# BIOLOGICAL RESOURCE MANAGEMENT OF BAMBOO

Oleh:

**Amrina Rosyada, S.T.P, M.Agr.Sc.**

**NIP. 199506112024062003**

**FAKULTAS KEHUTANAN DAN LINGKUNGAN**

**INSTITUT PERTANIAN BOGOR**

**2025**

**DAFTAR ISI**

Judul **: Biological Resource Management of Bamboo**

Nama : Amrina Rosyada, S.T.P, M.Agr.Sc

NIP : 199506112024062003

Jabatan : Asisten Ahli

Bogor, 30 Juni 2025

Penulis,

Amrina Rosyada, S.T.P., M.Agr.Sc.

NIP. 199506112024062003

## I. Introduction

Bamboo is a commodity that has many benefits for humans and the environment in the world. Bamboo as non-timber forest product and substitute for wood, has increasingly in demand by ecologists because of its fast and high growth to mitigate climate change. If managed properly, bamboo plantations can conserve soil and air, and increase soil fertility and local conservation. The potential of bamboo is firmly rooted in knowledge and tradition in Asia, South America and Africa, where bamboo has been an integral part of people's lives as far as history is concerned and has more than a thousand documented uses ranging from building materials to food.

The number of uses continues to grow at this time because advances in industrial engineering allow the processing of bamboo into new forms Indonesia is one of the prosperous countries in the world in terms of bamboo resources and bamboo forests area (extension). The area of bamboo plants in Indonesia in 2000 was 2,104,000 ha, consisting of 690,000 hectares of bamboo in the forest area and 1,414,000 hectares in bamboo outside the forest area. Management of bamboo plantation, such as fertilization, pruning, thinning, irrigation, shoot and timber harvesting. Applications of bamboo (timber, food, and conservation and ecology) in general. This application will lead to economic benefits that can improve the welfare of the surrounding community.

## II. Research Objectives

This article presents an overview of bamboo resources in Indonesia, the management of bamboo plantations and the economic role of products obtained from edible bamboo and bamboo shoots. The importance of the bamboo forest environment is also discussed.

## III. Materials and Method

The compilation and compilation material comes from various scientific articles, most of which are published in indexed journals. The information collected is reliable and very new. The introduction contains an introduction to the mportance of bamboo throughout the world and in Indonesia; The biggest bamboo producing country in the world; Bamboo in Indonesia; Climate and Edict for Bamboo Growth. Furthermore, the management of bamboo cultivation will be explained in various fields, bamboo certification, and the use of bamboo in various fields.

## IV. Result and Discussion

There are two major groupings of bamboo, sympodial (Clumping) and monopodial (Running). Sympodial bamboos are the dominant type of bamboo in the tropics The underground stem of a sympodial bamboo is called a rhizome and is made of a network of what look like inter-connected umbrella handles (other rhizomes). Buds (called rhizome buds) sprout off of these rhizomes, turn into shoots when they emerge from the soil and then into culms as the extend into the canopy. The distance between mother and offspring is small, and thus sympodial bamboos grow in clumps. Monopodial bamboos are known as running bamboos, because their rhizomes extend far from the origin of the bamboo plant. Buds emanate from nodes on the rhizome, and can either emerge from the soil as a bamboo shoot or turn into another rhizome. Monopodial bamboos are infrequent in tropical and sub- tropical forests (Rabik, 2003).

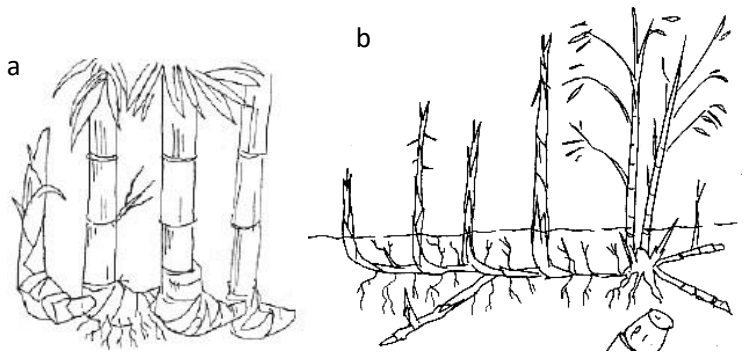


Figure 1

(a) Sympodial bamboo (b) Monopodial bamboo

*4.1 Management of Bamboo Plantation*

The productivity of bamboo is relatively high. Theoretically, the dry weight yield per hectare could total as much as 32-38 tones of biomass per annum. This estimation is based on the efficient use of solar energy by bamboo. In current practices of management, the productivity is still far below this estimation. It is obvious that there is great room for improvement in bamboo management and maximizing productivity. The studies of bamboo management categorize production management practices into 5 end-use categories: timber stand, shoot stand, pulp stand, ornamental stand and water/soil conservation stand. The species and the management systems involved will vary depending upon the end-use. (Somboon, 2001).

Given favourable conditions, bamboo will be the first plant to colonize in a new site in a seed year and the last to leave it. Once established in soil, it is difficult to eradicate it. The rhizomes are found throughout the area where bamboo grows. Bamboo rhizomes give out new shoots to take the place of felled trees, even if bamboos are also felled along with the trees (Maoyi, 1995).

*4.2 Management Techniques for Different Purpose*

Timber Stand. The planned end-product of large-sized monopodial species, is 7/8 year old culms. The density for high, medium and low production is about 3 000,2 225 and 1500 culms per hectare, respectively, with the relative annual yield per hectare of culm timber in fresh weight being 7-10 tonnes, 3.5-7 tonnes and below 3.5 tonnes. A well-managed stand can annually produce 3 tonnes of shoots and 9 tonnes of culm timber per hectare. Shoot Stand. The cultural measures for shoot stand differ from those for timber stand because the former needs better site conditions in terms of light, heat and water. A shoot stand also consumes more mineral nutrients from the soil than a timber stand and hence, the application of organic or chemical fertilizers is important. The reasonable stand density would be 2 225 culms (1 to 6-year-old) per hectare for large-sized monopodial species such as *P. pubescens,* and 9 000 to 12 000 culms (1 to 3-year-old) for medium and small-sized ones. Sympodial species can be planted at 4x5 m or 5x5 m spacing, and each clump can have 6 to 8 culms of 1 to 2 years of age. Bamboo stands managed in this way can produce 10 to 20 tonnes of edible shoots per hectare annually for monopodial species or 10 to 30 tonnes for sympodial ones. (Maoyi, 1995)

Mature culms of desirable sizes are ready for harvest at 3-5 years after planting. Based on observable traits, the following indexes are generally used in identifying a mature culm:

1) Leaf sheaths are naturally detached from the culm;
2) The bark of the culm has a glossy texture;
3) The bark of the culm approaches bronze-like or yellowish colour. (Xu, 2014).

Pulp Stand. To obtain high-quality paper, the raw materials for pulping must have long fibres and low silica and lignin content. It is necessary to remove old stumps and rhizomes periodically. Cutting of the top parts should be avoided since this will make the culm very fragile and is detrimental for pulping. Ornamental Stand. Bamboos grown for ornamental purpose are often characterized by beautiful appearance and colour combination of clump, culm and foliage. (Maoyi, 1995).

Although bamboo can survive in poor soils, it is advantageous to apply fertilizer for optimum growth. Fertilizer can be applied at the rate of 200-300 g per plant after planting and every 3-4 months thereafter. As the clumps become thicker, the rate of fertilizer should also be increased progressively. The application of fertilizer can be scheduled at the start and at the end of the rainy season in areas having pronounced dry and rainy seasons. Organic fertilizers such as compost and manures may also be used in combination with or as a substitute to synthetic fertilizers (Bareja, 2010).

Fertilization should be made some time soon after planting if the situation allow, inorganic fertilizers will be more immediately favorable to the vegetative growth of bamboo plantlets. The following fertilization application rate is recommended for each hectare of bamboo; nitrogen: 20-30 kg; phosphate: 10-15 kg; silica: 20-30kg. The best timing for the first application of inorganic fertilizer is 1 month after planting when the transplanted plantlets have resumed growth, the second fertilization may be performed 4 months later, and then organic fertilizers can be added 6 months later. (Troya and Xu, 2014).

4.3 *Management Techniques for Adult Stand*

Cultivation and Manuring. With organic fertilizer as the dominant part, manure applications can be of tender grass or rape cake in summer and fall, supplemented with a fertilizer such as urea in spring and summer. Application can be done 1-3 times a year (usually just before new shoots emerge, then again when height growth stops, and again just before cold weather begins) and at 10-15 kg/mu (150-225 kg. per hectare) each time. Pruning. The lower branches of the culms should be removed to enhance farm visibility, promote air movement and facilitate ease in fertilization and harvesting. Partial pruning is also recommended to allow passage between clumps especially when planted with narrow spacing. (Troya and Xu, 2014)

Thinning. Thinning or removal of dead, damaged and defective culms is done 3 years after planting. This will promote visibility and provide more space for the growth of new shoots. Getting rid of old balls and rhizomes in a timely manner is regarded as a key to regeneration, rejuvenation, and improved harvest from the bamboo stand. Irrigation and Drainage. Mostly bamboos are water loving but intolerant of being waterlogged. So adequate irrigation is a must in dry seasons while drainage may be a necessity in wet seasons, otherwise growth of the bamboo stand will be negatively affected. Shoot havesting. Studies in China using *Phyllostachys pubescens* have shown that there is a definite advantage to harvesting the shoots while they are still underground with sheaths just appearing above ground. Protein and amino acid content are highest when shoots are still underground. By careful management of bamboo plantations a maximum number of shoots can be encouraged to grow each year. They can then be harvested when they are about 15- 30 cm long, depending on the species. (Troya and Xu, 2014)

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