ANDMEJ
ASEAN Natural Disaster Mitigation and Education Journal
ANDMEJ 2(2): 129-143
ISSN 3025-0285

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

The potential of carbon sequestration in community forests for climate change mitigation and disaster risk reduction

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Received Date: December 16, 2024 Revised Date: January 29, 2025 Accepted Date: January 29, 2025

ABSTRACT

Background: Climate change is a significant global concern, with its effects observed worldwide. Community forest management, which involves local communities in managing and utilizing forest resources, is a sustainable approach to forest preservation. This method not only provides economic benefits but also contributes to carbon sequestration, a strategy for mitigating global warming. This research explores the role of community forests in carbon sequestration and climate change mitigation, focusing on Sidodadi Village in Lawang District, Malang Regency. **Method**: The research used a quantitative approach, applying the allometric method for carbon calculation. **Findings**: The community forest in Sidodadi Village showed notable carbon sequestration: 381.0334 tons C/ha for Jabon (Anthocephalus cadamba), 374.8768 tons C/ha for Balsa (Ochroma pyramidale), and 40.9963 tons C/ha for Sengon (Albizia chinensis). **Conclusion**: The findings highlight the substantial carbon storage potential of community forests and their contribution to environmental sustainability. Raising public awareness of the importance of preserving these forests is crucial, given their role in combating climate change. **Novelty/Originality of this article**: This study emphasizes the significant contribution of community forests to carbon sequestration and the potential role they play in climate change mitigation, offering valuable insights for environmental management strategies.

KEYWORDS: carbon sequestration; community forest; climate change; global warming; sustainability.

1. Introduction

The phenomenon of climate change has become a significant global concern, with its impacts being observed and experienced in diverse locations across the globe. The United Nations Framework Convention on Climate Change defines climate change as a change in the composition of the global atmosphere resulting from an increase in greenhouse gases (GHGs), caused by human activities either directly or indirectly over a period. Human activities are estimated to have caused global warming of approximately 1^{0}C since the pre-industrial period. Furthermore, global warming is projected to reach 1,5^{0}C between 2030 and 2052, an increase that will be significant. Greenhouse gas emissions encompass a range of substances, including carbon dioxide, methane, nitrous oxide, flourinated gases, and other gases.

Furthermore, the IPCC (2023) reports that climate change has caused enormous damage and increasingly irreversible losses to terrestrial, freshwater, ice sheet, coastal and

Cite This Article:
Aprilia, R. (2025). The potential of carbon sequestration in community forests for climate change mitigation and disaster risk reduction. *ASEAN Natural Disaster Mitigation and Education Journal, 2*(2). 129-143. https://doi.org/10.61511/andmej.v2i2.2025.1520

marine ecosystems. The negative impacts of climate change are widespread, causing loss and damage to nature and humans. Economic damage due to climate change has been identified in sectors that are exposed to climate change, such as agriculture, forestry, fisheries, energy and tourism.

According to Leontinus, (2022), climate change as a consequence of global warming caused by an increase in greenhouse gases, especially carbon dioxide (CO_2) and methane (CH_4), results in two main things that occur in the lower layer of the atmosphere, namely high rainfall variability and sea level rise. Global warming causes extreme climate changes that affect people's lives (Ivando et al., 2019) and threatens the lives of all living beings in the form of increased temperatures, food crises, the potential for more frequent natural disasters, sea level rise, extinction risks and increased health risks (Pratama et al., 2022). Furthermore, climate change exerts a direct influence on global water resources, with alterations in the hydrological cycle and climate patterns resulting in shifts in water availability (Ahsan et al., 2023). Other negative impacts of climate change include rising global seawater temperatures, sea levels, declining pH levels and a reduction in the availability of nutrients and oxygen (Strang & Bosker, 2024). As the adverse impacts of climate change increase alarmingly in line with global climate change, exploring potential strategies to reduce greenhouse gas emissions in becoming an urgent necessity to mitigate further risk of damage (Rijal et al., 2022).

In accordance with the Paris Agreement, Indonesia has outlined its commitment to reduce the global temperature rise in its Nationally Determined Contribution (NDC). This outlines a greenhouse gas reduction by 2030 of 31,89% with its own efforts and 43,20% with international assistance. Furthermore, Indonesia has submitted a Long-Term Strategy for Low Carbon and Climate Resilience (LTS-LCCR 2050), which includes a Net Zero Emission (NZE) or sooner plan. To facilitate the realisation of NZE 2060 or sooner, the forestry and other land use sectors, in conjuction with the energy sector, represent the primary means of reducing GHG emissions in Indonesia (The Ministry of Environment and Forestry, 2024).

Tropical regions are strategically positioned to mitigate the impacts of climate change through the utilisation of their forest resources (Sugiarto et al., 2024). Forests represent a significant natural asset, providing a range of goods and services to forest communities (Maua et al., 2018) and offering substantial socio-economic and environmental benefits to local and sorrounding communities (Ullah et al., 2021). The benefits of forests as producers of goods, including wood, rattan, herbal medicine, fruit, and other produce. Furthermore, forests serve as providers of essential services, including carbon sinks, oxygen producers, water purifiers, and maintainers of ecosystem sustainability. They also prevent soil erosion and perform other vital functions (Mayasari et al., 2024). The World Bank (2004) asserts that forests support nearly half of the 2,8 billion people living on USD 2,00 or less per day, indicating that the crucial role forests play in rural livelihoods.

In the context of climate change, forests play a significant role as both carbon sinks and carbon sources (Ali et al., 2020). Forests represent one of the most significant carbon dioxide sinks (Fatwa et al., 2024) with forest tress contributing the greatest biomass and carbon stocks to forest ecosystems, thus playing a vital role in climate change mitigation (Haq et al., 2022). The role of forests in climate change mitigation is acknowledged in the Paris Agreement under the UNFCCC, with numerous countries incorporating forests as a pivotal element in attaining carbon removal and emission reduction objectives (Njana et al., 2021). It is therefore recommended that the sustainable utilisation of forests and their forests products be promoted in order to provide sustainable ecosystem services (Chishaleshale et al., 2024). Furthermore, it is essential to ensure that local communities are at the core of any decision-making processs by sensitising forest communities on the importance of sustainable utilisation (Sourokou et al., 2023).

Conversely, the absence of protection for forests and the practice of deforestation will result in an increase in temperatures and carbon dioxide (CO_2) emissions. In Indonesia, the largest source of CO_2 emissions is the land use sector, where the greatest increase in forest cover loss was observed from 2000 to 2012, with a total of 6,02 million tonnes of primary forest loss recorded during that period (Matsumoto et al., 2019). The loss of forest cover reduces the capacity of ecosystems to absorbs CO_2 from the atmosphere, resulting in a net accumulation of greenhouse gases and contributing to a gradual increase in temperature (Abreu et al., 2024). Deforestation is regarded as the second most significant anthropogenic source of greenhouse gas emissions, with the burning of forest biomass and the decomposition of remaining plant material and soil carbon (Van der Werf et al., 2009) representing a significant contributor to this phenomenon. Furthermore, deforestation is identifies as a principal driver of biodiversity loss (Tilman et al., 2017). A growing body of research demonstrates that in tropical countries, climate change and deforestation are increasing temperatures and heat exposure. However, the combined risks of these changes have not yet been acknowledged (Wolff et al., 2021). It is therefore evident that forest management should be an integral part of national planning for carbon redustion and countries must develop clear strategies and management of forest resources, given the cricial role that forests play in atmospheric carbon removal through carbon sequestration (Mackey et al., 2020).

The fulfilment of commitments to reduce greenhouse gas emissions necessitate the collaboration of a multitude stakeholders, including local communities residing in and arround forests (Zunnuraeni et al., 2018). Historically, local communities and indigenous peoples have derived not only economic benefits from forests but also cultural, spiritual and social advantages (Deb et al., 2021). It is recommended that communities be included in forest management initiatives with the objective of reducing deforestation and promoting the restoration of degraded area (Kimaro et al., 2024). Local communities exert a significant influence on forest management practises due to their reliance on land and timber resources for energy and construction purposes, in addition to the utilisation of non-timber forest products. The involvement of local communities represents a crucial step in enhancing the contributions of resources to community development and improving management through local community participation (Duguma et al., 2018). The Study conducted by Wale et al. (2022) demonstrated that factors such as the capacity of community forests to support the livelihoods of rural communities, awareness of community members about changes in temperature and rainfall, and trends in the availability of forest products play a significant role in enhancing adaptive capacity in the context of climate change.

One approach to forest management that engages local communities in the stewardship and utilisation of forest resources is the establishment of community forests. In accordance with the Minister of Forestry Regulation No. P.69/Menhut-II/20211, a community forest is defined as a forest that grows on land encumbered by property rights or other rights outside the forest area, with a minimum area of 0,25 ha, crown closure of woody plants and other plants of more than 50%. Community forests are predominantly situated on land that is either privately or communally owned, or on customary land, and comprise a diverse array of tree species. The total area of community forests in Indonesia is estimated to be approximately 1.560,229 ha, representing 1,13% of the country's total forest area (Putri et al., 2015). The sustainable maintenance and utilisation of forest is a viable proposition. The preservation and protection of forest as carbon reservoirs and sinks enables their contribution to the mitigation of global climate change (Ali et al., 2020).

From an ecological perspective, community forests can enhance land conditions and soil fertility through the input of litter, and can mitigate surface run off due to their canopy cover and increased carbon stocks (Sari et al., 2018). Community forests are beneficial for the local economy, providing timber and non-timber forest products, and acting as carbon sinks and carbon storage units (Hendrayana et al., 2019; Zulkarnaen, 2020). As stated by Sianturi & Woesono (2024), community forest play a pivotal role in the development of environmental services, thereby contributing to the reduction of carbon emissions. This is because they possess land security and stand conditions that are readily assessable and subject to monitoring. The planting of fast-growing tree species in community forests has been demonstrated to result in the sequestration of carbon at a faster rate species (Rizki et al., 2016). Community-managed forests have the potential to engage in carbon trading, with the financial benefits derived from such trading indicating a viable option for improving the socioeconomic welfare and livelihoods of local communities (Rijal et al., 2022).

To date, several studies have been conducted regarding the carbon potential of community forests. Some of the studies in question are as follows: (1) estimation of Carbon Stored in Community Forests in Pekon Kelungu, Tanggamus Regency (Ristiara et al., 2017); (2) comparison of Carbon Emissions with Carbon Stored in Community Forest of Buana Village, Batanghari District, East Lampung Regency (Rizki et al., 2016); (3) carbon Storage as an Indicator of Forest Health in Community Forests (Case Study in the Community Forest of Pinang Jaya Village, Kemiling Distric, Bandar Lampung City, Lampung Provincy (Arianasari et al., 2021); (4) vegetation Structure and Carbon Storage of Sambak Village Community Forest, Magelang, Central Java (Zulkarnaen, 2020).

Sidodadi Village is one of several villages in the Lawang District of Malang Regency that have developed community forests. It is believed that the existence of community forests will enable them to play a role in increasing carbon dioxide absorption. This is based on the findings of Hersaputri & Santoso (2018), which indicate that forest in East Java are subject to environmental degradation on an annual basis as a result of economic activities that utilise the natural wealth of the forest in question, namely deforestation or logging activities. In accordance with the findings of Hairiah et al. (2011), plants, both within and beyond the boundaries of forest areas absorb carbon dioxide from the atmosphere through the process of photosynthesis. This is then converted into carbohydrates, which are distributed throughout the plant body and ultimately stored within it. Moreover, it has been proposed that the measurement of the quantity of carbon stored in the biomass of living plants on a given land surface can provide insight into the extent of carbon dioxide absorption by plants with carying carbon reserves. Consequently, the measurements of carbon stored in each land surface is a necessary undertaking. The objective of this research was to quantify the amount of carbon sequestration in each tree within the community forest, thereby elucidating the role community forests in carbon sequestration and their potential contribution to climate change mitigation. It is anticipated that the findings will enhance community awareness and understanding of the significance of community forest management and its impact on carbon storage.

2. Methods

This research employs a quantitative methodology, utilising secondary data from other researchers on vegetation type and measurement data on tree diameters and heights in the community forest in Sidodadi Village, Lawang District, Malang Regency. The data obtained is then processed by determining the number of sampling tress that represents purposive sampling. From the total area of community forests in Sidodadi Village, the number of sampling trees from sample plots of each stratum was calculated. The calculation of carbon sequestrations is conducted by calculating using the allometric equation formula.

The area of community forest managed by the community in Sidodadi Village, Lawang District, Malang Regency is 40 ha and is utilized as a community economy. The administrative boundaries of Sidodadi Village are as follows: to the north (Mulyoarjo Village, Purwodadi Subsdistrict, to the east (Srigading Village, Jabung Subsdistrict), to the south (Bedali Village, Singosari Subsdistrict) and to the west (Kalirejo Village, Singosari Subsdistrict). Sidodadi Village covers an area of 592,7 ha, consisting of dry land or settlement, rice field and other land uses.

2.1 Tree biomass calculation

In accordance with the IPCC (2006), carbon is stored in five carbon pools in terrestrial ecosystems, such as forest. The following five biomass pools are considered: (1) aboveground biomass, which includes tress and their crowns of varying sizes, from seedlings to trees, as well as other plant species; (2) below ground biomass, comprising plants roots; (3) biomass of litter, or non-woody necro mass; (4) biomass of dead wood, or necro mass; and (5) soil biomass, or the remains of plant and animal life that have been partially or completely weathered and have become part of the soil. The measurements of aboveground forest biomass is of great significance, as it serves as a fundamental indicator of the productivity, biodiversity and carbon storage capacity of forest ecosystems (Ma et al., 2024). As Wibowo et al. (2013) observe, the measurement of stored carbon stocks is important because it allows us to ascertain the amount of carbon stocks at a given point in time, as well as any changes that may have occurred. Furthermore, the results of such measurements can be used to determine the extent to which sequestered carbon stocks have been acquired. Furthermore, the estimation of biomass from forests is of great significance in the context of global environmental change, with the objectives of reducing carbon dioxide emissions from natural resources (Biswas et al., 2024).

The research project on the carbon potential of community forests in Sidodadi Village, Lawang Distric, Malang Regency will employ a nondestructive method for calculating aboveground biomass, utilizing allometric equation to estimate biomass. The allometric equation is employed to estimate aboveground biomass due to its accuracy and simplicity (Dutta Roy & Debbarma, 2024). As Sanogo et al. (2021) have observed, a significant number of researchers worldwide have employed nondestructive carbon stock estimation through the allometric formula, citing its cost-effectiveness, time efficiency and comprehensive results. The estimation of biomass through the utilization of the allometric equation approach is achieved through the input of values pertaining to tree diameter or height into an existing allometric equation (Irundu et al., 2023).

This study will employ the carbon calculation methodology outlined by Zulkarnaen (2020), which entails the estimation of tree biomass and carbon sequestration. The allometric formula utilized is derived from the allometric equation that is most applicable to the specific species in question, as illustrated in Table 1 (Hairiah, 2007; Ketterings et al., 2001).

Table 1. Lists the allometric aquations used for each tree species

No.	Tree pecies	Allometric equation
1	Mahagony	$BK = 0{,}902\ (D^2H)^{0{,}08}$
2	Teak	$BK = 0{,}015\ (D^2H)^{1{,}08}$
3	Sengon	$BK = 0{,}020\ (D^2H)^{0{,}93}$
4	Coffee	$BK = 0{,}281\ (D)^{2{,}06}$
5	Palm	$BK = EXP\ (-2{,}134)\ D^{2{,}530}$
6	Cocoa	$BK = 0{,}1208\ (D)^{1{,}98}$
7	Branched tree	$BK = 0{,}11\rho(D)^{2{,}62}$
8	Unbranched tree	$BK = 3{,}14\rho D^2H/40$

(Hairiah. 2007; Ketterings et al., 2001)

The description defines key variables used in biomass estimation for trees. BK represents the biomass of a tree, measured in kilograms per tree. D refers to the diameter at breast height (DBH), measured in meters, which is a standard metric for assessing tree growth. H denotes the tree height, also measured in meters, providing another critical factor in biomass calculations. ρ represents the tree's specific gravity or wood density, with a given value of 0.7 g/cm^3, which helps determine the mass-to-volume ratio of the tree's wood. These variables are essential for calculating tree biomass and understanding forest carbon storage.

2.2 The Calculation of carbon sequestration

The calculation of carbon sequestration in the stand is a conversion of the biomass calculation obtained, whereby the correction factor is multiplied by 0,5. The estimation of carbon sequestration in the forest was conducted using the following Equation 1.

$$C = W \times 0{,}5 \quad \text{(Eq. 1)}$$

The description defines key variables used in estimating carbon sequestration in a given area. C represents the total carbon sequestration, measured in tons of carbon per hectare (tons C/ha), which quantifies the amount of carbon stored in biomass. W refers to the biomass, measured in tons per hectare (tons/ha), representing the total weight of living organic material within the specified area.

The C calculation result was converted into CO_2 equivalent by multiplying the result by a correction factor of 3.67 as Equation 2.

$$WCO_2 = C \times 3.67 \quad \text{(Eq. 2)}$$

The description defines key variables related to carbon sequestration. C represents the total carbon sequestration, measured in tons of carbon per hectare (tons C/ha), which indicates the amount of carbon stored in biomass. WCO2 refers to the amount of CO_2 sequestered, measured in tons of CO_2 per hectare (tons CO_2/ha), representing the total carbon dioxide absorbed and stored by vegetation. These variables are essential for understanding the role of ecosystems, particularly forests, in capturing atmospheric CO_2 and mitigating climate change.

It is assumed that the biomass carbon is 50% (0,5), in accordance with the findings of Mackey et al. (2020), who determined that a default value of 0,5 is appropriate when no local value is available and when applied across different forest types. The number 3,67 in the calculation of the amount of sequestered CO_2 is the equivalent/conversion number of the element carbon (C) to CO_2 [atomic mass of C=12 and O=16, CO_2=3,67] (Ivando et al., 2019).

3. Results and Discussions

The community forests in Sidodadi Village, Lawang Districs, Malang Regency encompass an area of 40 hectares and are managed by the local community. The tree species that are cultivated by the community include Balsa type (*Ochroma pyramidale*), Jabon type (*Anthocephalus cadamba*) and Sengon type (*Albizia chinensis*). The most prevalent tree species planted across the 40 hectares area are Balsa and Jabon, with Sengon representing the remaining portion. The height and diameter of each tree species exhibit a range of variations, spanning from smaller to larger diameter classes. The distribution of tree species within the community forest of Sidodadi Village, Lawang Subdistrict, Malang Regency is illustrated in Figure 1.

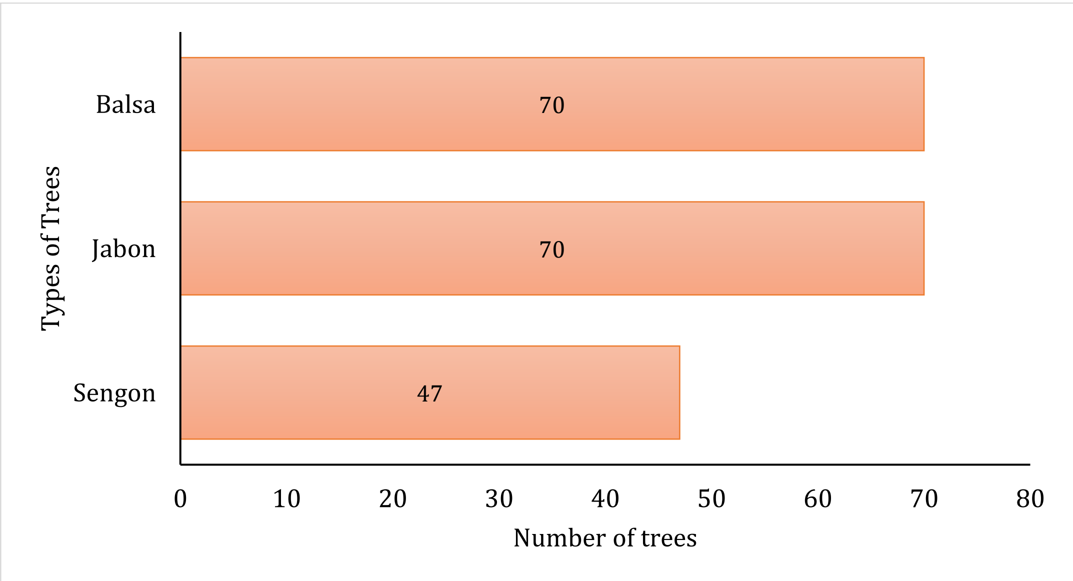

Fig. 1. Distribution of trees in the community forests in Sidodadi Village

The forestry tree species present in the community forests of Sidodadi Village, Lawang District, Malang Regency, include Balsa (*Ochroma pyramidale*), Jabon (*Anthocephalus cadamba*) and Sengon (*Albizia chinensis*). These are the most planted and found tree species in community forests. This is due principally to the fact that these tree species have the advantage of rapid growth, and the wood produced is frequently in demand by the wood industry for the manufacture of wooden furniture. The high market share of this type of wood has prompted many individuals to select this type of tree for cultivation on community land. As posited by Fajriani et al. (2013), the sengon (*Paraserienthes falcataria*) and Jabon(*Anthocephalus cadamba*) are two varieties of wood that can be develop through community forests with short rotations and small diameter, provinding a source of wood for industries. Sengon and Jabon trees have been widely planted throughout the island of Java by communities, and the trees have adapted to take advantage of the region's continous growing season and suitable growing locations (Darmawan et al., 2013). Sengon and Jabon trees are good values as sawn timber, core liners for plywood, and pulpwood (Darmawan et al., 2013).

Sengon is regarded as a rapidly growing plant spesies in Indonesia (Krisnawati et al., 2012), and is known for its lightweight and superior quality properties (Laksono et al., 2022). Sengon produces branch-freee timber with excellent form and can be managed on 5-7 year rotation on sites with good quality (Stewart et al., 2021). Sengon is of significant importance to the sawn timber industry, exhibiting the capacity to grow to a considerable size with straighh stems, the ease of pruning, robust, and stable dimensions, and uniform and branch-free wood (Evans & Turnbull, 2004). Sengon is also among the moset promising forestry plant species for developments in industrial plantation forest. It offers several advantages, including relatively short harvest maturity, relatively easy management, uncomplicated growing site requiremenets, versatile wood, the ability to fertilize the soil, improved land quality, and high utility and profit potential (Istikorini & Sari, 2020). Furthermore, Sengon wood serves as an exemplar of biomasss utilized as an alternative energy source (Ridjayanti et al., 2021).

Several studies have been conducted on Jabon wood. As posited by Arsyad et al. (2019), Jabon wood (*Anthocephalus cadamba*) represents one of the most promising fast-growing wood species in Indonesia. Jabon does not require pruning because the branches fall off naturally during the growth period, making it an excellent choice for plywood or sawn timber (Muslimin et al., 2023). Jabon wood contains a greater proportion of juvenile wood, which exhibits lower physical and mechanical proporties and natural resistance compared to mature wood (Lestari et al., 2018). Jabon can be harvested at an early age as a source of pulp and paper production due to its rapid growth rate (Darwis et al., 2024). Jabon is distinguished by a straight, cylindrical trunk and a wide crown, with the potential to reach 45 meters in height and posses a trunk measuring 100-160 cm in cicumference (Atunnisa et al., 2024), at the age of 5-6 years, the trunk circumference can reach 40-50 cm, with diameter growth of between 5-10 cm/year (Purwoko et al., 2023). Meanwhile, Balsa (*Ochroma pyramidal*) is a fast-growing species with a very los wood density, making it the lightest commercial wood (Borrega & Gibson, 2015). Balsa wood has become an important material in construction (Galos et al., 2022) due to its low density and light weight, which facilitate its use as the primary material for manufacturing various types of home furniture.

The calculation of tree biomass was then carried out using the allometric equation, which was applied to the various types of forestry plants found in the Sidodadi Village Community Forest. The allometric equation utilized was that which had been previously formulated by several researchers. The results of the calculation yielded the carbon sequestration of each tree species in the Sidodadi Village Community Forest as shown in figure 2. The carbon sequestration of Jabon (*Anthocephalus cadamba*) was found to be 381,0334 tons C/ha, the Balsa (*Ochroma pyramidale*) 374,8768 tons C/ha and the Sengon (*Albizia chinensis*) 40,9963 tons C/ha.

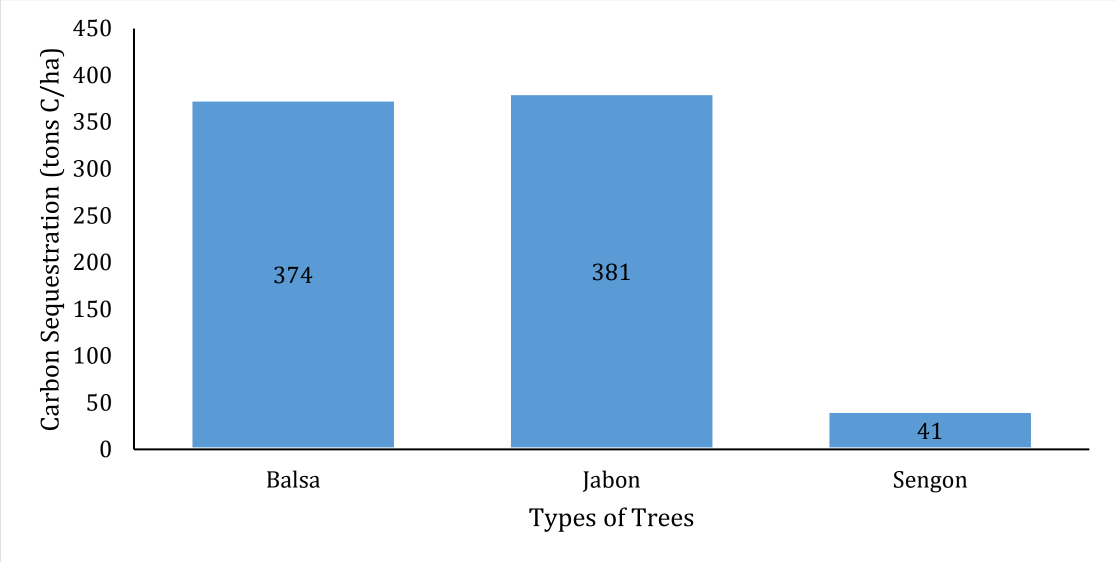

Fig. 2. Carbon sequestration in the community forests in Sidodadi Village

The results of the calculation demonstrate that the amount of carbon present in each tree species is distinct. This is due to the considerable diversity in diameter and height observed among the tree species, with notable variations between small and large diameter classess. The Jabon tree species exhibits a greater diameter range than the Balsa and Sengon tree species. The value of carbon stored in each individual is contingent upon the diameter and specific gravity of plants (Zulkarnaen, 2020), stand density (Ivando et al., 2019) and the age and productivity of tree crops (Suhartati et al., 2023). In accordance with the findings of Hendrayana et al., (2019), tree diameter is a significant factor influencing the quantity of biomass and carbon reserves stored. The findings of research conducted by Darmawan et al. (2022) indicate that tree age has a significant impact on biomass accumulation and carbon sequestration. It was observed that as trees age, their biomass increases. Additionally, Zhang et al. (2019) reported that with the progression of stand age, the biomass and total carbon density of trees, including aboveground tree, tree trunks, and tree roots, also increase.

A comparison of the results of this study with those of other studies on community forests, such as the research conducted by Ristiara et al. (2017) related to the estimation of carbon sequestration in community forests in Pekon Kelungu, Tanggamus Regency, reveals that the potential value of carbon sequestration in the community forests of Sidodadi Village is relatively large. The results of the research conducted Ristiara et al. (2017) indicated a total aboveground carbon of 101,61 tons/ha, comprising a tree component of 99,92 tons/ha, necro mass of 0,81 tons/ha, litter of 0,87 tons/ha and organic matter in the understory of 0,02 ton/ha. The study revealed a total of 22 tree species in the community forest, including *Theobroma cacao* (cacao), *Michellia champacha* (champaka), *Durio zibethinus* (durian), *Gnetum gnemon* (melinjo), *Paraserinthes falcataria* (sengon). In comparison to the findings of other research on community forest conducted by Fatwa et al., (2024) regarding the carbon stocks estimation in Tangga Community Forest of North Lombok, the carbon potential in the community forest of Sidodadi Village is relatively modest. The results of this study indicate that the estimated carbon stock contained in the Tangga community forest of north Lombok Regency is 9.972 tons/ha, comprising a diverse array of vegetation, including coffee (*Coffea* arabica), cocoa (*Theobroma cacao)*, cashew (*Anacardium* occidentale), mango (*mangifera* indica), candlenut (*Aleurites moluccana*), and others. The discrepancy in the estimated carbon potential is contingent upon the biomass content of each tree. As Hairiah & Rahayu (2007) posited, the disparity in biomass accumulation is influenced by the density of vegetation, the diversity of its diameter size, and the distribution of specific gravity within the vegetation. Land use comprising trees with high density values will yield higher biomass compared to land with species exhibiting low wood density values.

The amount of carbon dioxide absorbed by each tree species is as follows the Jabon species (*Anthocephalus cadamba*) absorbs 1.398,393 tons CO_2 per hectare; the Balsa species (*Ochroma pyramidale*) absorbs 1.375,798 tons CO_2 per hectare; and the Sengon species (*Albizia chinensis*) absorbs 150,4564 tons CO_2 per hectare. The quantify of carbon absorption is directly proportional to the biomass content, whereby an increase in biomass results in a proportional increase in carbon absorption (Lutz et al., 2018). As Lindenmayer & Laurance (2017), have observed, climate change, disturbance regimes, and logging contribute to the accelerated decline of large-diameter trees. The dynamics of large-diameter trees are contingent upon at least two factors: the presence of species with the capacity to reach considerable sizes and the existence of conditions, including disturbance regimes, that facilitate the growth of large-diameter individuals (Musavi et al., 2017). The accumulation of carbon dioxide absorption is contingent upon the presence of large forests with optimal vegetation conditions (Fatwa et al., 2024).

The value of carbon sequestration potential in the community forest of Sidodadi Village demonstrates that community forests offer additional benefits beyond their direct use value in the form of timber. In addition to providing economic value in the form of timber sales, community forest can also offer indirect use value through carbon sequestration. This is consistent with the findings of Bravo-Oviedo et al. (2014), which indicate that forests provide a range of resources, including wood for construction, paper, and firewood; additional food sources such as honey and mushroom; and non timber forest products such as resin, medicinal plants, and more. Additionally, forests contribute to carbon sequestration, enhance biodiversity, and offer recreational and aesthetic benefits in rural and suburban landscapes. The sequestration of carbon in community forests can provide benefits and contribute to the mitigation of climate change. This is consistent with the findings of Bonan (2008) and Pan et al. (2011) which indicate that forests play a significant role in carbon sequestration, with an estimated 45% of global terrestrial carbon stored in forests. The conservation of forest carbon stocks can assist in the mitigation of climate change and the achievement of carbon neutrality, as the majority of carbon stocks are stored in trees that actively accumulate significant quantities of carbon (Liu et al., 2021; Heinrich et al., 2021).

The decisions of the community to maintain the vitality of the tress within the community forest and refrain from harvesting them do not preclude the community from deriving benefits from the forest ecosystem services. The retention of community forests and the prevention of their felling allows communities to play a role in providing ecological and economic benefits in the form of trees that function as carbon sinks, stored in the form of tree biomass. Community forest is a forest management regime that engages local communities in efforts to enhance community livelihoods and safeguard forests that provide vital ecosystem services for human life and other forms of life. Community forests can facilitate the conservation of forest resources and encourage sustainable practices, thereby reducing the rates of deforestation and forest degradation. It is therefore of great importance that local communities are involved in the management and conservation of forests. The empowerment of local communities in all aspects of forest management, with the provision of robust governmental support, will have a considerable impact on forest governance.

4. Conclusions

The objective of this study is to ascertain the potential for carbon storage in the community forest of Sidodadi Village, Lawang District, Malang regency. The study revealed that the community forest Sidodadi Village is composed of three main types of vegetation: Jabon (*Anthocephalus cadamba*), Balsa (*Ochroma pyramidale*) and Sengon (*Albizia chinensis*). The carbon sequestration potential of each forest vegetation type was determined to be as follows: 381,0334 tons C/hectares for Jabon (*Anthocephalus cadamba*), 374,8768 tons C/hectares for Balsa (*Ochroma pyramidale*) and 40,9963 tons C/hectares for Sengon (*Albizia chinensis*). The aggregate value of the carbon content in the community forests of Sidodadi Village is 11.748,62 tons C/hectares. The carbon sequestration of the community forests of Sidodadi Village demonstrates that these forests possess not only economic benefits in the form of timber sales, but also indirect values such as carbon sequestration. Consequently, those who choose not to harvest their trees are contributing to carbon sequestration, thereby mitigating climate change.

Acknowledgement
The author would like to express my sincere gratitude to all those who supported this research, especially the community of Sidodadi Village for their cooperation and valuable insights.

Author Contribution
The author solely conducted the research, including conceptualization, methodology, data collection, analysis, and manuscript writing for this study.

Funding
This research received no external funding.

Ethical Review Board Statement
Not available.

Informed Consent Statement
Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The author declares no conflict of interest.

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