for 3 years on 10 hectares of land

vegetation in the area around the Lajer spring, the number of plants 3000 trees, with plant species including 1000 bamboo (Dendrocalamus asper), 600 candlenut (Aleurites moluccana), 400 kluwek (Pangium edule), 300 kluweh (Artocarpus communis), 100 banyan (Ficus benyamina), 500 durian (Durio sp) and 100 elo (Ficus glomerata). Plant care financing for 3 nurse farmers for 3 years in a 5 hectare vegetation area around the Dawuan springs, the number of plants was 1500 trees, plant species data including petung bamboo (Dendroca-lamus asper) 300 trees, candlenut (Aleurities mollucana) 500 trees, banyan (Ficus benyamina) 50 trees, bendo (Artocarpus elasticus) 450 and ivory 200 trees. Funding for plant maintenance in the Sumberkuning springs area. Revegetation area was 25 hectares with a total of 5000 trees, with types of plants including mountain spruce (Casuarina junghuniana) 2000 trees, 300 trees squared, petung bamboo (Dendrocalamus asper) 500 trees, cover (Mallocus moluccana) 200 trees, mlandingan (Leucaena glauca) 500 trees, kaliandra (Calliandra calothyrsus) 1000 trees and gmelina (Gmelina arbora) 500 trees. Plant care funding for 28 nurse farmers for 3 years in a 46 hectare vegetation area around the Watupereng springs, a total of 8000 trees, with types of plants including bamboo petung (Dendrocalamus asper) 1300 trees, banyan (Ficus sp) 500 trees, kluweh (Artocarpus communis) 180 trees, candlenut (Aleurities mollucana) 450 trees, matoa (Pometia pinnata) 820 trees, tutup plant (Syzygium aromaticum) 850 trees, soursop (Annona muricata) 800 trees, avocado (Persea americana) 1000 trees, durian (Durio sp) 1200 trees and coffee (Coffea sp) 900 trees. Based on survey results and socialization in group discussion, the target to be carried out with plant care in the revegetation of Arjuna mount forest in the second period of 2019- 2020 was plant care financing for 32 nurse farmers for 3 years on vegetation in an area of 90 hectares in the area around the source of the Dayurejo Curahtangkil springs, Jatiarjo Puthukbunder springs and Ledug Talangwatu springs, the number of plants was 18000 trees. Cempaka foundation and nurse farmers are responsible for maintaining crop growth rates up to 3 years by 90% of the trees planted are still alive and growing. Based on the results of structural equation modeling analysis, explaining the human and social capital resources of the community contributes to the preservation of forests and springs, a critical ratio value of 5.005. The probability value of the analysis results was more than 0.05 and the critical ratio was more than 1.96, then the structural equation modeling analysis recommendation states that human and social capital resources of the community provide benefits to the preservation of forest development. [27], explains that there was a positive and significant influence of empowerment factors such as profiles, institutions, economics and policy on forest rehabilitation productivity. [14], explains that sustainable community development based on an environmentally friendly alternative income generation approach was very important in supporting global forest sustainability. While [11], states that community empowerment has a positive influence on forest conservation and prevents illegal logging which includes 3 aspects, namely: (1) increasing income and economic growth of environmentally friendly rural communities; (2) provision of facilities and infrastructure; (3) creation and positive behavior in environmental conservation. The results of the structural equation modeling (SEM) analysis indicate that both human and social capital within the community significantly contribute to the preservation of water springs, with a critical ratio value of 4.344. The probability value obtained from the analysis exceeds 0.05, and the critical ratio is greater than 1.96. These findings suggest that human and social capital have a positive impact on the conservation of water springs. According to, the management of water springs based on community empowerment has been effectively implemented due to the importance of environmental sustainability and the availability of water for the local population (Buwono et al., 2017). Key strategies for community empowerment in water resource management include: (1) continuously enhancing human resource management capabilities, such as professionalism, accountability, innovation in management, and the adoption of new technologies; (2) ensuring the availability of infrastructure for water springs; and (3) fostering active participation and involvement from the community in the development of water management technologies. (Anwar & Pranata, 2014). The results of structural equation modeling analysis, explaining the human capital and social resources of the community contributed to the preservation of spring water sources, the value of the critical ratio of 4.344. The probability value of the analysis results was more than 0.05 and the critical ratio was more than 1.96, then the structural equation modeling analysis recommendation states that human and social capital resources of the community provide benefits to the preservation of the spring (Buwono et al., 2017), explains that spring management based on community empowerment has been evidently carried out because of the importance of the environment and the availability of water for the community. Community empowerment strategies for water resources management include (1) human resource management capabilities continue to be improved such as professionalism, accountability, management innovation and technology; (2) availability of facilities for spring water sources and (3) encouraging community participation and role for the development of water management technology (Anwar & Pranata, 2014) Conclusion Human capital of the community around Mount Arjuna, including the level of education and employment, plays a significant role in the success of sustainable forest management and conservation efforts. In this context, the minimum education level of the community is at the junior high school level, with most community members engaged in farming as their primary occupation. Additionally, there are livelihoods in livestock and fisheries, along with some individuals running side businesses outside of farming and animal husbandry. These activities, while diverse, all contribute to the preservation of the forests and springs surrounding Mount Arjuna. The existence of these forms of human capital supports the community's ability to engage in forest management practices and underscores the importance of local knowledge and economic participation in the long-term sustainability of the ecosystem. Similarly, social capital plays a crucial role in strengthening community-based forest management practices. Most respondents indicated that social capital in the form of mutual- cooperation remains a central practice in the villages of Leduk, Jatiarjo, and Dayurejo. The community is actively involved in communal activities, with a high level of voluntary participation in social events and local traditions. The culture of helping one another during critical life events such as funerals, illness, weddings, and natural disasters is still vibrant in these villages. This strong social network not only enhances local solidarity but also facilitates collective action for forest conservation. Moreover, most residents express awareness and support for the Arjuna Mount forest revegetation program. Community leaders, including traditional leaders, village heads, neighborhood heads, and other local figures, actively participate in forest rehabilitation activities. Their involvement in these initiatives demonstrates the integration of social capital into forest preservation efforts, further solidifying the community's commitment to protecting their natural resources, particularly the forests and springs around Mount Arjuna. Through these forms of human and social capital, the community is better equipped to engage in sustainable forest management practices, contributing significantly to the ongoing conservation efforts in the region. References Adekola, G., & Mbalisi, O. F. (2015). 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Assistance of Sustainable Forest Management through Strengthening of Human and Social Capital in Arjuna Mount East Java Community

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Assistance of Sustainable Forest Management through Strengthening of Human and Social Capital in Arjuna Mount East Java Community

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Abstract
This study is part of a community service project aimed at examining the role of human and social capital in the sustainable forest management of Mount Arjuna East Java. The objective of the community service initiative is to empower local communities around the forest to actively participate in forest conservation efforts. The study employs a descriptive method with a survey technique to gather factual data from the research area, which includes the spring areas around Mount Arjuna in East Java, Indonesia. The study population consists of communities from three villages: Leduk, Jatiarjo, and Dayurejo, located in Pasuruan, East Java. Data were collected from respondents through questionnaires and analyzed using Structural Equation Modeling (SEM) to understand the general responses regarding community participation in forest preservation. The results indicate that the human capital of the community, particularly education level and employment, contributes significantly to the success of sustainable forest development. Additionally, social characteristics such as mutual-cooperation and kinship within the community play a vital role in supporting long-term forest management. This community service initiative aims to strengthen both human and social capital to foster a sustainable forest management approach based on local wisdom and community-driven efforts.

Keywords: human capital; social capital; forest management

Introduction

Forests, as ecosystems, are basic functional units in ecology, comprising organisms and their biotic and abiotic environments, all of which interact and influence each other (Odum, 1993). These elements, whether living or non-living, form an interconnected system that cannot function in isolation. The relationships between these elements provide essential functions and benefits, supporting human needs across primary, secondary, and tertiary levels. Sustainable forest management, therefore, requires a holistic approach where these interdependencies are recognized and nurtured.

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A sustainable forest is one that maintains its ecological and economic functions. The ecological function ensures that the forest supports balanced interactions among all its components, while the economic function guarantees that the forest provides resources without crossing critical thresholds that would result in irreversible damage (Safei & Tsani, 2016). Healthy forests exhibit several characteristics, including: (1) adequate vegetation cover, (2) well-maintained hydrological cycles, (3) soil fertility preservation, (4) balanced interactions between biotic and abiotic components, and (5) successful ecological succession (Kolb et al., 1995). In tropical forests, vegetation cover helps prevent flooding by reducing surface runoff and increasing groundwater infiltration, enhancing water storage and reducing flood risks by 10-40% (Mondry, 2023) .

The preservation of forests is intrinsically linked to the growth and development of surrounding communities. Issues such as reduced agricultural land, population growth around forests, and the transformation of protected forests into production forests or tourist destinations pose challenges to forest sustainability. Additionally, increased industrial expansion and the growing demands of local communities have intensified the extraction of forest resources, including water, flora, and fauna, often leading to unsustainable practices.

The 2005 Forest Research Assessment (FRA) identified several factors contributing to forest damage, including fires, pests, diseases, and human-induced pressures (Geneva, 2006). Monitoring data from USAID and the Kaliandra Environmentalists Foundation (2008) revealed significant forest degradation in the Arjuna Mount region. The decline in water flow from springs, particularly in sub-watershed areas, is closely linked to the degradation of recharge areas, which have been severely impacted by land conversion, forest fires, and resource exploitation, resulting in soil erosion and increased sedimentation.

The communities living around forests play a critical role in the success of forest conservation efforts. Human capital, defined as the knowledge, skills, and capabilities of individuals within the community, is essential for empowering local institutions. Every institution is created with the vision of improving human welfare, and human capital is a strategic factor in fostering institutional and community development. Social capital, which includes social relations, trust, adherence to local norms, solidarity, and community engagement, further strengthens the collective response to forest conservation and management.

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Through community service initiatives, we aim to strengthen both human and social capital within the local communities of Mount Arjuna. By focusing on local empowerment, these initiatives seek to foster a deeper sense of responsibility toward sustainable forest management. The ability of the community to collaborate effectively, based on shared goals and mutual support, is essential for the long-term sustainability of the forest. Strengthening social capital through cooperation and trust enables communities to respond collectively to environmental challenges and enhance the resilience of their ecosystems.

In the context of community service, this study examines the importance of human and social capital in the sustainable development of forests in the Mount Arjuna region of East Java. By focusing on local communities in the villages of Leduk, Jatiarjo, and Dayurejo, the goal is to empower them through participatory approaches that enhance their capacity to manage natural resources sustainably. This approach involves not just educating the community about sustainable practices, but also reinforcing social ties and cooperation, which are essential for the success of conservation efforts.

Human capital development, such as increasing access to education and improving livelihood opportunities, contributes directly to the community's ability to manage forest resources effectively. Simultaneously, strengthening social capital, particularly through the cultivation of trust, mutual cooperation, and solidarity, creates a supportive environment for collective action. These initiatives help to build a resilient and knowledgeable community capable of sustaining forest conservation efforts over time.

Based on the challenges and opportunities outlined above, it is crucial to explore the impact of human and social capital on sustainable forest management in the Mount Arjuna region. Through community service initiatives aimed at strengthening these forms of capital, local communities are empowered to take an active role in the preservation of their natural environment. The synergy between human capital development and social capital enhancement offers a comprehensive approach to ensuring the sustainability of forest ecosystems, benefiting both the environment and the livelihoods of the surrounding communities.

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Method

This study employs a descriptive method with a survey approach, forming an integral part of the community service process. This approach was selected as it provides a clear depiction of community participation in sustainable forest management through the strengthening of human and social capital, which is central to the community service activities conducted around the spring areas of Mount Arjuna, Pasuruan, East Java, Indonesia.

The aim of this study is to explore the causal relationship between two or more variables. In the context of this community service initiative, the research variables are divided into two types of relationships:

1. Independent (exogenous) variables. These include factors that support the success of sustainable forest management and community empowerment through the strengthening of human and social capital.
2. Dependent (endogenous) variables. These focus on the level of community participation in forest conservation and the preservation of natural resources around Mount Arjuna.

The selection of these variables is based on empirical conditions observed in the field, including the current state of the forests around Mount Arjuna and the socio-economic characteristics of the surrounding communities. Additionally, theoretical frameworks that emphasize the importance of community empowerment in the context of sustainable forest management further inform the choice of research variables.

To collect data, a survey technique was employed through the distribution of questionnaires to the local community residing in three villages around Mount Arjuna: Leduk, Jatiarjo, and Dayurejo. Respondents were selected from community members directly involved in forest management and conservation activities.

The data obtained from the questionnaires were analyzed using Structural Equation Modeling (SEM) to explore the relationships between the research variables, specifically:

1. Human capital (such as education level and employment),
2. Social capital (such as mutual-cooperation and kinship relationships), and their influence on community participation in forest conservation.

This analysis aims to provide a general overview of the community's responses to sustainable forest management activities conducted as part of the community service initiative.

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Results and Discussion

Human capital

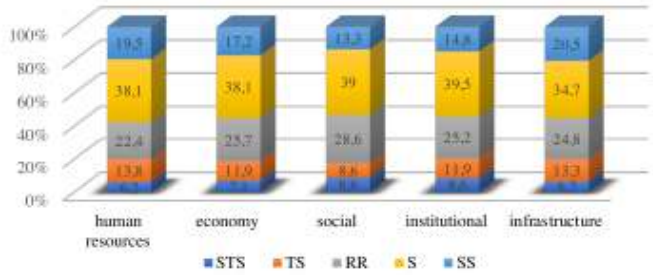

Figure 1. Respondents' perceptions of community empowerment

Note:

STS	:	strongly disagree
TS	:	disagree
RR	:	Doubtful
S	:	Agree
SS	:	strongly agree

The profile of human resource empowerment in the communities of Leduk, Jatiarjo and Dayurejo Villages was: (1) the minimum education level of junior secondary schools; (2) most of the main work of the farming community; (3) there were jobs as breeders and fisheries; (4) there were people who have a side business, besides being farmers and breeders. The response of 210 respondents to the profile of human resources, in Figure 1. shows that human capital was a determinant of the success of community empowerment for the preservation of the Arjuna mount forest, because 57.6% of respondents said they strongly agreed and agreed. Figure 1. describes respondents' perceptions of empowerment in Leduk, Jatiarjo and Dayurejo villages.

Social Capital

The social profile of empowering the people of Leduk, Jatiarjo and Dayurejo villages was: (1) mutual cooperation activities were still being carried out in Leduk or Jatiarjo and Dayurejo villages; (2) most of the residents actively and voluntarily participate in mutual

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cooperation activities in the community; (3) the culture of social activities such as helping each other at death ceremonies, sick people, marriages and being hit by calamities still exist in the community; (4) most residents know that there was a revegetation program for the Arjuna mount forest; (5) community leaders (indigenous leaders, community leaders, hamlet and village heads, heads of neighborhood) participate actively in forest rehabilitation. The perception of 210 respondents to the social profile of empowering the people of Leduk, Jatiarjo and Dayurejo villages, in Figure 1. shows that the social capital of Leduk, Jatiarjo and Dayurejo villages was a determinant of the success of community empowerment for revegetation of the Arjuna mount forest, because almost 52.3% of respondents agreed and strongly agree.

Forest Preservation

Plant species

The profile of Arjuna mount forest plant species, namely: (1) the current vegetation condition of Arjuna mount forest plants, was better compared to 10 years ago; (2) the amount of vegetation of Arjuna's mount forest plants was currently increasing, and the source of the spring continues to flow; (3) the variety of plant species in the forests of Arjuna mount was currently increasing; (4) tree species planted in the forests of Arjuna mount were native plants of the forest; (5) what names of tree species planted in the forests of Arjuna mount include bamboo, kaliandra tree, rattan, banyan, sono tree, mahogany, rengas tree, kesambi tee, trengguli, tamarind trees. The perception of 210 respondents towards the profile of Arjuna mount forest plant species towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 18.2% of respondents expressed strongly agree, 40.9% of respondents stated agree, 23.3% of respondents expressed doubt, 10.9% of respondents stated disagree and 6.7% of respondents stated strongly disagree. Based on these data the revegetation plant species of Arjuna mount forest influence the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 59.1% of respondents stated strongly agree and agree. Figure 2. explain the responses of respondents about the revegetation plant species of Arjuna mount forest.

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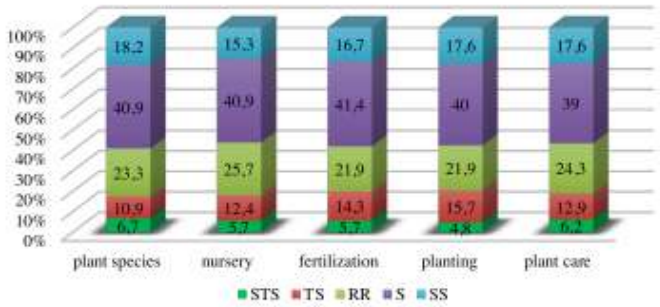

Figure 2. Respondent's perception of revegetation of Arjuna's

Note:

STS	:	strongly disagree
TS	:	disagree
RR	:	doubtful
S	:	agree
SS	:	strongly agree

Nursery

Profile of forest nursery plants in Arjuna mount, namely: (1) community members around the forest were involved and provide plant seeds for the preservation of Arjuna mount forest; (2) tree seedlings planted in the forests of Arjuna mount, originating from certified nurseries; (3) the height of the initial tree seedlings planted in the Arjuna mount forest was a minimum of 2 meters; (4) seed nursery function, before planting in Arjuna mount forest was quality and uniform seedlings and (5) the estimated price of seedlings for each tree with a height of 2 meters was around IDR 20,000 to IDR 25,000. The perception of 210 respondents to the profile of the Arjuna mount forest plant nursery towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 15.3% of respondents expressed strongly agree, 40.9% of respondents stated agree, 25.7% of respondents expressed doubt, 12.4% of respondents stated disagree and 5.7% of respondents stated strongly disagree. Based on these data, revealing that the nursery of Arjuna mount forest revegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 56.2% of respondents stated strongly agree and agree.

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Figure 2. explain the responses of respondents about the nursery of the Arjuna mount revegetation plant.

Fertilization

The profile of Arjuna mount forest plant fertilization includes: (1) plant fertilization was carried out by community farmers from the villages of Leduk, Jatiarjo and Dayurejo; (2) the purpose of fertilizing plants was to meet the adequacy of soil nutrients, and plant growth could be optimally optimized; (3) fertilizing the plants was done at the beginning of planting, and continuously every 3 months, until the age of the plants was 3 years; (4) the type of fertilizer given to fertilizing plants was inorganic fertilizer (nitrogen, phosphorus and potassium) and organic (manure); (5) nitrogen, phosphorus and potassium fertilization method for each plant was fertilizing by circling around the plant. The perception of 210 respondents towards the profile of Arjuna mount forest plant fertilization towards the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 16.7% of respondents expressed strongly agree, 41.4% of respondents stated agree, 21.9% of respondents expressed doubt, 15.7% of respondents stated disagree and 4.8% of respondents stated strongly disagree. Based on these data, revealing the fertilization of Arjuna mount forest vegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 58.1% of respondents agreed and strongly agreed. Figure 2. explain the responses of respondents about the fertilization of Arjuna mount forest revegetation plants.

Planting

Profile of Arjuna mount forest tree planting includes: (1) managing the forest together with the government, applying strict regulations to the lawbreakers of forest destruction and actively involved in tree planting activities and caring for them were a number of forest management activities, so that they could continue to benefit humans and their environment; (2) The village government makes village regulations for forest management; (3) tree planting, width and distance between trees, greatly affect plant growth; (4) spacing and number of trees planted in forest revegetation was 3 meters x 3 meters (300 trees/ha); (5) a simple procedure for planting trees was to make holes and plant tree seeds in an upright position, as deep as 3 cm from the neck of the root, and cover the soil again. The perception of 210 respondents to the profile of Arjuna mount forest planting on the preservation of the Lajer,

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Dawuan, Sumberkuning and Watupereng springs, in Figure 3. shows that 17.6% of respondents expressed strongly agree, 40% of respondents stated agree, 21.9% of respondents expressed doubt, 15.7% of respondents stated disagree and 4.8% of respondents stated strongly disagree. Based on these data stated the planting of Arjuna mount forest trees influence the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 57.6% of respondents agreed and strongly agreed. Figure 2. explain the responses of respondents about the planting of Arjuna mount forest trees.

Plant Care

The profile of Arjuna's mount forest care includes: (1) care was needed to maintain the plants so they were not damaged after planting; (2) maintenance activities include: cleaning plants from grass, weeding plants, making firebreaks during the dry season, reporting treatment results to forest village community institutions once every 1 month, and then evaluating them; (3) the duration of plant maintenance was carried out once a week, for 3 years after planting; (4) the plant maintenance process was also carried out monitoring activities, which include direct growth checking, which was done every 3 months; (5) caring for plants includes prevention of plant diseases, fertilizing and administering drugs, weeding from weeds, providing water during the dry season and protecting plants from natural and human damage. The perception of 210 respondents towards the care profile of Arjuna mount forest plants towards the preservation of the spring water source of Lajer, Dawuan, Sumberkuning and Watupereng, in Figure 3. shows that 17.6% of respondents stated strongly agree, 39% of respondents agreed, 24.3% respondents expressed doubt, 12.9% of respondents expressed disagreement and 6.2% of respondents stated strongly disagree. Based on these data, revealing the maintenance of Arjuna mount forest vegetation affects the preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs, because almost 56.5% of respondents said they agree and strongly agree. Figure 2. explains the respondent's response to the maintenance of Arjuna mount forest revegetation plants.

Discussion

Human Capital

The constraints of human resources related to the empowerment of communities in Leduk, Jatiarjo and Dayurejo Villages were the level of education of the community as farmers

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in general was junior high school and elementary school. The survey results showed that there were 7 formal education institutions, 10 elementary schools, 4 junior high schools, non formal, 2 pursuit packages C and 3 Islamic boarding schools. There are 361 active members in women's organizations, 178 youth organizations, and professional organizations such as 69 people. Based on these data, the community was conditioned to develop dryland agriculture as the basis of their livelihood, and some do livestock business. The lack of knowledge and skills of the community around the forest, so that people use the forest as their main source of income, this has resulted in them doing things that are actually a factor in forest destruction. The level of community education has a significant effect on community empowerment and forest revegetation. (Adekola & Mbalisi, 2015), explained that the education of rural communities regarding forest conservation has a significant influence on preventing damage to forest ecosystems.

The successes that have been carried out in the development of human resources in Leduk, Jatiarjo and Dayurejo villages include: (1) the formation of a group discussion of communities around the source of water; (2) an environmental school was held once a week, every Sunday by the Cempaka Foundation; (3) livestock skills training activities and (4) tourism service business development, the Arjuna mount forest area has high tourism potential.

Based on the results of surveys and socialization in group discussions, the 2 objectives to be implemented in human resource empowerment in Leduk, Jatiarjo and Dayurejo villages were: (1) increasing knowledge and changing attitudes of the community, towards the revegetation movement of the Arjuna mount forest and (2) the environmental school model, which implements education on forest conservation and biodiversity through a local competency-based curriculum by the Cempaka foundation. According to [9], knowledge can be influenced by formal education factors. Knowledge was very closely related to education, where it was expected that with higher education, then the person will be more knowledgeable.

Social Capital

Constraints on cultural and social conditions related to the empowerment of communities in Leduk, Jatiarjo and Dayurejo Villages are beginning to decline in values and norms as well as patterns of social interaction in regulating the daily lives of community members, because more and more industries were penetrating several neighboring villages

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some of the people who previously farmed live within the norms of mutual cooperation, especially women who switched professions as individualized factory workers, and there was not enough time to contract with the surrounding community.

The emergence of mutual trust between the community and Indonesian state forest company, so that forest management activities run independently without coordination. Adaptation of community-based forest management was also not optimal because of the weak socialization and exclusive approach. Indonesian state forest company's position was weak because people who have no land use the conditions of the reform era that often use coercion. Community empowerment requires the development of social capital on an ongoing basis, namely improving social relations, trust, and norms. The social relations in question include participation, cooperation, mutual care, and reciprocity. Trust and norms in social capital were considered as very important components because they support existing social relations. In this case it can be interpreted if there was no trust, then the existing social relations relationship cannot be said as social capital (Anggita, 2013).

The successes that have been carried out in the social empowerment of communities in Leduk, Jatiarjo and Dayurejo villages include: (1) implementing forest resource conservation in accordance with the social characteristics of the forest communities; (2) increasing the social capital of forest village communities in accordance with local wisdom. Examples of activities that are routinely carried out every year were ritual social activities of thanksgiving, salvation of the community and preservation of springs in the villages of Dayurejo, Jatiarjo and Leduk. According to, revealing that communities around the forest still maintain elements of social capital such as the types of customs, culture, beliefs and rituals that were consistently maintained until now. The village community living around the forest has customary regulations in utilizing forest resources, these values or norms are mutually agreed and implemented, with the aim of forest resources remaining sustainable and they can continue to survive.

Based on the results of surveys and socialization in group discussions, the objectives to be implemented in community social empowerment in Leduk, Jatiarjo and Dayurejo Villages were: increasing the active role of community social capital such as social/work networks, level of trust between people, adherence to norms, concern for fellow human beings and families and involved in community social activities in forest village community institutions,

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then forest management will be more effective in supporting conservation based on ecology, economics and social. (Fukuyama, 2002), explains that social capital was a value of trust that exists in a society.

Forest Preservation

Plant species

Constraints of plant species conditions for revegetation of Arjuna mount forest were endemic plant species and spring water vegetation. (Doležal & Šrůtek, 2002), explained that the main indicator of forest revegetation through the restoration of degraded ecosystems was plant species. Selection of tree species to be planted was determined by three factors, namely: (1) the importance of natural species for revegetation, (2) the availability of seedlings and propagation, and (3) the location of revegetation to be carried out (Basyuni, 2002).

Some of the successes that have been carried out in relation to Arjuna mount forest revegetation plant species preservation of the Lajer, Dawuan, Sumberkuning and Watupereng springs were the first stage revegetation activities at the Lajer spring with an area of 10 hectares, the number of plants 3000 trees, with a breakdown of plant species: 1000 bamboo (*Dendrocalamus asper*), 600 candlenut (*Aleurites moluccana*), 400 kluwek (*Pangium edule*), 300 kluweh (*Artocarpus communis*), 100 banyan (*Ficus benyamina*), 500 durian (*Durio* sp) and 100 elo (*Ficus glomerata*).

The second stage of revegetation of Arjuna mount forest in the area around the Dawuan spring was 15 hectares, the number of plants was 1500 trees, with details of plant species including petung bamboo (*Dendroca-lamus asper*) 300 trees, candlenut (*Aleurities mollucana*) 500 trees, banyan (*Ficus benyamina*) 50 trees, bendo (*Artocarpus elasticus*) 450 and ivory 200 trees.

The third stage of revegetation of Arjuna mount forest in the area around the Sumberkuning springs, the area of revegetation area of 25 hectares, the number of plants of 5000 trees, with the details of the types of plants including mountain spruce (*Casuarina junghuniana*) 2000 trees, 300 trees kesek 300 trees, petung bamboo (*Dendrocalamus asper*) 500 trees, tutup (*Mallocus moluccana*) 200 trees, mlandingan (*Leucaena glauca*) 500 trees, kaliandra (*Calliandra calothyrsus*) 1000 trees and gmelina (*Gmelina arbora*) 500 trees.

Revegetation of the fourth stage of Arjuna mount forest in the area around the Watupereng springs, the area of revegetation area of 46 hectares, the number of plants 8000

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trees, with details of the types of plants including bamboo petung (*Dendrocalamus asper*) 1300 trees, banyan (*Ficus* sp) 500 trees, kluweh (*Artocarpus communis*) 180 trees, candlenut (*Aleurities mollucana*) 450 trees, matoa (*Pometia pinnata*) 820 trees, cloves (*Syzygium aromaticum*) 850 trees, soursop (*Annona muricata*) 800 trees, avocado (*Persea americana*) 1000 trees, durian (*Durio* sp) 1200 trees and coffee (*Coffea* sp) 900 trees.

Based on the results of surveys and socialization in group discussions, the targets to be carried out related to the revegetation plant species of Arjuna mount forest preservation in 3 springs are springs that were Curahtangkil Dayurejo village), Puthukbunder Jatiarjo village and Talangwatu Leduk village, with a total revegetation area of 90 hectares, the number of plants 18000 trees, with details of the types of plants include:

1) Endemic plant species, namely: bendo (*Artocarpus elasticus*) 1000 trees, kluwek (*Pangium edule*) 1000 trees, breadfruit (*Artocarpus altilis*) 1000 trees, candlenut (*Aleurites mollucanus*) 1000 trees, gondang (*Ficus variegate*) 1000 trees
2) Species of spring water plants, namely: petung bamboo (*Dendrocalamus sp*) 2000 trees, aren (*Arenga pinnata*) 1000 trees, banyan (*Ficus benyamina*) 2000 trees, epek (*Ficus elastica*) 1000 trees
3) Fruit plant species, namely: avocado (*Persea americana*) 1500 trees, oranges (*Citrus* sp) 1000 trees, coffee (*Coffea* sp) 1000 trees, soursop (*Annona muricata*) 1500 trees, durian (*Durio* sp) 1000 trees and guava (*Psidium guajava*) 1000 trees.

Plant Nursery

The obstacle of plant nursery conditions for revegetation of Arjuna mount forest was that the quality of seedlings was not the same, so plants die in the first month of planting, plant seeds were unable to adapt to the environmental conditions in which they grow. In the first phase revegetation at the Lajer spring with an area of 10 hectares, the number of plants was 3000 trees, for 3 years the number of dead trees was 801 trees. In the second phase revegetation in the area around the Dawuan spring area of 15 hectares, the number of plants was 1500 trees, the number of trees that died over 3 years was 325 trees. In the third stage revegetation in the area around the Sumberkuning spring, the area of the revegetation area was 25 hectares, the number of plants was 5,000 trees, the number of trees that have died for 3 years was 697. In the fourth stage revegetation of Arjuna mount forest in the area around

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the Watupereng spring, revegetation area of 46 hectares, the number of plants 8000 trees, the number of trees that die during 1 year was 42 trees.

Provision of quality plant seedlings could be done through seedbed, nursery first in the nursery before planting in the field intended to get good seedlings in terms of quantity and quality and could be planted at the right time too. High-quality plant seeds could only be obtained from seed sources that were built from the best selected individuals. It was expected that with the use of quality seeds, crop productivity will increase. The seed source of forest plants was an influential factor in improving the appearance of forest stands (Danu & Bramasto, 2004).

Some of the successes that have been carried out related to plant nurseries for revegetation of Arjuna mount forest were the availability of plant seeds for revegetation in the area around the Lajer, Dawuan, Sumberkuning and Watupereng springs with an area of 90 hectares, and the number of plants of 17500 trees. The height of the initial tree seedlings planted was at least 2 meters. The price of seeds per tree with a height of 2 meters was IDR 18,000. Plant seeds that die due to disease pests or damaged by porcupine pests, then immediately replaced with other plants that were able to live with the environmental conditions in which they grow. Good quality disease-resistant seeds were affected by a variety of factors including: tree age, tree size, crowns, genetic factors, climate, soil fertility, stand density, pests and diseases, fruit maturity and handling processes ranging from downloading in the field to storage and distribution (Nath, 2013).

Based on the results of the survey and socialization in the group discussion, the targets to be carried out in relation to the nursery of Arjuna mount forest revegetation were (1) providing quality seedlings from 18,000 trees; (2) tree seedlings consist of endemic plants, springs and fruit plants; (3) height of tree seedlings planted at least 2 meters.

Fertilizing

The obstacle of fertilizing plants for revegetation of Arjuna mount forest was the type of fertilizer that was given to plants that was not in accordance with the changing soil nutrient content, this was due to the loss of nutrients from forest damage or erosion. Fertilization was done if there was a lack of nutrients or growth was slow (Budiawan & Suprayogi, 2012).

Fertilizers given to plants were organic fertilizer and inorganic fertilizer. Provision of organic fertilizer can improve soil structure, increase soil absorption of water, improve living

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conditions of soil microbes and as a food source for plants. Application of inorganic fertilizers could stimulate overall plant growth and important assistance in the formation of green leaves (Dewanto et al., 2013).

Some of the successes that had been carried out related to plant fertilization for revegetation of Arjuna mount forest are providing nitrogen, phosphor and potassium organic fertilizer and inorganic manure for 17500 trees 3 times in 1 year for 3 years of care by small holder farmers. According to (Nath, 2013), fertilization was a very important way to improve crop productivity and soil quality. The use of organic fertilizers and inorganic fertilizers was the right way, not only to produce crop productivity but can maintain intensive plant production stability.

Based on the results of surveys and socialization in group discussions, the target to be carried out by plant fertilization in the advanced forest revegetation program was to provide nitrogen, phosphor and potassium organic fertilizer and inorganic manure for 18000 trees 3 times in 1 year for 3 years of care by the cultivating farmers.

Planting

The obstacle of planting trees for revegetation of Arjuna mount forest was the size and the distance between plants was a factor that must be considered for plant growth, because the success of forest revegetation technically according to, was the regulation of light (light control) and selection of plant species. The width and distance between revegetation plants of Arjuna mount forest towards the preservation of Lajer, Dawuan, Sumberkuning and Watupereng springs were 10 meters x 10 meters (200 trees/ha).

According to the Minister of Forestry Regulation Number P. 70/Forester Minister-II/2008 about technical guidelines for forest and land rehabilitation, explained in chapter IV. point 2. In general the number and distance of planting that was often used for revegetation was divided into several groups, namely: (1) spacing of 5 meters x 5 meters (400 trees/ha); (2) spacing of 5 meters x 2.5 meters (800 trees/ ha); (3) spacing of 3 meters x 3 meters (1,110 trees/ha); (4) spacing of 3 meters x 2 meters (1,666 trees/ha); plant spacing of 3 meters x 1 meter (3,333 trees/ha).

Some of the successes that had been carried out related to planting for revegetation of Arjuna's mount forests were the implementation of revegetation around the area of the Lajer, Dawuan, Sumberkuning and Watupereng springs, a total area of 93 hectares and a total

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of 19,500 trees. This revegetation program was carried out by PT. Sorini Agro Asia Corporindo in collaboration with the Kaliandra Foundation, Cempaka and the people of the villages of Leduk, Jatiarjo and Dayurejo.

Table 3. Arjuna mount forest revegetation to the springs preservation period 2014-2018

No	Springs location	Number of trees	Area (hectares)	the percentage of trees living
1	Lajer – Arjuna mount	3000	10	94%
2	Dawuan – Arjuna mount	1500	5	92%
3	Sumber Kuning – Arjuna mount	5000	25	86%
4	Watu Pereng – Arjuna mount	6000	34	99%
5	Watu Pereng – Arjuna mount	4000	19	99%
		19500	93	

Source: PT. Sorini Agro Asia Corporindo (Corporindo, 2017)

Revegetation of forests I in 2014 Lajer springs area

The first year of forest revegetation program began planting on February 27, 2014, with the purpose of improving the vegetation of around area of Lajer springs, by planting and maintaining plants for 3 years to keep the volume of water flowing and increasing, and preventing landslides and floods. Guidelines for revegetation of the Lajer spring water source area were government regulations number 43 of 2008, that revegetation was carried out thoroughly in groundwater basins which include recharge areas and groundwater discharge areas, through (1) protection and preservation of groundwater; (2) preservation of ground water; and (3) quality management and control of groundwater pollution. The decrease in spring discharge was caused by a reduction in protected areas or water catchment areas due to illegal deforestation and land conversion that results in critical land occurrence and a decline in the quality of water catchment areas. The result of revegetation phase I was to increase the vegetation cover of 10 hectares of land in the area around Lajer springs, with a total of 3000 trees. 3000 species of plants include: 1000 bamboo (*Dendrocalamus asper*), 600 pecan (*Aleurites moluccana*), 400 kluwek (*Pangium edule*), 300 kluweh (*Artocarpus communis*), 100 banyan (*Ficus benyamina*), 500 durian (*Durio zibethinus*) and 100 elo (*Ficus glomerata*). Intensive plant maintenance was carried out for 3 years, with 5 nurse farmers from the community around the forest.

Based on verification results in each year shows that in the first year period of 2014 the percentage of living trees was 98%, in the second year of 2015 the percentage of living

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trees was 96% and in the third year 2016 the percentage of trees the life was 94%. Some factors that influence the percentage of the number of trees that live relatively stable are nurse farmers who directly replace dead plants with other plants, even though the plant species are different, so the number of trees was relatively close to a percentage. While other technical factors that affect the percentage of living trees are relatively stable, among others: (1) treatment of grass cleansing on plants, (2) weeding plants, (3) giving water to plants in the dry season, (3) making bulkhead burn, during the dry season, (4) routine evaluation of plant maintenance from farmers to NGOs, forest village community institutions, companies and the government every month, (5) corporate social responsibility programs for economic empowerment for nurse farmers. The results of verification for 3 years showed that the highest number of plant deaths occurred in durian plants reaching 98.8% (the initial number of plants 500 trees, which lived were 6 trees), the cause of death of durian trees (*Durio zibethius*) was eating animal Porcupines especially new stems who sprouted, so that the corrective action was to replace the types of plants that are resistant to porcupine pests such as jackfruit, mahogany, sengon buto, srampang balong and segawe plants. The dry season factor during August-November 2014, with temperatures above normal temperature (temperature 37-39^{O}C), has the potential to cause forest fires.

Forest revegetation II year 2015 Dawuan springs source area

Based on the results of verification on February 23, 2015 shows that the area of forest rehabilitation in the second period in the area around the Dawuan spring was 15 hectares, with the number of plants was 1500 trees, data on types of plants include petung bamboo Petung (*Dendroca-lamus asper*) 300 trees, candlenut (*Aleurities mollucana*) 500 trees, banyan (*Ficus benyamina*) 50 trees, bendo (*Artocarpus elasticus*) 450 trees and Ivory tree 200 trees. The number of nurse farmers who directly carry out and care for plants was 3 people, each of whom receives 6 goats breeding assistance. Plant maintenance was scheduled every 1 week with the main goal of caring for and maintaining plant growth. 3 months after the initial planting, in April 2015 the nurse farmers carried out fertilization and planting dead plants.

Based on the results of verification at the planting location around the Dawuan spring, it showed that up to May 30, 2015 the number of dead plants was 103 plants, and the nurse farmers immediately replaced with 140 new plants for planting. The total number of plants from verification in December 2016 was 1537 trees. Some types of plant replacement for

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revegetation include: spathodea (*Spathodea camponulata*) 20 trees, mahogany (*Sweetenia mahagoni*) 8 trees, srikaya (*Annona squamosa*) and jackfruit (*Artocarpus heterophyllus*) 5 trees. Dewanto *et al*. (2013), states that plant growth was influenced by soil factors, climate, microorganisms, competition by other organisms, and is also influenced by available organic substances, humidity and sunlight. Based on the results of the implementation of this second rehabilitation program, researchers measured and verified that Petung bamboo plants were very strong and resistant to be planted in critical areas and with little water, and able to hold water when the rainy season occurs.

Based on the results of observations and measurements show that the number of plant deaths in the second stage rehabilitation program in the Dawuan springs, verification during the first year of 2015 the number of living trees was 1442 trees (96%), in the second year 2016 the number of living trees was 1404 trees (94%), and in the third year verification in April 2017 the number of trees that lived to be 1380 trees or 92% of the initial number of trees planted as many as 1500 trees.

Forest revegetation III year 2016 Sumberkuning springs area

The third stage of the forest revegetation program was held on March 29, 2016 with a location in the Sumberkuning springs area. The revegetation area was 25 hectares with a total of 5000 trees, with plants including mountain cypress (*Casuarina junghuniana*) 2000 trees, kesek 300 trees, petung bamboo (*Dendrocalamus asper*) 500 trees, tutup tree (*Mallocus moluccana*) 200 trees, mlandingan (*Leucaena glauca*) 500 trees, calliandra (*Calliandra calothyrsus*) 1000 trees and gmelina (*Gmelina arbora*) 500 trees. Sumberkuning spring was included in the area of Jatiarjo Village, Prigen Subdistrict, Pasuruan Regency, with different conditions compared to phase 1 and 2 revegetation activities (Lajer and Dawuan springs). The Sumberkuning spring was located at an altitude of 2,427 meters above sea level, and the forest area was under the management of the East Java Province forestry service. Community forest park of Raden Soerjo. The area was included in the conservation forest status, where there was a community allowed to do forest conservation but cannot take anything inside the forest area. The selection of forest rehabilitation sites in the Sumberkuning area was to protect upstream springs, which have been damaged by forest fires in November 2015, so that these forests need to be treated and protected from forest fires. If the water discharge in the area of the spring was reduced, then it has an impact on a number of springs under it.

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Based on the results of verification on March 29, 2016, the third period of forest revegetation area in Sumberkuning springs area were 25 hectares, with a total of 5000 trees. The results of planting verification for 2 years showed that in the first year the number of living plants was 4485 trees (90%) and 515 trees died. In the second year of verification in April 2017, the number of living plants was 4303 trees (86%) and the number of plants that died from 2017 to April 2017 was 697. The number of nurse farmers who were directly involved in the management of Sumberkuning springs forest rehabilitation in the program community empowerment was 5 people.

Forest revegetation IV year 2017 Watu Pereng springs area

The fourth stage of the forest rehabilitation program was carried out in the springs area of Watupereng, the Gumandar Sub-watershed (watershed) in Jatiarjo Village, Prigen District, Pasuruan Regency on February 21, 2017, with the theme "caring for the forest". The area of the forest rehabilitation area was 46 hectares, with the number of trees as many as 8,000 trees, this rehabilitation area was included in the protected forest of the Indonesian state forest company of west Lawang in plot 35. The types of trees planted include petung (*Dendrocalamus asper*), banyan (*Ficus sp*), kluweh (*Artocarpus communis*), pecan (*Ale mollucana*), matoa (*Pometia pinnata*), clove (*Syzygium aromaticum*), soursop (*Annona muricata*), avocado (*Persea americana*), durian (*Durio Zibethinus*) and coffee (*Coffea canephora Pierre*). By implementing this revegation program, Sorini Cargill had been conserving 4 springs (Lajer, Dawuan, Sumberkuning and Watupereng), with a total area of 83 hectares, and 17,500 trees planted and involving 28 forest nurse farmers in the form of a program to empower communities around the forest Through this sustainable forest rehabilitation program, the company was committed to carrying out the obligation to improve the rainwater catchment area that was upstream for water needs for all communities in Pasuruan Regency. The results of tree planting verification show that up to April 2017 the number of living trees was 7958 trees (99%).

Based on survey results and socialization in group discussions, the target to be carried out with planting for the forest revegetation program was to carry out a revegetation program for the second period of 2019-2020 in the area around of springs the Dayurejo Sumbertangkil, Jatiarjo Puthukbunder and Leduk Talangwatu. The extent of revegetation was 90 hectares, the number of plants was 18000 trees. This revegetation program was carried out by PT. Sorini

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Agro Asia Corporindo, in collaboration with the Cempaka foundation, Indonesia state forest company, the Pasuruan Regency Environmental Service and the villagers of Dayurejo, Jatiarjo and Leduk.

Some tree species planted include: (1) endemic plant species, namely: bendo (*Artocarpus elasticus*) 1000 trees, kluwek (*Pangium edule*) 1000 trees, breadfruit (*Artocarpus altilis*) 1000 trees, candlenut (*Aleurites mollucanus*) 1000 trees, gondang (*Ficus variegate*) 1000 trees; (2) springs plant species, namely: petung bamboo (*Dendrocalamus* sp) 2000 trees, sugar palm (*Arenga pinnata*) 1000 trees, banyan (*Ficus benyamina*) 2000 trees, epek (*Ficus elastica*) 1000 trees; (3) fruit plant species, namely: avocado (*Persea americana*) 1500 trees, orange (*Citrus* sp) 1000 trees, coffee (*Coffea* sp) 1000 trees, soursop (*Annona muricata*) 1500 trees, durian (*Durio* sp) 1000 trees and guava (*Psidium guajava*) 1000 trees.

The purpose of this revegetation program was to improve the condition of forest cover in the area around 3 springs, covering 90 hectares on the slopes of Arjuna and Welirang mount through the concept of enrichment of productive plants that can be utilized by the community to improve the welfare of forest farmers. The location of the planting was in the area around the Dayurejo Sumbertangkil springs, Jatiarjo Puthukbunder and Leduk Talangwatu, all three villages are included in the Kedunglarangan Sub-watershed, which was part of the catchment area as an underground water source of PT. Sorini Agro Asia Corporindo.

Plant care

The obstacle of tree care for revegetation of Arjuna's mount forest was the growth of weeds or weeds around the plants, replacing and replacing dead plants, due to pests and plant diseases and damaged by animals. According to [18], care plays an important role in achieving successful planting. Maintenance activities include weeding from weeds, pests or the like that were wrapped around the plant, and from pioneers that rival the plants, and replanting if any plants die. In the treatment of plants, monitoring activities could also be carried out which includes verification of growth (plant survival), growth performance (growth performance), increment (growth increments) including height, diameter, volume and attack of pests and diseases.

Some of the successes of plant maintenance that had been carried out for revegetation of Arjuna mount forest were funding of plant care for 5 nurse farmers for 3 years on 10 hectares of land vegetation in the area around the Lajer spring, the number of plants 3000

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trees, with plant species including 1000 bamboo (*Dendrocalamus asper*), 600 candlenut (*Aleurites moluccana*), 400 kluwek (*Pangium edule*), 300 kluweh (*Artocarpus communis*), 100 banyan (*Ficus benyamina*), 500 durian (*Durio* sp) and 100 elo (*Ficus glomerata*).

Plant care financing for 3 nurse farmers for 3 years in a 5 hectare vegetation area around the Dawuan springs, the number of plants was 1500 trees, plant species data including petung bamboo (*Dendroca-lamus asper*) 300 trees, candlenut (*Aleurities mollucana*) 500 trees, banyan (*Ficus benyamina*) 50 trees, bendo (*Artocarpus elasticus*) 450 and ivory 200 trees.

Funding for plant maintenance in the Sumberkuning springs area. Revegetation area was 25 hectares with a total of 5000 trees, with types of plants including mountain spruce (*Casuarina junghuniana*) 2000 trees, 300 trees squared, petung bamboo (*Dendrocalamus asper*) 500 trees, cover (*Mallocus moluccana*) 200 trees, mlandingan (*Leucaena glauca*) 500 trees, kaliandra (*Calliandra calothyrsus*) 1000 trees and gmelina (*Gmelina arbora*) 500 trees.

Plant care funding for 28 nurse farmers for 3 years in a 46 hectare vegetation area around the Watupereng springs, a total of 8000 trees, with types of plants including bamboo petung (*Dendrocalamus asper*) 1300 trees, banyan (*Ficus* sp) 500 trees, kluweh (*Artocarpus communis*) 180 trees, candlenut (*Aleurities mollucana*) 450 trees, matoa (*Pometia pinnata*) 820 trees, tutup plant (*Syzygium aromaticum*) 850 trees, soursop (*Annona muricata*) 800 trees, avocado (*Persea americana*) 1000 trees, durian (*Durio* sp) 1200 trees and coffee (*Coffea* sp) 900 trees.

Based on survey results and socialization in group discussion, the target to be carried out with plant care in the revegetation of Arjuna mount forest in the second period of 2019-2020 was plant care financing for 32 nurse farmers for 3 years on vegetation in an area of 90 hectares in the area around the source of the Dayurejo Curahtangkil springs, Jatiarjo Puthukbunder springs and Ledug Talangwatu springs, the number of plants was 18000 trees. Cempaka foundation and nurse farmers are responsible for maintaining crop growth rates up to 3 years by 90% of the trees planted are still alive and growing.

Based on the results of structural equation modeling analysis, explaining the human and social capital resources of the community contributes to the preservation of forests and springs, a critical ratio value of 5.005. The probability value of the analysis results was more than 0.05 and the critical ratio was more than 1.96, then the structural equation modeling

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analysis recommendation states that human and social capital resources of the community provide benefits to the preservation of forest development. [27], explains that there was a positive and significant influence of empowerment factors such as profiles, institutions, economics and policy on forest rehabilitation productivity. [14], explains that sustainable community development based on an environmentally friendly alternative income generation approach was very important in supporting global forest sustainability. While [11], states that community empowerment has a positive influence on forest conservation and prevents illegal logging which includes 3 aspects, namely: (1) increasing income and economic growth of environmentally friendly rural communities; (2) provision of facilities and infrastructure; (3) creation and positive behavior in environmental conservation.

The results of the structural equation modeling (SEM) analysis indicate that both human and social capital within the community significantly contribute to the preservation of water springs, with a critical ratio value of 4.344. The probability value obtained from the analysis exceeds 0.05, and the critical ratio is greater than 1.96. These findings suggest that human and social capital have a positive impact on the conservation of water springs.

According to, the management of water springs based on community empowerment has been effectively implemented due to the importance of environmental sustainability and the availability of water for the local population (Buwono et al., 2017). Key strategies for community empowerment in water resource management include: (1) continuously enhancing human resource management capabilities, such as professionalism, accountability, innovation in management, and the adoption of new technologies; (2) ensuring the availability of infrastructure for water springs; and (3) fostering active participation and involvement from the community in the development of water management technologies. (Anwar & Pranata, 2014).

The results of structural equation modeling analysis, explaining the human capital and social resources of the community contributed to the preservation of spring water sources, the value of the critical ratio of 4.344. The probability value of the analysis results was more than 0.05 and the critical ratio was more than 1.96, then the structural equation modeling analysis recommendation states that human and social capital resources of the community provide benefits to the preservation of the spring (Buwono et al., 2017), explains that spring management based on community empowerment has been evidently carried out because of

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the importance of the environment and the availability of water for the community. Community empowerment strategies for water resources management include (1) human resource management capabilities continue to be improved such as professionalism, accountability, management innovation and technology; (2) availability of facilities for spring water sources and (3) encouraging community participation and role for the development of water management technology (Anwar & Pranata, 2014)

Conclusion

Human capital of the community around Mount Arjuna, including the level of education and employment, plays a significant role in the success of sustainable forest management and conservation efforts. In this context, the minimum education level of the community is at the junior high school level, with most community members engaged in farming as their primary occupation. Additionally, there are livelihoods in livestock and fisheries, along with some individuals running side businesses outside of farming and animal husbandry. These activities, while diverse, all contribute to the preservation of the forests and springs surrounding Mount Arjuna. The existence of these forms of human capital supports the community's ability to engage in forest management practices and underscores the importance of local knowledge and economic participation in the long-term sustainability of the ecosystem.

Similarly, social capital plays a crucial role in strengthening community-based forest management practices. Most respondents indicated that social capital in the form of mutual-cooperation remains a central practice in the villages of Leduk, Jatiarjo, and Dayurejo. The community is actively involved in communal activities, with a high level of voluntary participation in social events and local traditions. The culture of helping one another during critical life events such as funerals, illness, weddings, and natural disasters is still vibrant in these villages. This strong social network not only enhances local solidarity but also facilitates collective action for forest conservation.

Moreover, most residents express awareness and support for the Arjuna Mount forest revegetation program. Community leaders, including traditional leaders, village heads, neighborhood heads, and other local figures, actively participate in forest rehabilitation activities. Their involvement in these initiatives demonstrates the integration of social capital

into forest preservation efforts, further solidifying the community's commitment to protecting their natural resources, particularly the forests and springs around Mount Arjuna.

Through these forms of human and social capital, the community is better equipped to engage in sustainable forest management practices, contributing significantly to the ongoing conservation efforts in the region.

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