PLANTATION MODELS AND COST NORMS

Indo-German Development Cooperation

Climate Change Adaptation Programme in the Himalaya, Component II: Tripura – Climate Resilience of Forest Ecosystems, Biodiversity & Adaptive Capacities of Forest Dependent Communities

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GOPA WORLDWIDE CONSULTANTS

in association with:

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(Sub-Consultant)

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Acronyms

ANR	Assisted/Aided Natural Regeneration
AR	Artificial Regeneration
CCA	Community Conserved Area
DL	Daily Labour
FRA	Forest Rights Act
FYM	Farm Yard Manure
HDB	High Density Bamboo Plantation
INR	Indian National Rupee
JFMC	Joint Forest Management Committee
VDP	Village Development Plan

1 Introduction

Besides reducing climate vulnerability of the forest-dependent communities, the management of forestland for climate resiliency and undertaking mitigation measures for minimizing the adverse impacts of climate change on biodiversity are two important objectives of CREFLAT project. This is very much manifested in the three key outputs of the CREFLAT Project as envisaged in Results-Matrix (i.e., Outputs 2,3 and 4). Therefore, plantations on either government-owned forestland or privately owned land including the patta land having the usage rights of people under Forests Right Act (FRA), are the target degraded forest lands for plantation interventions under the project. Since plantation activities combined with soil and water conservation based on a participatory approach are the main strategy for climate change mitigation under the project, it is desirable that these interventions in identified landscapes are planned/designed in a most scientific and appropriate manner optimizing the available resources so that the envisaged objectives are achieved. Hence all the plantation models have been conceived in a way that these conform to the project outputs and indicators as stated in the separate agreement/Results Matrix with sustainable management concept defined.

1.1 Relevant CREFLAT Project outputs directly linked to plantation

The plantation models need to be selected conforming to the following three project outputs as mentioned in the Annexure 1 of the Separate Agreement:

- Output 2: Climate resilient forestland management implemented: 14,600 ha area to be treated, 420 earthen check dams to be created, and 60 springs to be rejuvenated.
- Output 3: Measures for mitigating adverse climate impacts on biodiversity applied: 3,500 ha area covered under various community biodiversity conservation measures.
- Output 4: Natural resources products processing and marketing supported: 11 farm and forest product centres, 43 certified entities and 4 organic value chains.

1.2 Plantation models aligned with the CREFLAT Project Indicators

The CREFLAT project has five indicators to measure its success. These are:

1) Forest cover is maintained while crown coverage is increased: No decrease in forest cover compared to the baseline, while the crown cover of forest should increase by 5%.

2) Forest biomass increased: Increase in above ground biomass stock in degraded forest areas by a minimum of 2-3% per year. No decrease in growing stock biomass in the moderately dense and dense forest classes.

3) Total income as well as income diversity of target population is increased: Household income increased by 15% and 25% of households show income diversity from the project.

4) Biodiversity increased: Biodiversity indices including Shannon's index show an increase of more than 5% compared to the baseline.

5) Reduced climate vulnerability of the target groups: Reduced by 10% the number of households falling in the vulnerable category.

1.3 Need for more plantation models

To achieve the above outputs and indicators, and based on early field assessment of the project area, it was felt that there is a need to add a few more plantation models under the project than what was proposed in the Feasibility study report. The Separate Agreement provides such scope under "open Project Approach" vide Clause 1.1.13. While adding the new plantation models, several interactions

with the members of JFMCs and other villagers of the proposed project villages were undertaken. People's preference/need was captured, and accordingly their choices were given top priority.

1.4 Process followed to select new planation models

The feedback from the community was received during the VDP preparation in Sukhnacherra Village and informal interactions with the other villagers during physical verification of already established plantations under the project during the years 2021-22 and 2022-23. The people's preferences were aligned with the above listed project indicators, and outputs mentioned in Results matrix i.e., Annexure 1 of the Separate Agreement. The proposed plantation models were discussed at several levels including in villages while undertaking the preliminary village development planning exercise. Finally, a workshop was convened at Ambassa on 16 November 2022 involving forest field officials and village representatives, where the models and the respective cost norms were discussed in detail and final recommendations were made (Annexure 1).

All the plantation models added have direct relevance to climate change adaptation, biodiversity conservation, ecosystem service restoration, livelihood improvement and diversification, and value chain development for forest products.

2 Plantation Models

2.1 Plantation models recommended

In addition to the four models mentioned in the Feasibility Report viz., Energy plantation, Aided Natural Regeneration (ANR), High Density Bamboo Plantation, and Three-tier plantation on *patta* land, seven additional models have been suggested (Table 1), which have high potential to contribute to the project objectives during the given project duration.

The code numbers for Outputs and Indicators relevant to the plantation activities are:

- Output 2: Climate resilient forestland management implemented;
- Output 3: Measures for mitigating adverse climate impacts on biodiversity applied;
- Output 4: Natural resources products processing and marketing supported; and

- Indicator 1: Forest cover is maintained while crown coverage is increased;
- Indicator 2: Forest biomass increased;
- Indicator 3: Total income as well as income diversity of target population is increased;
- Indicator 4: Biodiversity increased;
- Indicator 5: Reduced climate vulnerability of the target groups.

Table 1. Plantation models recommended for CREFLAT project.

Sl. No.	Plantation Model Code	Models	Contribution to Indicator	Contribution to Output	Total Area to be covered (ha)	Plants/ha	Total Plants to be Planted
MODELS: Aided / Assisted Natural Regeneration (ANR)							
1	ANR 1	ANR in regenerating degraded forest	1, 2 and 4	2	1000	250	250000
2	ANR 2	Biodiversity Conservation	1, 2, 3 and 4	2, 3	1000	250	250000
3	ANR 3	Catchment area protection	1, 2, 4 and 5	2, 3	1500	250	375000
4	ANR 4	Enrichment plantation	1, 2, 4 and 5	2	1500	250	375000
MODELS: Artificial Regeneration (AR)							
5	AR 1	Energy Plantation	1, 2, 4 and 5	2 and 3	400	1111	444400
6	AR 2	Wild Edible Fruit Tree Plantation	1, 2, 3, 4 and 5	2 and 3	800	1111	888800
7	AR 3	Mixed Plantation	1, 2 and 4	2 and 3	600	1111	666600
8	HDB	**MODEL: High Density Kanak kaich plantation**	3 and 5	4	1200	2500	3000000
9	HA	**MODEL: Gandhaki**	3 and 5	4	200	74074	14814800
10	TM	**MODEL: Broom Grass**	3 and 5	4	300	2500	750000
11	FTP	**MODEL: Three/Four tier plantation on *Patta* land**	1, 3 and 5	2 and 3	2500	-	-
		TOTAL			**11,000**		

2.2 Description of Plantation Models

2.2.1 Aided / Assisted Natural Regeneration (ANR)

2.2.1.1 ANR in regenerating degraded forest (Code: ANR1)

Main Objective: Regenerating degraded forests

Associate Objectives: Biodiversity conservation, Enhanced carbon sequestration and other ecosystem services, Livelihood support

Land category suitable for the model: Degraded forestland with canopy cover range between 10% and 60%

Species selection: Preferred species by the villagers during VDP exercise; Fruit bearing trees and medicinal trees indicated.

Spacing: No specific spacing; 250 seedlings/saplings per ha to be planted in available larger canopy gap areas.

Silvicultural operations and maintenance: Natural regeneration through seeds to be encouraged. Mother plants to be protected. Coppice regeneration to be supported depending on the past history. Silvicultural thinning as per the species-specific silvicultural needs and fsupporting growth of existing trees surrounding the gap. Fire lines need to be provided and weeding has to be undertaken as per norms to control invasion od alien species.

2.2.1.2 Biodiversity Conservation (ANR2)

Main Objective: Biodiversity conservation/enhancement

Associate Objectives: Habitat conservation, Corridor connectivity, Enhanced carbon sequestration and other ecosystem services, Livelihood support.

Land category suitable for the model: Forestland with high diversity and natural habitats of threatened and endemic species.

Species selection: Preferred species by the villagers during VDP exercise; Fruit bearing and medicinal trees, shrubs, lianas and herbs, particularly those belonging to threatened categories. In the Community Conservation Areas (CCAs), efforts should be made to plant as many threatened species as possible which are found in Tripura.

Spacing: No specific spacing; 250 seedlings/saplings per ha to be planted in available canopy gap areas.

Silvicultural operations and maintenance: Natural regeneration through seeds to be encouraged. Mother plants are to be protected. Restricted harvest of biomass is to be ensured while regular removal of invasive species is done.

2.2.1.3 Catchment area protection (ANR3)

Main Objectives: Protection of catchment areas of springs, streams, rivulets, and rivers to ensure flow of water ecosystem services in the downstream areas of the landscape.

Associate Objectives: Habitat conservation, reduced soil erosion, Enhanced carbon sequestration and other ecosystem services, Livelihood support, reduced climate vulnerability across the landscape. It can be an integral part of spring rejuvenation.

Land category suitable for the model: Forestland with moderate to high degradation in the catchment areas of streams, rivulets and rivers, and riverbanks.

Species selection: Preferred species by the villagers during VDP exercise; Fruit bearing and medicinal trees, shrubs, lianas and herbs may be prioritized.

Spacing: No specific spacing; 250 seedlings/saplings per ha to be planted in available canopy gap areas or larger gaps.

Silvicultural operations and maintenance: Natural regeneration through seeds to be encouraged. Mother plants to be protected. Restricted harvest of biomass e.g., only fruits and sustainable harvest of NTFPs is to be ensured. Fireline is to be provided.

2.2.1.4 Enrichment plantation (ANR4)

Main Objectives: To convert a degraded forest into a high and restored forest dominated by desired high value crops. By definition, the process by which trees are planted to increase the population density of existing tree species or increase tree species richness by adding tree species to a degraded forest. An alternative definition is: the planting of desired tree species in a modified natural forest or secondary forest or woodland with the objective of creating a high forest dominated by desirable (i.e. local high-value) species (Anonymous 2008).

Associate Objectives: Long-term high value forestry, Habitat and biodiversity conservation, Enhanced carbon sequestration and other ecosystem services, Livelihood support.

Land category suitable for the model: Degraded forests.

Species selection: Preferred species by the villagers during VDP exercise; commercially important high value timber species e.g., Mahogany; Fruit bearing and medicinal trees.

Spacing: No specific spacing; 250 seedlings/saplings per ha to be planted in available canopy gap areas.

Silvicultural operations and maintenance: Species-specific silvicultural practices. Firelines will be provided and removal of invasive species will be undertaken through weeding as per norms. All the existing trees will be retained and maintained. .

2.2.2 Artificial Regeneration

2.2.2.1 Energy Plantation (AR1)

Main Objective: Energy plantation means growing select species of trees and shrubs, which are harvestable in a comparably shorter time (3-8 years rotational cycle) and are specifically meant for meeting fuel wood needs.

Associate Objectives: Habitat conservation, Ecosystem services, Livelihood support.

Land category suitable for the model: Degraded forestland.

Species selection: Preferred fuel wood species by the villagers during VDP exercise. Examples: *Anogeisus latifolia*, *Acacia* spp., *Albizia* spp. *Anthocephalus cadamba*, *Pongamia pinnata* (oil/biofuel yielding) etc.

Spacing: 3 m x 3 m i.e., 1111 plants per ha.

Silvicultural operations and maintenance: Species-specific short-rotation silviculture. Firelines need to be provided, and invasive species will be removed.

2.2.2.2 Wild Edible Fruit Tree Plantation (AR2)

Main Objective: Meeting fruit/nutrition requirements of the villagers, food requirements of wildlife, and livelihood support for forest-dependent populations.

Associate Objectives: Habitat and biodiversity conservation supporting wildlife, Enhanced carbon sequestration and other ecosystem services.

Land category suitable for the model: Degraded forestland near the village.

Species selection: Preferred wild edible fruit bearing species by the villagers during VDP exercise; Under-utilized local fruit trees may be preferred. Examples: Jack fruit (*Artocarpus integrifolia*), Jamun (*Syzygium cuminii*), Ber (*Ziziphus mauritiana*), Tetul (*Tamarindus indica*), Longchak (*Parkia roxburghii*). A few Litchi (*Litchi chinensis*), Mango (*Mangifera indica*), and star fruit (*Averrhoa carambola*) trees (respecting the local choices) may be allowed while conforming to the provisions of the Forest (conservation) Act, 1980.

Spacing: 3m x 3m; 1111 seedlings/saplings per ha to be planted.

Silvicultural operations and maintenance: Sustainable harvest of fruits, no felling. Regular removal of invasive species through weeding as per norms and firelines around the plantation will be created.

2.2.2.3 Mixed Plantation including Mritinga bamboos (AR3)
Main Objective: Plantation of multi-purpose trees and bamboos for forest resilience.

Associate Objectives: Habitat conservation, Enhanced carbon sequestration and other ecosystem services, Livelihood support.

Land category suitable for the model: Degraded forestland.

Species selection: Preferred species by the villagers during VDP exercise; Bamboo species such as *Bambusa tulda*, *Bambusa balcooa* and *Bambusa nutan* may be planted.

Spacing: 3m x 3m.

Silvicultural operations and maintenance: Species-specific silvicultural practices and maintenance will be undertaken. Firelines will be created and regular weeding will be done to manage the invasive species. Existing trees will be maintained.

2.2.2.4 High Density Kanak Kaich Bamboo Plantation (HDB)
Main Objectives: Raw materials for processing of natural products, Entrepreneurship development, and livelihood diversification.

Associate Objectives: Habitat conservation, and other ecosystem services, Livelihood support.

Land category suitable for the model: Degraded forestland.

Species selection: *Bambusa affinis*.

Spacing: 2m x 2m; 2500 rhizomes/ha.

Silvicultural operations and maintenance: Maintenance will be done as per schedule, and soil will be added to increase the number of culms through enhanced rhizome production. The sustainable harvest practice will be followed from third year onwards. The canopy cover will continuously increase despite harvest as the new culms will keep on adding every year,

2.2.2.5 Gandhaki Plantation: Gandhaki (HA)
Main Objective: Cash crop for raw material production for essential oil extraction (processing of natural products)

Associate Objective: Livelihood support.

Land category suitable for the model: Forestland with or without canopy cover.

Species selection: *Homalomena aromatica*.

Spacing: 30 cm x 30 cm@300kg/ha (Rhizomes)

Silvicultural operations and maintenance: Maintenance of the plots through regular weeding and provision of fireline has to be ensured.

2.2.2.6 Broom grass Plantation (TM)
Main Objective: Cash crop plantation for processing of natural resources and livelihood diversification

Associate Objectives: Habitat conservationand other ecosystem services, Livelihood support.

Land category suitable for the model: Degraded Forestland.

Species selection: *Thysanolaena maxima*.

Spacing: 2 m x 2 m i.e. 2500 plants (rhizomes) /ha.

Maintenance: Cleaning after the harvest of inflorescence; every five years replanting through rhizome.

2.2.2.7 Four tier Patta land Plantation (FTP)

Main Objectives: Livelihood improvement and reduction of climate vulnerability. The four-tier model would provide multiple – income to land owners.

Associate Objectives: Habitat conservation, Sustainable resource management, Enhanced carbon sequestration and other ecosystem services,

Land category suitable for the model: Fallow land (Patta land)

Species selection: Based on farmers'/land owner's choice including nitrogen fixing crops, vegetable crops normally cultivated in *jhum* fields, tree crops, rice or maize crop, and one of the cash crops i.e. ginger or turmeric or pineapple will be cultivated under FTP. The final crop combinations will be decided during VDP exercise. Some examples of such combinations are:

- Bamboo +Jackfruit + Maize + Pineapple + Vegetable crops with beans, cowpeas, pigeon pea, + yam/colocassia
- Gamari + Lemon + Ginger + Pegion pea + Paddy + Nitrogen fixing vegetable crops (Beans)
- Bamboo + Arecanut + Dalbergia + Maize+ Black pepper + vegetables including beans, Arhar + Sweet potato/Colocasia/Yam + Pineapple
- Acacia + Litchi + Lemon + Maize +Turmeric + Vegetable crops including nitrogen fixers – beans, pegion pea etc.
- Albizia + Jackfruit + Maize + Ginger + Vegetable crops including nitrogen fixers – beans, pegion pea etc.
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- Bamboo + Mango + Maize + Pineapple + Longchak (Parkia) + Vegetable crops including nitrogen fixers – beans, pegion pea etc. + Yam/Colocasia/ Diascorea/Sweet potato
-
- Agar + Arecanut +Turmeric+ Black pepper + Vegetable crops including nitrogen fixers – beans, broad bean, cowpea, pegion pea etc.

- Banana + Moringa +Turmeric + Corombola + Vegetable crops including nitrogen fixers – beans, pegion pea etc.
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- Orange + Moringa + Papaya +Turmeric + Vegetable crops including nitrogen fixers – beans, pegion pea etc. + Maize
-
- Guava + Amla + Paddy + Nitrogen fixing vegetables + Yam/Diascorea/Sweet potato+Pineapple

Spacing: Four tier plantation model provides choice of different species for each tier. Species proposed for raising four-tier plantation are given in Table 2. Depending on species combination and species to be planted, the spacing will be decided as given in Table 3.

Table 2: Species composition for each tier under the Four-tier plantation (FTP).

Sl No	Canopy layer	Crops
1	Below ground	Turmeric, ginger, yam, colocasia, sweet potato, diascorea etc.
2	Lower Canopy	Pineapple., paddy, maize, vegetable crops, pigeon pea, beans, broad bean, cowpea, etc.
3	Middle Canopy	Lemon, moringa, guava, papaya, orange, banana etc.

4	Top Canopy	Agar, yongchak, kathal, arecanut., mango, tamarind, bel, corombola, amla, chalita, coconut , jamun etc.

Table 3: Spacing and pit size for different species under Four-tier plantation model.

Tier	Crop	Seedling/rhizome requirement ha^{-1}	Sowing/ planting time	Spacing (m x m)	Pit size (cm x cm x cm)
Below-ground layer	Ginger	700 kg	April - May	0. 15 x 0.15	
	Turmeric	700 kg	April – May	0. 15 x 0.15	
	Colocasia/Sweet potato		September-October	0.33 x 0.33	30x30x30
	Yam		September-October	1 x 1	30x30x30
Lower canopy layer	Pineapple	20,000	May - Jun	0.5 x 0.5	30x30x15
Middle canopy layer	Mango	277	May - June	6 x 6	30x30x30
	Lemon	277	May - Jun	6 x 6	30x30x30
	Moringa	277	May - June	6 x 6	30x30x30
	Guava	277	May - June	6 x 6	30x30x30
Top canopy layer	Arecanut	277	June - Dec	6 x 6	30x30x30
	Kathal	277	May - June	6 x 6	30x30x30
	Youngchak	277	May - June	6 x 6	30x30x30

Maintenance: To be maintained by the concerned farmer for the entire project period as well as during post-project period for sustainability of the patta lands. Maize, paddy and vegetables are to be planted as inter-crop.

2.3 Disposal of polybags after planting the seedlings in the field

The discarded polybags immediately after planting will be collected, cleaned, and transported to the plant site of the designated agencies in each district for recycling. The relevant agencies in both the districts have been identified by the project authorities. The costs of cleaning and transport of discarded polybags will be met from the “Contingencies” head (i.e. 10% of the plantation and maintenance costs, that includes monitoring, signage and other unforeseen costs in addition to the cost towards discarded polybag collection, cleaning, and transport) under each plantation model.

3 Cost Norms for Plantation Models

Approved Wage: Rs. 226/-per DL- (as of 20 January 2023)

3.1 Plantation Models: Aided/Assisted Natural Regeneration (ANR)

Including:

- ANR in regenerating degraded forest (ANR1)
- Biodiversity Conservation (ANR 2)
- Catchment area protection (ANR3)
- Enrichment plantation (ANR4)

Table 4. Cost norms for ANR.

Sl. NO.	Component	No of DLs		Cost/ha (INR) [1]
		Existing	Proposed	
1	Site preparation	10	10	2,260.00
2	Digging of pits of 30 cm x 30cm x 30 cm size for 250 poly bags	7	7	1,582.00
3	Re-filling of pits	8	8	1,808.00
4	One weeding	6	6	1,356.00
5	Fire line	7	7	1,582.00
6	Earth mounding in case of bamboo	1	1	226.00
7	Seedling carrying cost	0	5	1,130.00
8	Fencing	0	15	3,390.00
	Total plantation	**39**	**54**	**13,334.00**
	Second year maintenance			
1	One weeding including gap planting and caring	12	12	2,712.00
2	Fire line	6	6	1,356.00
3	Mainenance of fence	0	7	1,582.00
	Total second year maintenance	**18**	**25**	**5,650.00**
	Third year maintenance			
1	One weeding including fire line maintenance	12	12	2,712.00
2	Mainenance of fence	0	7	1,582.00
	Total third year maintenance			**4,294.00**
	Total plantation, and 2nd and 3rd year maintenance			**23,278.00**
	Contingency and Seedling cost			
1	Contingency (including the cost of cleaning and transport of discarded polybags, signage, monitoring, and unforeseen expenses)@ 10% of total plantation, and 2nd and 3rd year maintenance cost			**2,328.00**
2	Cost of seedlings: 275 polybag seedlings (including 10% gap filling) @ Rs. 17/seedling			**4,675.00**
	Grand Total			**30,281.00**

3.2 Artificial Regeneration (AR) Models

Including

- Energy Plantation (AR1)
- Wild Edible Fruit Tree Plantation (AR2)
- Mixed Plantation (AR3)

[1] Proposed as per KfW MoM dated 16 January 2023

Table 5. Cost norms for AR.

Sl. No.	Component	Number of DLs		Cost/ha (INR)
1	Site preparation including clearing of forest	15	15	3,390.00
2	Staking at spacing 3 m x 3 m (1111 plants)	4	4	904.00
3	Digging of pits of 30 cm x 30 cm x 30 cm size for 1111 poly bags	23	23	5,198.00
4	Re-filling of pits	35	35	7,910.00
5	First weeding	25	25	5,650.00
6	Second weeding	18	18	4,068.00
7	Winter weeding and fire line	18	18	4,068.00
8	Seedling carrying cost	0	10	2,260.00
9	Fencing	0	15	3,390.00
	Total plantation	**138**	**163**	**36,838.00**
	Second year maintenance			
1	First weeding including gap planting	25	25	5,650.00
2	Second weeding	18	18	4,068.00
3	Winter weeding and fire line maintenance	10	10	2,260.00
4	Mainenance of fence	0	7	1,582.00
	Total second year maintenance	**53**	**60**	**13,560..00**
	Third year maintenance			
1	First weeding	20	20	4,520.00
2	Second weeding	15	15	3,390.00
3	Winter weeding and fire line maintenance	10	10	2,260.00
4	Mainenance of fence	0	7	1,582.00
	Total third year maintenance	**45**	**52**	**11,752.00**
	Total plantation, and 2nd and 3rd year maintenance			**62,150.00**
	Contingency and Seedling cost			
1	Contingency (including the cost of cleaning and transport of discarded polybags, signage, monitoring, and unforeseen expenses)@ 10% of total plantation, and 2nd and 3rd year maintenance cost			**6,215.00**
2	Cost of seedlings: 1222 polybag seedlings (including 10% gap filling) @ Rs. 17/seedling			**20,774.00**
	Grand Total			**89,139.00**

3.3 High Density Kanak Kaich Bamboo Plantation (HDB)

Table 6. Cost norms for High Density Kanak Kaich Bamboo plantation.

Sl. No.	Component	Number of DLs		Cost/ha (INR)
1	Site preparation	18	18	4,068.00
2	Staking	10	10	2,260.00
3	Digging of pits of 30 cm x 30cm x 30 cm size for 2500 rhizomes per ha	50	50	11,300.00
4	Re-filling of pits	62	62	14,012.00
5	First weeding including gap filling	30	30	6,780.00
6	Second weeding	25	25	5,650.00
7	Fire line	6	6	1,356.00
8	Earth mounding in case of bamboo	35	35	7,910.00
9	Rhizome transport and carrying cost	0	10	2,260.00
10	Fencing	0	15	3,390.00
	Total plantation	**236**	**261**	**58,986.00**
	Second year maintenance			
1	First weeding including gap filling	35	35	7,910.00
2	Second weeding	30	30	6,780.00
3	Fire line maintenance	6	6	1,356.00
4	Earth mounding	35	35	7,910.00
5	Mainenance of fence	0	7	1,582.00
	Total second year maintenance	**106**	**113**	**25,538.00**
	Third year maintenance			
1	First weeding	35	35	7,910.00
2	Earth mounding	35	35	7,910.00
3	Fire line maintenance	6	6	1,356.00
4	Mainenance of fence	0	7	1,582.00
	Total third year maintenance	**76**	**83**	**18,758.00**
	Total plantation, and 2nd and 3rd year maintenance			**103,282.00**
	Contingency and Seedlind cost			
1	Contingency (including the cost of signage, intensive monitoring and unforeseen expenses)@10 % of total plantation, and 2nd and 3rd year maintenance cost			**10,328.00**
2	Rhizome cost: 2750 rhizomes/ha (including 10% gap filling) @Rs. 13 per rhizome			**35,750.00**
	Grand Total			**149,360.00**

3.4 Plantation of Gandhaki (HA)

Table 7. Cost norms for Gandhaki Plantation.

Sl. No.	Component	Number of DLs		Cost/ha (INR)
		Existing	**Proposed**	
1	Site preparation	15	15	3,390.00
2	Digging of pits including planting	75	75	16,950.00
3	First weeding	24	24	5,424.00
4	Second weeding	18	18	4,068.00
5	Fencing	0	15	3,390.00
6	Fire line	0	6	1,356.00
	Total plantation	**152**	**173**	**34,578.00**
	Second year maintenance			
1	First weeding	24	24	5,424.00
2	Second weeding	18	18	4,068.00

3	Fire line maintenance	6	6	1,356.00
4	Maintenance of fence	0	7	1,582.00
	Total second year maintenance	48	**55**	**12,430.00**
	Third year maintenance			
1	First weeding	24	24	5,424.00
2	Second weeding	18	18	4,068.00
3	Fire line	6	6	1,356.00
4	Maintenance of fence	0	7	1,582.00
	Total third year maintenance	**48**	**55**	**12,430.00**
	Total plantation, and 2nd and 3rd year maintenance			**59,438.00**
	Contingency and planting material cost			
1	Contingency (including the cost of signage, intensive monitoring and unforeseen expenses)@10 % of total plantation, and 2nd and 3rd year maintenance cost			**5,944.00**
2	Rhizome cost: 300 kg rhizomes/ha @Rs. 30 per kg of rhizome			**9,000.00**
	Grand Total			**74,382.00**

3.5 Broom Grass Plantation (TM)

Table 8. Cost norms for Broom Grass Plantation.

Sl. No.	Component	Number of DLs		Cost/ha (INR)
		Existing	**Proposed**	
1	Site preparation including jungle cutting	15	15	3,390.00
2	Staking at spacing 2 m x 2 m (2500 plants)	10	10	2,260.00
3	Digging of pits of 30 cm x 30 cm x 30 cm size	50	50	11,300.00
4	Rhizome collection cost @ 125 rhizome/DL)	20	20	4,520.00
5	First weeding	24	24	5,424.00
6	Second weeding	18	18	4,068.00
7	Fire line	0	06	1,356.00
8	Fencing	0	15	3,390.00
	Total plantation	**137**	**158**	**35,708.00**
	Second year maintenance			
1	First weeding	24	24	5,424.00
2	Second weeding	18	18	4,068.00
3	Fire line maintenance	0	6	1,356.00
4	Maintenance of fence	0	7	1,582.00
	Total second year maintenance	**42**	**55**	**12,430.00**
	Third year maintenance			
1	First weeding	24	24	5,424.00
2	Second weeding	18	18	4,068.00
3	Fire line maintenance	6	6	1,356.00
4	Maintenance of fence	0	7	1,582.00
	Total third year maintenance	**48**	**55**	**12,430.00**
	Total plantation, and 2nd and 3rd year maintenance			**60,568.00**
	Contingency and planting material cost			
1	Contingency (including the cost of signage, intensive monitoring and unforeseen expenses)@10 % of total plantation, and 2nd and 3rd year maintenance cost			**6,057.00**
2	Rhizome cost: Only collection cost - already accounted			**0**
	Grand Total			**66,625.00**

3.6 Four- tier Patta land Plantation (FTP)

The planting material costs of j*hum* vegetable crops, nitrogen fixing crops, paddy, maize, and underground crops such as yam, colocasia and sweet potato will be borne by the respective farmers. All other expenses for creation, and maintenance for post-creation two years will be reimbursed by the project (Tables 9 – 11). The concerned farmer will also maintain the plot as per approved model for the entire project period. Framer needs to be trained for fireline and fencing etc. by the project. The farmer shall bear the labour cost and spend for cultivation from his income w.e.f. 4th year onwards, and mandatorily cultivate nitrogen fixing crops along with other crops as mentioned in crop combinations. . No chemical fertilizer or insecticide/pesticides will be used. FYM and biofertilizers will be used during cultivation.

Table 9: Cost of materials including planting materials to be borne by the CREFLAT project under Four-tier Plantation Model.

Crop/material	Seedling (No.)/quantity (kg) requirement per ha	Rate (per kg or per plant) (Rupees)	Total cost (Rupees)

Compost (FYM)	7500	1.80	13,500
Ginger	700	40.00	28,000
Turmeric	700	30.00	21,000
Pineapple sucker	20,000	0.80	16,000
Cost of tree seedlings	277	17.00	4,709

Table 10: Cost of labour for planting the crops (DL @Rs. 226/-) under Four-tier Plantation models

Item of work	**No. of DLs.**	**Total amount (Rupees)**
A. 1st Year Creation		
Pre - Survey	1	226
Jungle Cleaning	15	3390
Staking	4	904
Pit Digging	12	2712
Planting of tree spp.	18	4068
Bed preparation for Ginger/ Turmeric including Sowing Or Digging of pits including planting of pineapple	90	20340
Planting of other crops (vegetables, nitrogen fixing crops, rice, maize, below ground crops etc.)	10	2260
1st weeding	25	5650
2nd Weeding	18	4068
Winter cleaning including making of Fire Line	18	4068
Fencing	15	3390
Sub-Total (A) 1st year	**311**	**51,076**
B. 2nd year Maintenance		
1st Weeding	25	5650
2nd Weeding	18	4068
Winter cleaning including making of Fire Line	10	2260
Sub-Total (B) Sub-Total	**53**	**11,978**
C. 3rd year Maintenance		
1st Weeding	20	4520
2nd Weeding	15	3390
Winter cleaning including making of Fire Line	10	2260
Sub-Total (C) Sub-Total	**45**	**10,170**
TOTAL LABOUR COST		**73,224**

Table 11: Project contribution (Rupees per ha) for various species combinations under Four-tier *patta* land plantation (FTP) model.

Species Combinations	**FYM cost (Rupees)**	**Tree seedling cost (Rupees)**	**Cost of ginger /turmeric**	**Labour cost (Rupees)**	**Total (Rupees)**

			rhizomes/ pineapple suckers (Rupees)		
Model with ginger	13,500	4,709	28,000	73,224	1,19,433
Model with turmeric	13,500	4,709	21,000	73,224	1,12,433
Model with pineapple	13,500	4,709	16,000	73,224	1,07,433

3.7 Fencing materials

No cost has been assigned for procuring the fencing materials under any of the plantation models. Since adequate quantity of *Muli* bamboo (*Melocanna bambusoides*) is available for use as fencing material in surrounding forests of the project, only collection cost in terms of DLs have been budgeted.

3.8 Cost of Polybag Nursery

The cost of production of 1000 polybag seedlings in a nursery is given in Table 12.

Table 12: Cost of Polybag Nursery.

#	Particulars Of Works	No. of DLS		Cost/1000 seedlings (INR)
		Existing	Proposed	
1	Cleaning of site, preparation of primary nursery beds (mother beds) of size 4.57 m x1.12 m (15' x4') including hoeing up to 30 cm depth, re-hoeing, breaking of clods removal of roots and foreign materials, mixing sand & decompose cow dung/compost including cost of cow dung/compost and preparation of beds and sowing of seeds & watering etc. complete.	6	6	1356.00
2	Collection of top forest soil, breaking of clods removal of foreign materials, mixing FYM proper felling of mixed soil (70% soil, 20% sand, 10% manure) in poly bags i/c staking properly in rows in secondary beds made with bamboo edging and cost of materials like bamboo manure etc. including cost of poly bags. Filling of soil (15 cm x 23 cm size).	30	30	6780.00
3	Pricking out of seedlings from mother bed, transplanting in the poly bag and watering etc. complete including agency filling.	5	5	1130.00
4	Providing bamboo fencing of 4 ft. height with local jeol post at 2 m distance including maintenance complete.			500.00
5	Providing overhead shed by 50% agroshed net with bamboo post i.e. fitting fixing Cost of Agro shade net m² @22.00 per m² =330.00 + 0.5 person-days @ (Rs. 113.00) for fitting + cost of bamboo Rs. 100= Rs. 543.00			543.00
6	Application of organic insecticides and fungicides e.g. *Azadiracta* based products including their costs.			100.00
7	Cow dung			500.00
8	Cost of polybag (15 cm x 23 cm size) @ 200 bags/kg @ Rs. 160.00 per kg (5 kg)			800.00
9	Collection cost of seed			1000.00
10	Weeding six times a year	8	12	2712.00
11	Watering of seedlings	0	6	1356.00
	Total cost of production of 1000 polybag seedlings			**16777.00**

Cost per polybag seedling: INR 16.78 (Rounded to Rs. 17/-)

4 Conclusion

The draft report on plantation models and the respective cost norms were presented to the KfW Mission during its visit to Tripura in January 2023. After detailed discussion, the above proposed models and cost norms were finalized at the project level, and the present report is made in accordance with the recommendations made by the Mission in its Minutes of the Meeting dated 16 January 2023.