

# Farm Management Strategic Framework - Revised



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## 1 Introduction

Bamboo Bioproducts International LLC (also known as Bamboo Bioproducts Limited) (BBP) proposes to manufacture bamboo pulp in Jamaica in a sustainable and holistic manner. This bamboo will be cultivated in Jamaica and harvested on a managed and progressive basis, and then processed in a world-class pulp mill using state-of-the-art best available technology. The bamboo pulp will be sold to multinational corporations that produce consumer tissue and personal hygiene products.

The developers propose to construct and operate the first fully integrated Bamboo Market Pulp Mill in the Western Hemisphere that will focus on producing pulp for consumer tissue and personal hygiene products. The pulp mill will be situated on approximately 350 acres of land in Friendship, Westmoreland following a fully sustainable 'Agro-Ecological-Industrial' model. An Environmental Impact Assessment (EIA) report was developed for the construction and operation of the Pulp Mill.

The life of the pulp-mill is expected to be approximately 70 years, which will require a consistent supply of bamboo for efficient production. It is with this in mind that a substantial and permanent investment will be made into the sustainable development of bamboo farms in Jamaica. The proposed mill will have a design capacity to produce 250,000 air-dry metric tonnes (ADt) per annum (MTS pa) of Conventional Baled and Fluff Bamboo Pulp. The mill that will be constructed will follow the typical pulp mill layout and the produced pulp will be exported. To facilitate the logistics, transporting the produced bamboo pulp from the mill for export, will be done using trucking, with an intention to use electric vehicle trucks.

To support the Project, BBP proposes to have their own high-yield bamboo farms, at locations currently under review, as well as provide opportunities for contract farming for various local partners. This Preliminary Farm Management Strategic Framework outlines the steps that will be taken to ensure that farming practices are aligned to preserve the local ecological species of trees, prevent and/mitigate the risks of invasion and fire associated with the farming of bamboo as well as to conform with local requirements and best practice. In this document the overall safety of our environment is considered in the farming process.

As conceptualized, the Project is expected to wholistically (operation of a Pulp Mill and the cultivation of bamboo farms):

- Provide consumer tissue and personal hygiene producers with sustainable non-wood fibres from regionally sourced raw material.
- Contribute to the improvement of Jamaica's macro-economic performance and employment opportunities.
- Revitalize local rural communities, by focusing on 5 core principles of community life: ecology and environment; housing; community and well-being; education and training; and business and employment.



## 2 Bamboo Species Description

### 2.1 *Bambusa vulgaris*

*Bambusa vulgaris*, also known as “common bamboo”, is an open-clump type bamboo species. It is native to Indochina (Vietnam, Laos, and Cambodia) and to the province of Yunnan in southern China, but it has been widely cultivated in many other places and has become naturalized in several regions. Among bamboo species, it is one of the largest and most easily recognized.

#### 2.1.1 Classification of *Bambusa vulgaris*

In Jamaica, the *Bambusa vulgaris* is listed as an Invasive Alien Species. An Invasive Alien Species is defined by the Forestry Department as a deliberately or accidentally introduced species to an area different from its native range. The Forestry Department, through its Forestry Stewardship Council DRAFT Interim National Standard of Jamaica (2022), shall only use alien species when knowledge and/or experience have shown that any invasive impacts can be controlled.

Jamaica is a member of the International Bamboo and Rattan Organization (INBAR) since 2012. Jamaica’s designated focal point with INBAR is the Bureau of Standards of Jamaica (BSJ). INBAR has conducted research into the management of invasive species. In a 2016 report published by INBAR, the research analysed the types of invasive bamboo and the methods that countries can adopt to mitigate these risks. The report showed that, “although some bamboo species are known to be invasive, particularly ‘running’ bamboo species, many are not invasive in nature and pose no threat to natural environments,” (INBAR, 2016). INBAR has also concluded that there is information accessible to knowledge resources to effectively manage the species with a number of easy ways to reduce the risks of bamboo invasion. Some of these ways are through the implementation of preventative measures, assessing the risks of introducing bamboo species, enacting legislation and regulations to restrict the planting and use of certain species of bamboo and effective management strategies. The BSJ, the designated focal point, has also published the **JCP 8: 2021 Jamaican Standard Code of Practice for Bamboo Plantation** (2021) to guide the preparation and management of bamboo plantations in Jamaica.

Bamboo species are divided into two classes: Monopodials, also considered as invasive bamboos, and Sympodials, considered as non-invasive in nature. Monopodial bamboos are subtropical. They have long and thin rhizomes that quickly spread subterraneously in an unpredictable direction and the new shoots-poles appear in whatever place. This spreading speed is the main reason why many people have the misperception that all bamboos are invaders. Monopodial bamboos are runners or invaders. They grow in cold and temperate climates. The most important genus that covers this kind of bamboos is *Phyllostachys*.

Sympodial bamboos are tropical. They have short and strong rhizomes that grow in a circular shape forming aerially conglomerates of shoots-poles. These conglomerates are called clumps. Clumps are on average 1.5 m in diameter and when they reach this size they do not grow any further sideways. Sympodial bamboos are not invasive. They grow in tropical climates. The most important genus that covers this kind of bamboos are *Bambusa* and *Dendrocalamus*. The species *Bambusa vulgaris* is a sympodial bamboo and it is not invasive. Non-invasive bamboos do not need special control care to propagate naturally due to their growth type. A hectare planted with this bamboo species will always be a hectare.

### 2.1.2 Description

*Bambusa vulgaris* forms moderately loose clumps and has no thorns. It has lemon-yellow culms (stems) with green stripes and dark green leaves. Stems are not straight, not easy to split, inflexible, thick-walled, and initially strong. The densely tufted culms grow 10–20 m (30–70 ft) high and 4–10 cm (2–4 in) thick. Culms are basally straight or flexuose (bent alternately in different directions), drooping at the tips. Culm walls are slightly thick. Nodes are slightly inflated. Internodes are 20–45 cm (7.9–17.7 in). Several branches develop from mid-culm nodes and above. Culm leaves are deciduous with leaf blades narrowly lanceolate.

Flowering is rare, and there are no seeds (BSJ, 2021). Fruits are rare due to low pollen viability caused by irregular meiosis. At the interval of several decades, the whole population of an area blooms at once, and individual stems bear many flowers which is never seen locally in Jamaica. Vegetation propagates through clump division, by rhizome, stem and branch cutting, layering, and marcotting. The easiest and most practiced cultivation method is culm or branch cutting. When a stem dies, the clump usually survives. A clump can grow out of stem used for poles, fences, props, stakes, or posts. Its rhizomes extend up to 80 cm before turning upward to create open, fast-spreading clumps.

### 2.1.3 Ecology

*B. vulgaris* grows mostly on riverbanks, roadsides, wastelands, and open ground, generally in the low altitudes. It is a preferred species for erosion control. It grows best under humid conditions but can tolerate unfavourable conditions, like low temperatures and drought. Though adoptable to a wide range of soils, common bamboo grows more vigorously on moist soils. It can tolerate frost down to  $-3^{\circ}\text{C}$  ( $27^{\circ}\text{F}$ ) and can grow on ground up to 1,500 m (4,900 ft) above sea level, though in higher altitudes stems grow shorter and thinner. In extreme droughts, it may defoliate completely.

### 2.1.4 Pests

The two major threats to the species are small bamboo borers (*Dinoderus minutus*), which as adults bore stems, and bamboo weevils (*Cyrtotrachelus longimanus*), which destroy shoots during their larval stage. Other pests include leaf blight (*Cercospora*), basal culm rot (*Fusarium*), culm sheath rot (*Glomerella onductin*), leaf rust (*Kweilingia divina*), and leaf spots (*Dactylaria*). Also, bamboo blight caused by *Sarocladium oryzae* is a serious disease.

## 3 Bamboo Production Plan

### 3.1 Nursery Management

An initial two-acre nursery plot will be established in Westmoreland, at the current site undergoing test plot investigations, Jamaica to supply planting material for approximately 5000 hectares of bamboo located within the parish. All established nurseries will be located within a 25 km radius of all bamboo farms within the parish and transported in closed trucks to the farms. All nursery areas will be fenced and have 24-hour armed security onsite, with a closed-circuit camera system that covers the entire area of the nursery. Records of all entrances and exits of vehicles will be recorded with the numbers of plant being transported also recorded. All planting material will be made available through the established nurseries operated by BBP. Any contracted farmer found using plants not received through BBP will be immediately removed from the program.

Seedlings (Clumps) will be planted in bio-degradable plastic grow bags with a mixture of humus, sand and soil as the planting medium. Organic matter produced during the operation of the mill and the on-farm shaving of bamboo poles will be reused in the nursery as part of the planting medium. All nurseries will be fitted with drip irrigation systems to supply water in an efficient manner with the installation of a venturi pump for the addition of nutrients through fertigation. Pest and Disease Management best practices will be employed with the Integrated Pest Management model adopted to minimize the excess use of harsh chemicals.

### 3.2 Land Preparation

#### 3.2.1 Site Selection

*Bambusa vulgaris* is a species of bamboo that is widely adapted to most environmental conditions but prefers humid conditions. It can be grown on areas of marginal lands, highly adaptable to drought conditions and can be grown on a wide range of soil type and pH. Commercially, mechanized farming of bamboo, however, requires large areas of flat land that can be easily cultivated and harvested using machinery.

The site selection for bamboo farms that will provide feedstock for the proposed Bamboo Pulp Mill will be guided by a Strategic Environmental Assessment (SEA) which will also assess the site-specific impacts, risks and mitigative measures. The areas considered in the SEA should use certain criteria for the final selection of sites, such as allowing for mechanization, and the consideration of other risk factors such as: the proximity to communities, the proximity to water bodies and the creation of ecological buffer zones. Within the SEA, a rapid environmental, social, and ecological assessment will be done for each potential site to determine the impact on any environmentally sensitive flora and fauna or any other social impact that may result from establishing a bamboo farm in that area. Where impacts are identified, strong mitigation measure will be implemented and monitored independently. A buffer zone of a minimum of 50ft shall remain around any lands being cleared for planting but will be superseded by recommendations from the environmental assessment if it is recommended to be larger. Once these criteria are met, and the sites have been finalised, then the next step is to start the land clearing process.

### 3.2.2 Land Clearing

Land clearing requires the removal of native cover including trees, bushes, and boulders from the land surface. The land is subsequently broken to create a workable bed into which bamboo cuttings will be planted. Land breaking includes the removal of roots, stumps, and rocks. Each site will be assessed before the clearing process begins. This will be achieved by using appropriate machines, which include, but would not be limited to - Tractors with appropriate attachments, D6, D9.

Land clearing will be done during the months of January-March, which is the traditional dry season. This will minimize the direct exposure of soil and reduce the likelihood of soil erosion due to the clearing process. Land clearing will be done for areas that are being planted and a 10-metre area around the field for ease of movement. Buffer zones of 50 ft will be maintained around each cleared plot of land to reduce the risk of fire hazards and minimize fugitive dust and particulate matter drifting into nearby communities and/or water bodies.

### 3.2.3 Ploughing

Ploughing in agriculture involves the breaking up of soil in preparation for cultivation. This includes three (3) operations: ploughing, harrowing, and tilling. This will be done on bamboo farms using tractors affixed with different implements to carry out each operation. The main objective of ploughing is to aerate the soil, break up soil clods, manage weeds, improve soil internal drainage, remove debris and stones, incorporate soil amendment, if necessary and add nutrients, if necessary. The addition of soil amendments and nutrients will be determined by conducting chemical and biological soil tests on all areas slated for planting. Ploughing will be done during the dry months of the year March-April.

Spacing between rows after tilling will be no less than 6 metres, to accommodate the movement of machinery and equipment throughout field. The ploughing of land leaves the soil susceptible to soil erosion by wind and rainfall. Ploughing will be carried out during the months of March-April with the minimum rainfall recorded during this time of the year. Buffer zones around each cultivated area should minimize erosion by wind and reduce the drifting of dust during windy conditions. Minimum tillage will be practiced within areas that are planted and will not be reploughed for a minimum of 10 years.

### 3.2.4 Drainage

Agricultural drainage is the removal of excess water, known as free water or gravitational water, from the surface soil or below to create favourable soil conditions for plant growth. Drainage also deals with the lowering of the groundwater table (GWT) below the root zone of the crops to improve the plant growth in some cases or reduce the accumulation of salt in the crop root zone. This is through a process called ripping, which improves internal drainage of the soil. Drains will be constructed around the periphery of each field. The drainage design for each field will also be determined by the natural drainage capabilities of the land which will be assessed using drone technology to map and inform the designs. The drains shall be no less than 5 ft wide and 3 ft in depth, unless required to be greater after the mapping assessment. The construction of drainages should reduce water logging in soil, prevent nutrient loss from soil, control erosion, enhance soil microbial activities and improve the overall soil condition for the growth of the crop. The placement of drains shall also act as a method of preventing the bamboo roots from spreading into the buffer zones. Exposed roots seen growing into drains will be removed to contain growth within field areas.

### 3.3 Planting the Bamboo

*Bambusa vulgaris* will be planted using planting materials derived from vegetative propagation at the farm's nursery plots in Friendship, Westmoreland. Planting will be done during the months of May-June, which is usually the traditional spring rainy season. This should minimize the need for irrigation water that is critical during the transplanting phase of the bamboo. Planting will be done manually, by hand. Planting materials will be primarily prepared within nurseries. The transportation of planting material will be done between farms using an enclosed and secured vehicle to prevent material loss and the inadvertent contamination of other areas. Records of the date, time, location, persons involved, and the amount being transported will be kept for the monitoring of these materials.

### 3.4 Irrigation

Irrigation is the process of applying water to the crops artificially to fulfil their water requirements. Bamboo requires a lot of water, especially during the first 2-3 months of planting. Planting during the spring rainy season will help in supplying some of the water needed by the crop. Artificial drip irrigation systems will be in place to ensure that there is an adequate water supply throughout the crop production cycle. Adequate water reduces leaf drop, which can further reduce fire hazards on the farm.

### 3.5 Nutrition Management

Plant nutrients are elements that are essential for plant growth and reproduction. They are available in the soil (e.g., nitrogen, phosphorus, and potassium), or from air or water (carbon, hydrogen, oxygen). When existing soil nutrients are determined to be insufficient as prescribed by a soil test, additional nutrients will be added. Primary sources of nutrients will be taken from organic sources such as manure, compost or biosolids. Commercial fertilizers will only be applied in extreme cases where all other methods have failed to improve soil conditions.

### 3.6 Pest and Disease Management

Pest and disease management involves a range of activities that are carried out daily to prevent the infestation of pest into cultivated fields. The Integrated Pest Management (IPM) approach will be adopted to manage any pest infestation that is observed. The primary focus, however, is to prevent the occurrence of these infestation by implementing protocols to prevent the transfer of pest and disease from one farm to another. Where pests are identified, all organic, mechanical, and cultural methods of treatment must be exhausted before the use chemical treatments are considered. Workers must wear the appropriate safety apparatus during the application of such chemicals.

### 3.7 Field Maintenance

Rows between plants will be ploughed every 8-12 weeks using a tractor with the appropriate attachments to incorporate leaf litter into the soil. This will greatly reduce the risk of fires. Drains will be maintained, as needed, with the observation of root growth to be done weekly along drain edge for control of root growth outside of field area. Ten metre (10m) access roads around fields will be maintained to ensure accessibility to emergency vehicles and to deter unwanted rodents. Buffer zones (100 ft) will be maintained around the fields by the planting of fast-growing buffer crop or fruit trees. This will be done where it is determined that the natural vegetation is not adequate.



### 3.8 Crop Maturity (Reproductivity Capabilities)

Flowering is rare, and there are no seeds. Fruits are rare due to low pollen viability caused by irregular meiosis. At the interval of several decades, the whole population of an area blooms at once, and individual stems bear many flowers which is never seen locally in Jamaica.

### 3.9 Harvesting and Transporting

The *B. vulgaris* will be harvested using a combination of cultural and manual harvesting methods. Fields will be selected based on age, with a 4-year maturity timeline on each plot. Harvesting bamboo involves cutting from the base to allow the natural regenerative process of the plant to take place. Fell bamboo poles will be completely stripped or de-branched in field with a monitoring process in place, to ensure that no branch is transported to the factory. Biomass left over from the stripping process, that will not be used in the manufacturing process, will be grinded into pieces and used to create compost, which will then be added to the field after it has been broken down to aid in soil fertility. Additionally, farm owners will have a choice to create a kiln that converts the excess biomass into biochar, which will then be incorporated in the fields as a source of soil nutrients. The kiln will be guided by sustainable management and best practices. Transportation of shaved bamboo poles from farms to the Pulp Mill will be done primarily in cane cart trucks to accommodate the length of the bamboo. The transportation of pulp material will also be transported in a secured enclosed truck.

## 4 Fire Prevention

Bamboo farming present a fire risk. This risk must be mitigated against by the implementation fire prevention and containment measures. Buffer zones of no less than 50 ft will be created between farms and other areas. Where applicable and practical, fire-resistant crops (e.g., succulents) should be planted in those buffer areas. Installation of drains around the periphery of each farming plot will be done with a 10-metre road space for the ease of access to emergency vehicles in the event of a fire. Also a 6-metre space will be maintained between each field row to also allow emergency vehicles to access all areas of the farm. Contracted farmers will be required to have a minimum storage of 2000 gallons of water in tanks or otherwise on farms to aid fire control. Bamboo plants will be maintained under drip irrigation throughout the crop cycle to reduce leaf drop and where leaf drop occurs, a 8-12 weeks ploughing programme will be maintained to incorporate excess leaf litter into the soil. Also, a zero-tolerance fire policy will be enforced on all contracted farms and with all farmers to prevent the use of fire to clear lands or if used for any other purpose. Those found in breach will face the possibility of expulsion from the contract and programme of growing bamboo.

## 5 Land Remediation Strategy

Land Remediation for BBP includes any remediation measures needed on both BBP farms and on external contracted farms. BBP will appoint a Farm Liaison Officer/s to continuously monitor farms to ensure buffer zones are maintained and containment of the bamboo plants protocols are being adhered to. The number to Farming Liaison Officers will be dependent on the location, size and number of farms. Any breach of containment will be responded to immediately by extracting all plant material (root, shoot, stem) identified in unauthorized area. The use of tractors, trucks bulldozers and farm personnel will be used to effectively remove all material found outside farm boundaries. An assessment will be done to ascertain the extent of breach which will then guide the level of response to effectively remove the plant

in the shortest possible time. Additionally, a Grievance Mechanism will be in place to address any concerns/issues that may arise from contracted farmers, community members or the general public. The Grievance Mechanism will be managed by BBP through its Farm Liaison Officer.

In the event of natural hazard events, such as hurricanes, flooding, etc., a risk assessment will be conducted of surrounding areas within a 10-15 km radius of the farm prior to a potential hazard event. After a hurricane event, these areas will be monitored and rapidly assessed using drone technology to identify areas that need an immediate response to remove all bamboo plant material.

## 6 Training of Contracted Farmers and Drivers

The aim of this training will be to ensure that that all farm management practices outlined by the Farm Management Plan (to be developed) from Bamboo Bioproducts are adhered to and are being followed meticulously by contracted farmers. Trainings will be continuous and ongoing to ensure that contractors are compliant. The following training topics will be covered:

- On-farm fire prevention and mitigation measures.
- Protocols for the Harvesting and Transportation of bamboo poles and the process to repurposing of additional biomass.
- Field and drainage designs with the appropriate buffer zone areas observed.
- Protocols for transporting and receiving planting materials.
- Training for farmers on best practices for environmentally friendly land preparation, nutrition management, pest and disease management, as well as, how to identify and handle native, endemic and threatened fauna and flora species that may be encountered.
- Training for farmers on the risks of bamboo farming to our local flora and fauna as part of a strategy to contain all bamboo plant material on farm.
- Training for farmers on the use of native and endemic species in the buffer zones as a part of the strategy to compensate for biodiversity loss.
- Farms and drivers will be routinely audited to ensure that protocols are being followed and where breaches are found appropriate measures are taken.

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