

## **REHABILITATION**

The plant Nursery is expected to have **adequate** numbers and sizes of required seedlings of specified coastal indigenous plants vegetation to diversify vegetation from pioneer tree plantations to coastal indigenous forest.

Substrates used at the plant nursery include overburden, river sand, and manure; Common agricultural tools are used at the Plant nursery and they include spades, trowels, *jembes*, wheelbarrows, secateurs, knives, bow saw, buckets, watering cans, Hose pipes, sprinklers.

Our Propagules include seeds, and cuttings, Consumables: polythene planting tubing or planting bags, labels, mark pens, counter books, stationary counter books, receipt books, gate pass books.

The required Infrastructure includes water supply, water tanks, store, office, seedling enclosures. Seedling preparation time from sowing to grow to planting size depends on individual species. This ranges between 6 to 36 months respectively.

### **Preparations:**

Seedling requirements are identified for non-standard pioneer species (1yr in advance) At the same time seedlings requirements for enrichment planting (2-3yrs in advance) Seed / *propagule* sourcing are also identified. Propagation trials for new species are also undertaken. List of species and specifications required each season/yr are also obtained at this stage. Planning production program and schedules are established and Propagation information through research (with other experts) or experimental trials are obtained from this point.

### **Activity description**

The following is a sequence of event/tasks as carried out at the Plant nursery. First of all seeds are sourced from various places followed by treatment at the nursery. Seedbeds for the next action are carried out after which the selected and prepared seeds are sowed. After a period of 1-2 weeks seedlings are then pricked out into bags. It must be noted that Propagation through cuttings may call for a separate procedure and so the propagation through layering. Seedling care is undertaken to ensure healthy adaptation and growth. This care involves watering, root pruning, adjust light conditions among others. Finally all the above is followed by preparation for planting out (hardening to sunlight).

Due to the rigorous nature of the plant preparation process, the following are used as control points for the process.

1. number of seedlings and species produced vs. i.e. production request
2. seedling height for transplanting: >0.5m
3. roots not extending out of planting bags (roots pruned regularly)
4. roots not curled in the planting bags
5. seedlings labeled (species name, seed origin, sowing date)
6. buffer stock for replacement

7. seedlings hardened
8. cost per seedling
9. reports

The plant nursery section interfaces with other departments in the Lafarge Ecosystems in many ways. They include seedling requests from Tourism Department such as indigenous ornamentals and palms for replacement in the gardens, seedling requirements for butterfly food plants and many more. There are also special seedling requirements for Ecosystems Maintenance. This is in the form of fodder plants, food plant replacements, indigenous ornamentals for exhibits and landscaping works around facilities.

## **LAND PREPARATION**

### **Ripping and Leveling**

As a standard practice, the quarry floor is ripped and leveled in preparation for planting pioneer trees. This process helps in softening the ground to allow root penetration for successful establishment of pioneer trees.



Ripping ensures that Quarry floor has been ripped with a bulldozer or equivalent equipment, and the solid rock substrate broken to allow access for tree roots to ground water. Ripping lines are at a distance of not more than 2m distance. Ripped surface has been leveled by pulling the Cat shovel over the ripped ground, creating a level surface (level difference between extruding rocks & holes of not more than 0.3m in extreme; general level difference <0.2m). If ripping on a slope, ripping lines to follow contours. Machine models CATD7/D8/D9 are used in ripping our lands and are able to rip an average of between 8-11h/ha a day (depending on hardness of substrate).

Ripping is based on sound preparations that include Planning based on annual rehabilitation work plan (*or handing-over procedure*), Budgeting approval year before (if external equipment), request for equipment hire through purchasing department, site visit with the relevant Dept (or contractor) approx. 1 week prior to requested operation date – confirmation of agreed operations and dates in writing, identify and chalk-mark area for ripping , instruct operator(s) and

rehabilitation. Supervisor 1 day prior to start of work, mark operations area with barrier tape if accidental intrusion is likely.

### **Actual ripping process**

Actual ripping and leveling process involves Written instructions that has been signed off by relevant authority, ripping quarry floor with ripper teeth on the back of the D9. Ripping is carried out as deep as possible (approx. 1m). Ripping machine is turned at the end of the line (not ripping forward only and reversing), or level while reversing. Leveling is done by reversing and pushing shovel onto the ground so as to even out protruding rocks and cover holes and crevices created during ripping. Frequent supervision during operation by Land Use Planner or equivalent and relevant authority is done at least twice per day. Inspection on completion of the ripping exercise is officially signed off by Land Utilization Manager/ Land Use Planner----confirm??.

### **Controls**

Ripping exercise has a number of control points that serve as our key performance indicators. First of all, the area being ripped must remain as specified in written, signed instructions agreement. Ripping depth must be maintained at +/-1m. This is enforced by site supervision during operations. The final level smooth (level variations <0.3m) must be emphasized during this operation. Finally the operation must be completed within budgeted time and -cost in case of external equipment

### **Communication**

During the ripping operations, communication stands out as a vital part of the process. Work plan communication within department is carried out effectively and within specified time frame. Rehabilitation authorities instruct rehabilitation team and machine supervisor on area to be ripped and the actual operations to carry out. Emergency numbers to operator, supervisor in case of break-downs or other problems.

### **Interfaces with other Departments**



To begin with, work plan communication with Mombasa Plant (Bamburi Cement) is done in early January for the year. This is followed by request for equipment allocation or even hire

through purchasing department. There is also continued work organization and coordination with Quarry teams or contractors. Information to Lafarge Ecosystems tourism and ecosystems departments is also maintained. If operations are close to tourism/ecosystems operational areas security is informed. In case of any changes to the original quarry operations program, relevant authority in the Quarry /contractor informs Land use Officer immediately. These changes could be equipment failure or breakdown, any interruption of operations for other reasons or due to site conditions among others. Land use Planner or Rehabilitation supervisor informs Land Utilization Manager or Chief operating Officer in case of changes in original program due to site conditions. Where heavy machinery and intensive works will be carried, prior arrangement are made with other departments so as to ensure harmony of operations with other departments or sections.

### **PIONEER TREE PLANTING**

The expected results for Pioneer planting during rehabilitation is a well established plantations of pioneer trees

#### **Pioneer planting**

This process involves setting up planting plots and Planting seedlings, followed by staking, then protecting and finally replacing any mortality of the seedlings. This is in most cases on a fresh quarry land. In many instances *Casuarina equisetifolia* is mixed with *Conocarpus lancifolius*, *Albizia verticolor*, and other species as per specific planting plans. Expected survival rate after 1yr is 90% in low-level plantations. During Pioneer tree planting we organize our Manpower into teams of 1 team leader and 5 attendants to implement this function.

#### **Materials**

Substrates in the quarry floor is ripped and leveled. During this process basic tools such as planting pegs, knives and others are used for marking the sites.

Individual Seedling species are prepared as per planting plans: size 0.3-0.5m and as per specifications. It takes is one year for full plantation establishment.

Lafarge Eco systems standards require that quarrying is done to a level of 20-60cm above groundwater level. The rehabilitation team ensures that quarry floor is ripped and leveled, rehabilitation annual work plan is developed, seedlings are purchased or propagated and that finally that coordination with rainy season (ideally plant early in the rainy season).

#### **Actual process**

This process involves setting up planting plots (100x100m plots) and extend existing gridline system into new plantation (or establish new system); allow for 5m-wide grid roads at 100m distance. This is followed by marking plant locations with sisal string (and species to plant in multi-species plantations). Planting seedlings is undertaken, followed by staking, then protecting and finally replacing any mortality of the seedlings. Records of the success story of this process marks the official end of this process.

## Controls



In pioneer planting, it's important to establish meaningful control points, key achievements or Key performance indicators. Lafarge Ecosystems uses a number of guidelines to achieve this.

First of all planting plots are set up as per work plan (annual objectives on maps). Plant locations and species are planted as per planting plan. Seedling quality as per planting are set as per specifications (as specified in 4.2. planting seedlings sub-procedure). All seedlings leaning at  $<45^\circ$  are staked in order to enhance successful adaptation and growth. Seedlings in South Quarry are protected from browsing, while in the other quarries they are treated as the need arises. Finally survival count is conducted after 1yr to assess survival rate of the planted species and populations.

## MAINTAINING PIONEER TREE PLANTATIONS

The Purpose and objective of this activity is to ensure Healthy and secure plantations with high visibility up to 2m above ground, and a final pioneer tree density of half the original tree density.

Maintaining pioneer tree plantations is an activity that falls under rehabilitation process is a stage that specifically and critically maintains young pioneer tree plantations. This document therefore describes how young pioneer plantations are maintained for plantation health and security.

General Safety Rules associated with this process.

Other than the specific rules per each activity, the following general safety rules are applied in all sites of pioneer plantation maintenance activities.

- The team leader is responsible for assessing the risks of the job being performed. In case of thinning of trees of  $>2''$  diameter, he goes through risk assessment checklist with the team, assess and addresses risks present, or aborts operation if risks cannot be mitigated; fills checklist, signs and keeps it with him on site
- Entire team required to wear mandatory personal protective equipments (overalls, safety boots, helmets and hand gloves) at all times while working in the forest

- All accidents requiring first aid and worse and incidents must be reported immediately by mobile phone reporting to site supervisor, Safety Environment and Health (SHE) representative, Safety and Logistics Officer or Head of Department.
- Inspect all tools prior to use (during issuing in the morning) to ensure no defective or blunt tools are used (see tool inspection check list)
- Maintain a clean work place and all tools need to be cleaned after work & checked back into the store
- Site to be cleaned up of debris immediately after the completion of the task and before leaving the site.
- Fully-stocked portable first-aid kit to be on site at all time; team leader to be in charge of first aid, or appoints first aider in charge

## **Pruning**

To carry out effective pruning in the rehabilitation plantations, such requirements as manpower, suitable materials as well as safety (Personal Protective equipments) are considered.

A small team comprising of 1 team leader and 5 attendants, equipped with Pruning saws, secateurs, and *Pangas* (machetes) carry out this function. This rehabilitation team dress in standard and approved safety gear (shoes, overall, hard hats, and hand gloves).

The above team is capable of carrying out effective pruning to the speed of 12-20 man-days /ha (depending on browsing damage and excess of branching)

It must be noted that before the above function is undertaken, an assessment of pruning need is conducted (Trees >2m high, person at 10-15m distance cannot be seen).

### **Actual pruning process**

**First pruning** During the first pruning, all branches below 1.2m are cut off with *panga* (*machete*), pruning saw, secateurs.

**Second pruning** is conducted by cutting off all branches below 2m with *panga*, pruning saw, secateurs and leave to rot.

### **Quality standards**

To ensure quality standards during the pruning process certain activities are followed strictly.

First branches cut off at not more than 1cm from stem

Secondly the bark should not be allowed to shear off from the stem at pruning points (no injury to the bark below pruning point).

As a standard practice, clear control points are established to provide guidelines to this process.

They may be Key achievement points or performance indicators.

First of all, Clear view through plantation at height below pruning height (<1.2m yr1; <2m yr2) must be enhanced. Secondly all the above preliminary quality standards are fulfilled at all levels and to acceptable details.

### **Thinning**

Thinning is a rehabilitation activity that follows pruning. First thinning is done 3 years after

planting. Second thinning follows 5 years after planting (2 years after first thinning) This process involves identification of a pattern of trees to be removed.

### **Activity Description**

First thinning is carried out after 3 yrs initial removal of 25% of original plantation trees is conducted (= 625 of 2500 = every 2nd tree of every second row is removed :)

- row 1: left intact
- row 2: every 2nd tree removed (= 25trees/row)
- row 3: left intact
- row 4: every 2ndtree removed
- others follow the same sequence
- No. of trees that remains: 1875/ha

**Second thinning is conducted 5 yrs after planting and involves removal of another 25% of initial stand (= 625 of orig. 2500), as first thinning, but the rows originally left intact**

- row 1: remove every 2nd tree (= 25trees/row)
- row 2: left intact
- row 3: remove every 2ndtree
- row 4: left intact.

**The final number of trees remains at 1250/ha**

**Third thinning is carried out 10 years after planting. This involves removal of another 50% of remaining stand (= 625 of1250), by removing all trees in every second row**

- row 1: remove all remaining trees
- row 2: left as is
- row 3: remove all remaining trees
- row 4: left as is

**Final number of trees remains at 625/ha.**