A review of sustainable replanting eucalyptus: higher sustainable productivity

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Abstract. Eucalyptus is a plant that has a very beneficial value to the environment such as can reduce the risk of forest fires, be efficient in water use, nature became more natural, restore land degradation or unproductive land, and the growth of these plants has a sustainable potential for biodiversity. Therefore, the need to replant eucalyptus in order to create a sustainable process for the environment to offers opportunities for wealth and prosperity, while also providing solutions for efficient ways to combat climate change. The purpose of this literature review is to provide information to the public about the benefits of plants that actually have extraordinary functions and characteristics but often get criticism from the community because of community disregard about the benefits. It expects in the future eucalyptus can generate more wealth and benefits to the environment. Also, this review literature focuses on eucalyptus plants which provide significant benefits in various sectors, both for the environment and the industrial sector.

1. Introduction
The growth process of tree plantations around the world is very fast, it is caused by soil fertility and soil carbon storage [1]. So an important challenge that must be faced in the twenty-first century is the system of replanting sustainable eucalyptus forests to meet the demand for wood production and maintain links with biodiversity [2]. In the coming decades, it is estimated that global eucalyptus demand from plantations will increase. Demand for wood is used for the production of paper and pulp wood, but it can also be used for the production of high-quality multipurpose wood [3]

Initially, eucalyptus plants originated from Tasmania, Australia, and other Indo-Malaysia islands, which numbered around 700 plant species. Eucalyptus plants have great value for the environment, the industrial sector uses 37 of the temporary species for commercial purposes only as many as 15 of the existing species. Eucalyptus are derived from Greek eu (wells) and kalyptus (closed) which can be given protection by an operculum [4].

The development of eucalyptus was more than 200 years ago in Europe, starting from the Iberian Peninsula to Portugal in 1829. Mid-19th century as a result of the flow of migration from Australia and New Zealand this plant was introduced in the United States. Eucalyptus plants are widespread throughout the world because they have a broad ecological level and ability to adapt to the global forest surface area, only about 0.53% of the percentage owned by eucalyptus plants is found in more than 90 countries in the tropics and sub-tropics [4].
For more than 60 years ENCE has conducted various studies on eucalyptus plants. Every year thousands of hectares of forest have been created by ENCE, always developing new research techniques to improve the genetic makeup of eucalyptus plants and focus on species productivity to achieve eucalyptus plants with very diverse conditions and have uses to protect nature and the environment. In addition, the ENCE industrial sector has produced more than 4000 stable jobs that are beneficial to the surrounding area. Because of the many benefits, we can get from replanting eucalyptus plants, this literature review is carried out.

Benefits of eucalyptus plants for all sectors [4]:

A. Benefits in the environmental sector

1) Eucalyptus plants are very efficient at capturing CO2, producing oxygen, and improving carbon because these plants have higher growth capacity and dense wood characteristics;
2) Eucalyptus plants act as oxygen storage tanks because of the mass effect in the plants;
3) Eucalyptus plants can improve the amount of carbon CO2 is greater because of rapid renewal and growth every 10 or 15 years;
4) Eucalyptus is more efficient in water consumption than other species;
5) Forests planted with eucalyptus create new natural space and produce biodiversity;
6) Eucalyptus forests can act like natural forests because of their function, even though these plants are not natural forests;
7) Eucalyptus can increase soil fertility;
8) Eucalyptus can restore land degradation or unproductive land;
9) Eucalyptus leaves and stems can act as a nutrient and not acidic for the soil.

B. Benefits in the industrial sector
1) Planting these plants creates employment and wealth in rural areas because using land owned by the community
2) To produce pulp and renewable energy, eucalyptus plants are the right plants to use because they have excellent characteristics
3) Eucalyptus has a quality at a lower cost in making and printing tissue paper.
4) Around the eucalyptus plantations can also be used for many industrial and social purposes raising livestock and hunting
5) There are opportunities for economic and social development in the form of the energy potential offered by eucalyptus biomass

2. Material and Methods

2.1. Methodological aspects of research
To conduct a literature review and identification of opportunities to create sustainability for future research is identified replanting of eucalyptus, some literature has been reviewed. From a research literature review can be interpreted from a methodological point of view as systematic approach was taken to evaluate, interpret journal references and identify review literature

2.1.1. Determine the publication period for the literature to be reviewed
Several studies in the period 2018-020 have been selected as the main reference. The selection of this time period is considered sufficient to represent thoughts about the development of science.

2.1.2. Look for the literature to be reviewed
Therefore, some literature has been identified from four databases: Springer, Scopus, Science Direct and Google Scholar.

2.1.3. Select the literature to review
The main criteria in selecting the literature to be reviewed is to have a clear relationship between the contents of the article and the framework that has been previously defined.

2.1.4. Literature analysis
The next step is to study and examine the articles chosen to find out how the research has progressed over time.

In order to answer to the research questions identified, the research followed the eight steps presented in Figure 3.

![Figure 3. Research methodology](image)

The range of review of this paper is limited from 2018 to 2020, the search thread used to collect data is Sustainable Replanting Eucalyptus. The search was carried out in an online journal database.
Table 1. Literature database search summary (2018-2020)

| Keywords                                    | Journal review                                                                 | Language |
|---------------------------------------------|-------------------------------------------------------------------------------|----------|
| “Sustainable” and “Eucalyptus” and “Replanting” | de Souza et al. [5] C. Medauar et al. [6] Rezende et al. [7] Macana et al. [8] | English  |
| “Sustainable” and “Eucalyptus”             | de Souza et al. [9] Ogunsanwo et al. [10] Paper et al. [11] Schweier et al. [12] Jin et al. [13] | English  |
| “Replanting” and “Eucalyptus”              | Amazonas et al. [14] Bandara and Aththanayake [15] Mailard et al. [16] Voigtländer et al. [17] | English  |
| “Sustainable” and “Replanting”             | Kenney-Lazar et al. [18] Li et al. [19] Vrignan-Brenas et al. [20] Faaij [21] | English  |

Table 2. Number of articles per database

| Database       | Quantity |
|----------------|----------|
| Springer       | 7        |
| Book           | 1        |
| Science Direct | 8        |
| Google Scholar | 19       |
| Total          | 35       |

3. Results and Discussion

3.1. Literature review

This study uses paper review methods available from books, book reviews, editorials, and brief interpretations not counted in the analysis.

Table 3. Literature reviews on various topics in sustainable replanting eucalyptus

| Authors          | Focus                                                                                                                                 |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| Cuong et al. [22] | The relationship between the government and the State towards the planting of eucalyptus, *Acacia mangium*, and manglietia conifer dandy plants |
| Chu et al. [23]  | Replanting native eucalyptus plants in the forest is highly recommended. However, it has several influences on the ecological process. This research was conducted in Southern China and focused on 16 years old eucalyptus to assess the effects of replanting eucalyptus trees |
| Nambiar et al. [24] | On the islands of Sumatra and Kalimantan, Indonesia and in Sabah, Malaysia, changes in species grown from *Acacia mangium* to eucalyptus were caused by two diseases spread and exacerbated by the destruction of humid tropical environments and diverse fauna |
| Ilseven and Bastas [25] | Various botanists, ecologists, foresters and geographers view eucalyptus plants as plants that are harmful to the environment and can only be considered as assets. However, this has not been proven if eucalyptus plants are planted individually |
| Xu and Zhang [26] | This study focuses on evaluating the impact of eucalyptus replanting on flood control and nutrition management capabilities on the environment |
| Costa et al. [27] | This study aims to identify and evaluate the ability to decay naturally occurring fungi on eucalyptus plants |
| Authors                      | Description                                                                                                                                                                                                 |
|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Muthu and Gardetti [28]      | Because of the results of industrialization in today's society, industrial development, increasing population etc. have caused great problems for the environment. Negative trends do not seem to stop and instead increase. Therefore, the need to replant forests to overcome these problems |
| Sharma and Sethi [29]        | Renewable resources can be excessively destroyed as a result of the exploitation of human desire for economic prosperity, material obedience and a desire for pleasure. Therefore, this research focuses on the need for sustainable development planning to solve these problems       |
| Subhan [30]                  | The problem of managing post mining coal through the reclamation of ex-mining land has become a national problem in Indonesia. This research focuses on how to restore environmental sustainability and land reclamation so that environmental problems can be resolved |
| Maghnia et al. [31]          | This research focuses on providing a description of the main objectives of biotic and abiotic reductions as well as knowledge of the impacts of reduced forest degradation                                             |
| Orewere et al. [32]          | The need for sustainable planting as a result of land degradation so as not to become a global problem in the 21st century because of its negative impact on the environment, agronomic productivity and its effect on food security and quality of life |
| Yang et al. [33]             | Yields can increase significantly when replanted and cultivated, but the "benefits of replanting" are unknown as a biological basis. Therefore, to identify candidate genes in eucalyptus plants. So, this research focuses on the use of the RNA-seq technique |
| Shukla et al. [34]           | In most developing countries, wood from the forests in this study is an attempt to obtain and store information about eucalyptus plants in India                                                                 |
| Nyakundi et al. [35]         | To achieve a stable supply of wood for the company, it is necessary to apply forest wood processing through optimal synchronization of plantation forests                                                                 |

3.2. Review

Based on the description in Table 3, it can be concluded that the replanting of native eucalyptus species in the forest is strongly recommended. Many studies have been conducted on eucalyptus, one of which is a study conducted in South China that focuses on 16 years old eucalyptus to assess the effects of replanting eucalyptus trees. While on the islands of Sumatra and Kalimantan, Indonesia and, Sabah, Malaysia, changes were also made to the plants that originally grew Acacia mangium to be converted into eucalyptus. In point 3 also explained the importance of sustainable planting as a result of land degradation so as not to become a global problem in the 21st century due to its negative impact on the environment, agronomic productivity, and its effect on food security and quality of human life.

4. Conclusion

The conclusions that can be drawn after a literature review are as follows:

a. Eucalyptus was first discovered in Australia, but in the Iberian Peninsula, especially in Galicia and in the Cantabria region, it has ideal conditions especially in the soil and climate for the development of these plants so as to produce higher sustainability productivity.

b. There are about 700 species of eucalyptus, all of which have good value for the environment, but the industrial sector uses 37 of these species while only 15 are used for commercial purposes.
c. Even though only 13 million hectares have productivity and are attractive from an industry perspective, eucalyptus plants are now present in more than 90 countries and are spread out over more than 22 million hectares worldwide.

d. Replanting eucalyptus plants has been proven to have so many characteristics and benefits from both the environmental and industrial sectors. These benefits have been explained in detail in this review literature. Therefore, it is very necessary to replant the eucalyptus plants in order to create a process of sustainability into the future.

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