



**Restoration of Degraded Forest Habitat:
Monitoring Report
Chunati Wildlife Sanctuary
2005-06 & 2006-07**

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Restoration of Degraded Forest Habitat: Monitoring Report Chunati Wildlife Sanctuary 2005-06 & 2006-07

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Executive Summary

1. A total of **298.98ha** of plantations raised by the Forest Department as *buffer* (**50ha**), *enrichment* (**190.12ha**) plantation and *assisted natural regeneration* (ANR) area (**58.86ha**) during the FY 2005-06 & 2006-07 at Chunati Wildlife Sanctuary (CWS). However, there remains a clear misinterpretation about enrichment planting and fodder plantation as per official documents. In addition, there is no indication or prescription about fodder plantation instead enrichment (in core areas) and buffer plantations (in buffer zone) are suggested.
2. These plantations were surveyed during September of 2007 by the monitoring team of Nishorgo Support Project (NSP). Subsequently for each plantation a separate report was sent to Dhaka office for later compilation. This is the compiled report which summarized all data and information on the plantation activities so far completed (e.g., site preparation activities, species planted, spacing maintained, maintenance operations, survival percentage of planted seedlings, information on other related activities, etc).
3. Overall, established plantations can be said to be successful, as survival/stocking percentage ranges from 78% (Chunati) to 161% (Aziznagar) based on the survey of sample plots. This also indicates over-stocking (in fifteen sites; Table 3) which might have an impact on future growth and hence requires frequent thinning.
4. In case of buffer plantation (stocking 107%), raised adjacent to the core areas, the dominated species is *Acacia* (69.8%) with other associates e.g. Gamar (*Gmelina arborea*), Arjun (*Terminalia arjuna*), Bohera (*Terminalia belerica*), Horitoki (*Terminalia chebula*), Amlaki (*Embllica officinalis*), Dhaki Jam (*Syzygium grande*, *S. cumini*), etc. As rule of thumb, around 10% of indigenous species has planted in the whole buffer plantation.
5. Inside the area of the sanctuary (i.e. core areas), enrichment plantations (mean stocking 90%) are raised with mixture of exotic (*Acacia auriculiformis*, *Acacia mangium*, and *Acacia* hybrid) and indigenous species (about 10-15 indigenous species, with emphasis on fruit bearing) which is irrelevant with the management plan prescriptions for CWS. Irrespective of sites, in case of broader species grouping exotic species (i.e. on average 56% *Acacia* spp. and in Eco-park 75% Ipil-ipil) are dominated compared to indigenous e.g. *Gmelina arborea* (53% in Chambol) are dominated in terms of individual species category.
6. The most important point to note that CMC or FUG and CPG members are not actively involved in plantation activities and moreover the participants are yet to finalize for buffer plantation programs. Hence, immediate approval and assignment of participatory work should be given priority for buffer plantation.
7. More active cooperation is needed for protection of enrichment plantation for its future success and sustenance.
8. We have identified a number of problems by critically analyzing the present situations and discussion with various FD staffs. Among those problems: financial constraints, wrong site selection, lack of understanding and knowledge about enrichment plantation, etc. are most important. The report ends up with possible recommendations in term of identified problems.

1. Background of the Report

Forest Department under Nishorgo Support Project has been doing different habitat restoration activities since FY 2005-06 and 2006-07 in and around the five pilot Protected Areas under Component 2 of contract between USAID & IRG (stated as Objective 6 of approved PP). Major habitat restoration activities include raising enrichment, buffer, special fruit/fodder tree plantation, assisted natural regeneration, grass plantation etc. Operationally, raising of these plantation and subsequent monitoring activities are done by the Department itself. However, the Project Director, recently in an official letter, has asked monitoring team members of Nishorgo to actively engage in the monitoring of these plantation activities with a view to help field level FD's officials to properly raise these plantation according to the guidelines specified in the respective management plans and also to amend error, if any, while doing such activity.

Accordingly, methodology and format for data collection was developed in Dhaka and distributed to field level monitoring officials of NSP for data collection. Based on the format and methodology, brief reports on each type of plantations were sent back to Dhaka office for compilation. This compiled Plantation Monitoring Report of Chunati Wildlife Sanctuary (CWS) is based upon reports done by Abu Rushed Jamil Mahmood, PMO Southern region, and compilation, mapping and editing by Nasim Aziz (ESMS).

2. Objectives of the Report

The objectives of the report are:

- to show and evaluate the performance of the raised plantations
- to identify problem(s) and/or limitation(s)
- to suggest suitable (or appropriate) option(s) to ensure more success in plantations (if needed)

3. Scope of the Report

It has to be noted that Nishorgo monitoring team was authorized only to monitor plantation raised under the FY 2006-07. The team, however, felt that it would be more helpful for the purpose of documentation if plantation raised under FY 2005-06 also been evaluated. Hence, plantation raised by the Department under NSP for both FY 2005-06 & FY 2006-07 were monitored (Table 1).

The survey was limited only to **the performance** of the raised plantation (Table 1) (*excluding grass plantation*), **not the financial evaluation** of the related activities.

Table 1: Plantations raised under Nishorgo Support Project at Chunati Wildlife Sanctuary.

Sl no.	Year	Plantation Type	Forest Division	Range	Beat	Area (ha)
1	2005-06	Buffer	WMNCD ¹ , Ctg.	Chunati	Chunati	15
2		Buffer	WMNCD, Ctg.	Jaldi	Puichari	5
3		Enrichment	WMNCD, Ctg.	Chunati	Herbang	10
4		Enrichment	WMNCD, Ctg.		Aziznagar	10
5		Enrichment	WMNCD, Ctg.	Jaldi	Chambal	10
6		Enrichment	WMNCD, Ctg.		Napora	10
7	2006-07	Buffer	WMNCD, Ctg.	Chunati	Chunati	15
8		Buffer	WMNCD, Ctg.	Jaldi	Jaldi	10
9		Buffer	WMNCD, Ctg.		Napora	5
10		Enrichment	WMNCD, Ctg.	Chunati	Harbang	10
11		Enrichment	WMNCD, Ctg.		Aziznagar	10
12		Enrichment	WMNCD, Ctg.	Jaldi	Chunati	10
13		Enrichment	WMNCD, Ctg.		Chambal	20.90
14		Enrichment	WMNCD, Ctg.	Chunati	Napora	10
15		Enrichment	WMNCD, Ctg.		Chunati	10
16		Enrichment	WMNCD, Ctg.	Chunati	Aziznagar	17.22
17		Enrichment	WMNCD, Ctg.		Harbang	20
18		Enrichment	WMNCD, Ctg.	Jaldi	Puichari	15
19		Enrichment	WMNCD, Ctg.		Napora	7
20		Enrichment	WMNCD, Ctg.	Jaldi	Chambal	5
21		Enrichment	WMNCD, Ctg.		Jaldi	5
22		Enrichment	WMNCD, Ctg.	Eco-park	Eco-park	10
23		ANR ²	WMNCD, Ctg.	Chunati	Harbang	18.86 ³
24		ANR	WMNCD, Ctg.	Jaldi	Chambal	40 ⁴
Total plantation area						298.98⁵

4. Methodology

There are different ways of monitoring plantations. We, the monitoring team of NSP, consulted Working Plan Division of FD so that our methods are similar to that of FD's to avoid any confusion and to be consistent with their methodology. In the sections below, the traditional rules and the methods we followed are described.

4.1 Buffer Plantation

Generally FD has some thumb rules to raise different kinds of plantation. For block/woodlot plantation (i.e. buffer plantation), the rule is to plant 2500 seedlings per ha area. Similarly for ease of monitoring couple of sample plots of 0.01ha is taken where survival percentage is measured. For 100% successful plantation, 25 seedlings have to survive in the sampled 0.01ha. Generally, if mean survival percentage is equal or greater than 80, then it is considered a successful plantation and vice-versa. Such plots were laid out for evaluating performance of the buffer plantations (50ha) mentioned above (Table 1).

¹ Wildlife Management and Nature Conservation Division.

² Assisted natural regeneration

³ These are managed by protection activities only and have been conducting since 1999-2000, dominated with fruit trees.

⁴ Only protection activities from last 4 years.

⁵ This value excludes the monitoring of grass plantation (15 ha) of 2006-2007 financial year.

Again, for evaluation, generally FD lays out 0.01ha plots per hectare. As total area of buffer plantation raised in 2006-05 is 20ha and 2006-07 is 30ha (Table 1), a total of 50 plots of 0.01ha is required for evaluation. However, number of plots becomes too many for timely evaluation and hence 20 sample plots (2 sample plots@5ha) were established for 50ha buffer plantation (in this case 2 buffer plantations × 5 plots = 10 plots of 0.01ha).

4.2 Enrichment Plantation⁶

Evaluating enrichment plantation is difficult as seedlings are planted sporadically over an open canopy area to enrich the existing site cover. In such case, easy way to evaluate is to take some individual seedlings as a sample. Another method is to lie a transect (of workable width and length based on situation in the field) then subsequently measure number of seedlings found planted and survived. In both cases, number of seedlings planted for enrichment needs to be known.

The enrichment plantations were raised in all the planned areas (190.12ha) (Table 1) following clear felling followed by repeated burning excluding in 2005-06 enrichment plantations (20ha) in Chunati Range (Table 1 & 2). Though, the plantation status resembles as buffer types except for species composition, we followed 17.84m radius with sample area coverage of 0.1ha (instead of 0.01ha of 5.6m radius). Therefore, the monitoring rule for enrichments was different from buffer type.

4.3 Assisted Natural Regeneration

The Assisted Natural Regeneration (ANR) is actually a restoration technique as practiced in two different areas of CWS (Table 1) those are difficult as seedlings are sporadically regenerating with variable density under the partial shelter of scattered tree cover to retain the previous vegetation composition. Due to longer management time as well as variable density, we lied a belt transect of 100m long and 10m width i.e. 1000 sq.m. size sample plot in each site. Hence, we have total 2 sample plots in 2 sites.

4.4 Data Collected

Apart from data to measure survival percentage, additional data was collected (tried to collect) on:

- GPS location of each plantation (few areas were not possible due to lack of satellite tracking problem by the instrument for heavy rainfall condition),
- seed and/or seedlings sources
- planting materials (number, age and height),
- species wise number of seedlings,
- site preparation activity, spacing,
- soil works and treatment,
- protection activities,
- weeding & refilling,
- if consultation with CMC was done while or before plantation activity, and lastly
- if plantation journal was maintained properly.

⁶ In this report 'enrichment plantation' is synonymously used for 'fodder plantation/ habitat restoration plantation'.

4.5 Limitation of the collected data

1. The survey couldn't actually measure the area reported for various plantation to see actually if there is any discrepancy in the reported area and actual area in the field. It was planned that traversing the boundary of each plantation will be done using hand held GPS to map the raised plantation and subsequent area estimation. Due to heavy rainfall, profound undergrowth, and undulating topography the attempt failed and later abandoned. Only the point location was taken and mapped.
2. Due to heavy rainfall and limitation of time, statistically adequate samples/ plots could not be taken for each type of plantation.
3. Few plantations were monitored instead of taking GPS reading due too instruments problem in receiving satellite tracking for rainfall.

5. Observations

5.1 Site Description

5.1.1 Geographic Description

The buffer plantations, enrichment plantations, and ANR are located in hilly areas with highest elevation of about 50m with aspects facing towards East-West. The area experience heavy rainfall and soil is sandy loam with coarse textured and slightly dark brown in color.

5.1.2 History of the Area and crop composition

Since history, the area were composed of tropical evergreen and semi-evergreen types of vegetation of which Garjan (*Dipterocarpus* spp) is still the dominated species and few patches are still composed of good Garjan forests. However, due to heavy human encroach with illegal and destructive harvesting and excess removal of trees resulted degraded and secondary vegetation especially with bushy and shrubs type of vegetation. Few areas comprised of degraded/failure plantations of recent past but most of the areas are covered with scattered undergrowth of bamboo.

5.2 Site Preparation Activities

1. For all plantations (except enrichment of 2005-06 and ANR) of both types, site preparation works were taken before hand (Table 2). These works includes bush clearing, repeated burning, alignment and stacking (spacing), pit digging, fertilizer application & soil treatment.
2. Depending on the type of plantation spacing varied, for buffer/enrichment plantations 2m × 2m spacing (with variations form error in traditional methods that arises due to irregular elastic properties ropes used for spacing and alignment) was maintained (2500 seedlings per ha) for all cases. For enrichment plantation in Chunati Range the spacing varied depending on availability of naturally regenerated seedlings with limited protection but for ANR the spacing is variable although the density is quite higher as compared with enrichment and buffer type as well as higher average height.
3. After pit digging, soils of each dugout pit were mixed with natural (cow-dung) and chemical fertilizer (Urea, TSP, and MP) irrespective of plantation type. In CWS, the amount of fertilizer application per seedling accounts: cow-dung-500gm, Urea-25gm, TSP-10gm, and MP-10gm. Noted, Urea was applied after planting.

Table 2. Site preparation technique(s) followed before plantation commencement in Chunati Wildlife Sanctuary.

Types of plantation	Locations (Beat)	Description
Enrichment (190.12ha)	Herbang and Aziznagar (2005-06) (Total 20ha)	Complete protection of the naturally regenerated seedlings by weeding and partial protection. Few (vacant) areas are managed by planting seedlings of few indigenous but maximum with <i>Acacia</i> spp.
	All enrichment plantations (150.12ha) in 2006-07 of CWS and for 2005-06 (20 ha) under Jaldi Range.	Complete removal of the existing degraded and poorly stocked vegetation with repeated burning before large-scale plantation activities.
Buffer (50ha)	Chunati, Jaldi, Napora, and Puichari	Complete removal of the existing degraded and poorly stocked vegetation with repeated burning before large-scale plantation activities.
Assisted Natural Regeneration (ANR) (58.86ha)	Herbang and Chambal	Complete protection of the naturally regenerated areas with limited enrichment in Herbang site using indigenous fruit bearing species. Noted, no site disturbance was conducted. The sites resembles natural forest condition at present especially Chambal site. Only, weeding is the prescribed practice in terms of management with very limited enrichment activities (only Herbang beat).

5.3 Number & Species Selection

The sample plot shows that both for buffer and enrichment plantations, more than 2500 seedlings were planted per hectare except few sites (Table 3). For buffer plantations, block plantation of both indigenous and fast growing species (such as *Acacia*) were conducted as per the Management Guidelines of CWS (2006). For indigenous species, Bohera (*Terminalia bellirica*), Arjun (*Terminalia arjuna*), Gamar (*Gmelina arborea*), etc. were mixed (10%) with fast-growing exotic species (70%) i.e. *Acacia auriculiformis*, *Acacia mangium*, and *Acacia* hybrid were planted in buffer plantation raised in 2005-06 & 2006-07.

For enrichment plantation, same rule followed as per buffer plantation i.e. block plantation of both indigenous and fast growing species (such as *Acacia*) were conducted. This type of plantation is supposed to be multiple species mixture with lack of single species dominance as per guideline of management plan of CWS. But, surprisingly dominated with *Acacia* (*Acacia auriculiformis*) and Gamar (*Gmelina arborea*) although comprised of about 10 – 15 types of species (fruit dominated) mixture (e.g. Amloki, Horitoki, Bohera, *Acacia* Hybrid, *Mangium*, Koufal, Garjan, Arjun, Kanthal, Dhewa, Koroi, Jalpai, Peyara, Am, Tentul, Chalta, Neem, Puti Jam, Kalo Jam, Dhaki Jam, Telsur, etc.) as planted in 2005-06 (in Jaldi Range) and 2006-2007 financial year. But, during 2005-06, about 20ha enrichment plantation has raised by following the guidelines as prescribed in CWS Management Plan (2006).

5.4 Maintenance & Refilling

4. Some weeding and/or refilling have been done so far for most of the plantations. It is not clear if budget was allocated for maintenance purposes but due to heavy rainfall and faster growth of weed species all plantations requires proper weeding.
5. Although management guideline only prescribed weeding operations for enrichment plantation (3 weeding operations in 2nd year and 2 weeding operation in 3rd year) but similar activity should also be carried out for buffer plantations as well.

5.5 Seedlings Establishment

6. Survival percentage of plantations was found to be satisfactory (Table 4) based on the samples taken. Mean stocking for all plantations is 98.54%.
7. As per the general rule, all plantations can be said to be successful due to more than 80% survival rate. However, in future this might be in question due to negative impact of over stocking and its associated problems. Because, 15 plantations out of 22 sites have $\geq 100\%$ stocking level.
8. On a general note, CWS plantation sites might not have severe weeding problem. But, we recommend taking regularized weeding operations in all plantations provided that budget allows.
9. Growth of planted seedlings (particularly for plantations of 2005-06) was also found to be satisfactory (Table 4).
10. Mean height of species planted in the FY 2006-07 is also found to be satisfactory (Table 4).

5.6 Site Selection

11. Overall site selection followed the general norms i.e. indigenous local species in core area and fast growing species in adjacent buffer area (Reserved Forest).
12. All the sites are suitably selected as because closeness and/or adjacent to the main/secondary road except for Eco-park and Jaldi enrichment plantation sites which are considerably far from main road.
13. It is a matter of special attention that FD field staff didn't pay much attention is selecting suitable and/or appropriate site for buffer and enrichment plantation. As, in Joldi and Napura Beat, both buffer and enrichment plantations are selected in the same area.

5.7 Documentation

14. Apart from very few sites (e.g. Puichari), plantation journal was not found in the Beat Office (Table 3). However, the journals are not properly maintained. FD senior officials should give special attention on this issue.
15. No information regarding seed/seedling sources, age and height of seedlings during plantation, number of seedlings planted according to species (i.e. species composition), vacancy filling, and amount of fertilizer applied as well as costing are not being maintained. More over, no regular monitoring and comment are put in the comment list.

Table 3. Summary of Plantation Activities in the Plantation Raised at Chunati Wildlife Sanctuary.

Sl	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
1	2005-06	Buffer	Chunati	15	Raised seedlings, age: 4-5 months, mean height 77.5cm; After bush cutting at ground level repeated burning was done; alignment and stacking was done; 1.9m×1.9m spacing although in few areas 2m × 2m (the problems are due to hilly area); Pit size: 45cm×45cm×45cm.	40,000 nos. of seedlings. 75% <i>Acacia</i> (<i>Acacia auriculiformis</i> , <i>A. mangium</i> , <i>Acacia</i> hybrid); rest 25%: Koroi, Bohera, Kadam, Amloki, Horitoki, etc.	Maintenance is good	Not available in the Range Office	421875.0
2	2005-06	Buffer	Puichari	5	Raised seedlings, age: 4 months, mean height: 85cm; after bush cutting at ground level; alignment and stacking were done; 1.75m×1.75m spacing although few areas 2m×2m (the problem is due to hilly area); Pit size: 45cm×45cm×45cm.	15000 nos of seedlings. About 65% <i>Acacia</i> (<i>Acacia auriculiformis</i> , <i>A. mangium</i> , <i>Acacia</i> hybrid); rest 25%: Jam, Garjan, Payara, Batna, Amloki, etc.	Weeding and gap filling were done.	Maintained but not well organized.	140625.0
3	2005-06	Enrichment	Herbang	10	Natural seedlings are maintained with few enrichment especially with <i>Acacia</i> seedlings of age: about 4 months, height: 73.5cm; Cutting was done in openings; planting were done in vacant areas; variable spacing; Pit size: 45cm×45cm×45cm	46% <i>Acacia</i> hybrid. However, other naturally regenerated species are Amloki, Bohera,	Good condition as the naturally regenerated species has reached beyond weed suppression.	Yes, well maintained	140625.0

⁷ All the costs are of financial year 2005-06 and 2006-07 are only from official record.

Sl	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
						Hortoki, Sal, Garjan, Dhakijam, Puti Jam, Cowfal, etc.			
4	2005-06	Enrichment	Aziznagar	10	Natural seedlings are maintained with few enrichment especially with <i>Acacia</i> seedlings of age: about 4 months, height: 91.6cm; Cutting was done in openings; planting were done in vacant areas; variable spacing; Pit size: 45cm×45cm×45cm	53% <i>Acacia</i> hybrid and rest are composed of about 11 indigenous (mainly fruit/medicinal dominated) species mixture as regenerated naturally	Well maintained due to closeness of the site and good protection.	Yes; but less informative	140625.0
5	2005-06	Enrichment	Chambal	10	Raised, age: 3-4 months, Spacing 1.95m×1.95m; mean height: 3m; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	28000 nos. of seedlings of <i>Acacia</i> spp. 100% <i>Acacia</i> .	Well stocked	Not available in the beat office.	140625.0
6	2005-06	Enrichment	Napora	10	Same as above (item #5). But spacing is 1.8m×1.8m and mean height is 64.5cm	27500 nos. of seedlings; 60% is <i>Acacia</i> followed by Cowfal, Dhakijam, Am, Amloki, Horitoki, Bohera, etc.	Weeding is needed.	Yes, but not well informed	140625.0
7	2006-07	Buffer	Chunati	15	Same as item #6 and mean height is 79.5cm; age 8 months.	40000 nos. of seedlings; 90%		Yes, but not well	421875.0

Sl	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
						Acacia followed by Gamar, Kanthal, Bohera, etc.		informed	
8	2006-07	Buffer	Jaldi	10	Raised, age: 3-4 months, Spacing 2.3m×2.18m; mean height: 1.07m; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm×45cm×45cm.	27000 nos of seedlings; 71% <i>Acacia</i> followed by Gamar, Arjun, Bohera, Dhakijam, etc.	Weeding is not needed due to <i>agri-crop</i> practice between inter-rows.	Yes, but not well informed	281250.0
9	2006-07	Buffer	Napura	5	Raised, age: 3-4 months, Spacing 1.78m×1.78m; mean height: 1.1m; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm×45cm×45cm.	9000 nos. of seedlings; 48% <i>Acacia</i> followed by Neem, Amloki, Chickrassia, Gamar, Koroi, etc.	Well managed	Yes, but in the divisional office.	140625.0
10	2006-07	Enrichment	Herbang	10	Raised, age: 3-4 months, Spacing variable; mean height: 62.5cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm×45cm×45cm.	29000 nos. of seedlings; 51% <i>Acacia</i> followed by Chickrasi, Gamar, Koroi, Mahagoni, Borta, Jam, Chapalish, Garjan, etc.	Well managed by maintaining existing natural regeneration and scattered trees.	Yes, but not available due to item # 9 of this table.	140625.0
11	2006-07	Enrichment	Aziznagar	10	Raised, age: 3-4 months, Spacing variable; mean height: 69.5cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm×45cm×45cm.	65.5% by <i>Acacia</i> followed by Payara, Amloki, Bohera, Am, Kanthal,	Well managed	Yes, please see item #10 (above)	140625.0

Sl	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
						Horitoki, Jalpai, etc.			
12	2006-07	Enrichment	Chunati	10	Raised, age: 3-4 months, Spacing variable; mean height: 63.8cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	72% by <i>Acacia</i> followed by Amloki, Bohera, Horitoki, etc.	Well managed	Yes, but in the DFO office	
13	2006-07	Enrichment	Chambal	20.90	Raised, age: 3-4 months, Spacing 3m×3m; mean height: 76.4cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	81% <i>Acacia</i> with composition of Bohera, Dhakijam, Garjan, etc.	Well managed	-do-	293906.0
14	2006-07	Enrichment	Napura	10	Raised, age: 3-4 months, Spacing 2.2m×2.2m; mean height: 1m; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	57% <i>Acacia</i> in association with Agar.	Well managed (weeding practice is going on)	-do-	140469.0
15	2006-07	Enrichment	Chunati	10	Raised, age: 3-4 months, Spacing 1.9m×2.1m; mean height: 83.7cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	64% <i>Acacia</i> ; other compositions are Bohera, Amloki, Jam, Garjan, etc.	Well managed	-do-	281250.0
16	2006-07	Enrichment	Aziznagar	17.22	Raised, age: 3-4 months, Spacing 1.7m×1.9m; mean height: 58.4cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	90% <i>Acacia</i> and others include Horotoki; Sal; etc.	Well managed	-do-	484310.0
17	2006-07	Enrichment	Herbang	20	Raised, age: 3-4 months, Spacing	48% <i>Acacia</i> in	Well	-do-	562500.0

SI	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
					2.1m×2.1m; mean height: 81.75cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	association with Bohera, Koroi, Amloki, Horotoki, Garjan, Chickrassi, etc.	managed		
18	2006-07	Enrichment	Puichari	15	Raised, age: 3-4 months, Spacing 1.85m×1.9m; mean height: 68.7cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	67% <i>Acacia</i> in association with Garjan, Batna, Cowgola, Payara, Jam, Amloki, Bohera, etc.	Well managed but needs special protection against grazing.	Available but not well informed	421875.0
19	2006-07	Enrichment	Napura	7	Raised, age: 3-4 months, Spacing 1.59m×1.76m; mean height: 85.5cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	57% <i>Acacia</i> in association with Amloki, Agor, Jolpai, etc.	Well managed as close to beat office	Same as item #12 of this table (above rows)	196875.0
20	2006-07	Enrichment	Chambal	5	Raised, age: 3-4 months, Spacing 2.0m×2.0m; mean height: 63.8cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	53% Gamar Followed By Jam, <i>Acacia</i> , Am, Kanthal, etc.	Well managed	-do-	140625.0
21	2006-07	Enrichment	Jaldi	5	Raised, age: 3-4 months, Spacing 2.3m×2.18m; mean height: 93.8cm; After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	41% <i>Acacia</i> floowed by Gamar, Arjun, Dhakijam, Chapalish, etc.	Might have protection problem	-do-	140625.0
22	2006-07	Enrichment	Eco-park	10	Raised, age: 3-4 months, Spacing 2.06m×2.0m; mean height: 67.5cm;	75% Ipil-Ipil followed by	Well-managed	-do-	281250.0

Sl	Year	Plantation Type	Beat	Area (ha)	Site Preparation & soil works	Number of seedlings	Maintenance & Refilling	Plantation Journal	Cost ⁷ (BDT)
					After bush cutting at ground level repeated burning had done; alignment and stacking followed by planting in pit: 45cm ×45cm×45cm.	Dhakijam, Agar, Amloki, Bohera, Arjun, etc.			
23	2006-07	ANR	Herbang	18.86	Only few planted seedlings especially fruit bearing species are planted in the vacant areas. Average height is 3m.	Mixed species of original vegetation dynamics e.g. Amloki, Horotoki, Bohera, Garjan, Cowgola, Jam, etc.	Only protection activities are going on.	No plantation journal are maintained	33000.0
24	2006-07	ANR	Chambal	40	Only few planted seedlings especially fruit bearing species are planted in the vacant areas. Average height is 2 – 2.5m.	Mixed species with huge no. of local vegetation trait that resembling natural forest condition. About 40 different species are recorded. Their frequencies both individual and total are quite time consuming due to very dense undergrowth.	Only protection activities are going on.	No plantation journal are maintained	70000.0

Table 4. Summary of Performance of Plantations Raised at Chunati Wildlife Sanctuary under Nishorgo Support Project

Plantation type	Location (Beat, Range)	Area (ha)	Mean height (cm)	Stocking ⁸ (%)	Dominant ⁹ Species	Others	Seed and/or seedling sources
Enrichment	Herbang (2005-06)	10	102.5	80.8	Acacia (46%)	Amloki, Bohera, Hortoki, Sal, Garjan, Dhakijam, Puti Jam, Cowfal, etc..	BFRI, Dulhazara, Local for planted seedlings only.
	Aziznagar (2005-06)	10	91.6	84	Acacia (53%)	composed of about 11 indigenous (mainly fruit/medicinal dominated) species mixture as regenerated naturally	-do-
	Chambal (2005-06)	10	300	89	Acacia (100%)	-	-do-
	Napura (2005-06)	10	62	130.8	Acacia (60%)	Cowfal, Dhakijam, Am, Amloki, Horitoki, Bohera, etc	- do -
	Herbang (2006-07)	10	62.5	123	Acacia (51%)	Chickrasi, Gamar, Koro, Mahagoni, Borta, Jam, Chapalish, Garjan, etc.	-do-
	Aziznagar (2006-07)	10	69.5	161	Acacia (65.5%)	Payara, Amloki, Bohera, Am, Kanthal, Horitoki, Jalpai, etc.	- do -
	Chunati (2006-07)	10	63.8	126	Acacia (72%)	Amloki, Bohera, Horitoki, etc.	- do -
	Chambal (2006-07)	20.9	76.4	108	Acacia (81%)	Bohera, Dhakijam, Garjan, etc.	- do -
	Napura (2006-07)	10	100	122	Acacia (57%)	Agar	-do-
	Chunati (2006-07)	10	83.7	117	Acacia (64%)	Garjan, Amloki, Bohera,	do

⁸ As per local Beat Officer's the higher stocking in most cases is due to ensure more stocking after 2nd or 3rd year of plantations which is not scientific.

⁹ Values in parenthesis indicate the percentage value of dominance of the respective plantation along the row.

Plantation type	Location (Beat, Range)	Area (ha)	Mean height (cm)	Stocking ⁸ (%)	Dominant ⁹ Species	Others	Seed and/or seedling sources
						Jam, etc.	
	Aziznagar (2006-07)	17.22	58.4	150	Acacia (90%)	Horotoki, Sal, etc.	-do-
	Herbang (2006-07)	20	81.75	81.75	Acacia (48%)	Bohera, Koro, Amloki, Horotoki, Garjan, Chickrassi, etc.	-do-
	Puichari (2006-07)	15	68.7	108	Acacia (67%)	Garjan, Batna, Cowgola, Payara, Jam, Amloki, Bohera, etc.	-do-
	Napura (2006-07)	7	85.5	138	Acacia (57%)	Amloki, Agor, Jolpai, etc.	-do-
	Chambal (2006-07)	5	63.8	106	Gamar (53%)	Jam, Acacia, Kanthal, Am, etc.	-do-
	Jaldi (2006-07)	5	93.8	100	Acacia (41%)	Gamar, Arjun, Dhakijam, Chapalish, etc.	-do-
	Eco-park	10	67.5	128	Ipil-Ipil (75%)	Dhakijam, Agar, Amloki, Bohera, Arjun, etc.	
ANR	Herbang (2006-07)	18.86	300	-	Dominated with local indigenous species especially Jam, Amloki, Horotoki, Arjun, Bohera, Garjan, cowgola, etc. However, dominated with fruit-bearing trees.		From the coppice and seeds of available tree species surrounding the site.
	Chambal (2006-07)	40	200	-	Dominated with about 40 different indigenous species as indentified by the local people during the sample plot assessment.		From the coppice and seeds of available tree species surrounding the site.
Buffer	Chunati (2005-06)	15	77.5	78	Acacia (75%)	Koro, Bohera, Kadam, Amloki, Horitoki, etc.	- do -
	Puichari (2005-06)	5	82.5	85	Acacia (65%)	Jam, Garjan, Payara, Batna, Amloki, etc.	
	Chunati (2006-07)	15	79.5	84	Acacia (90%)	Gamar, Garjan, Amloki, Bohera, etc.	
	Jaldi (2006-07)	10	107	140	Acacia (71%)	Gamar, Arjun, Bohera,	

Plantation type	Location (Beat, Range)	Area (ha)	Mean height (cm)	Stocking ⁸ (%)	Dominant ⁹ Species	Others	Seed and/or seedling sources
	Napura (2006-07)	5	110	148	Acacia (48%)	Dhakijam, etc. Neem, Amloki, Chickrassia, Gamar, Koro, etc.	

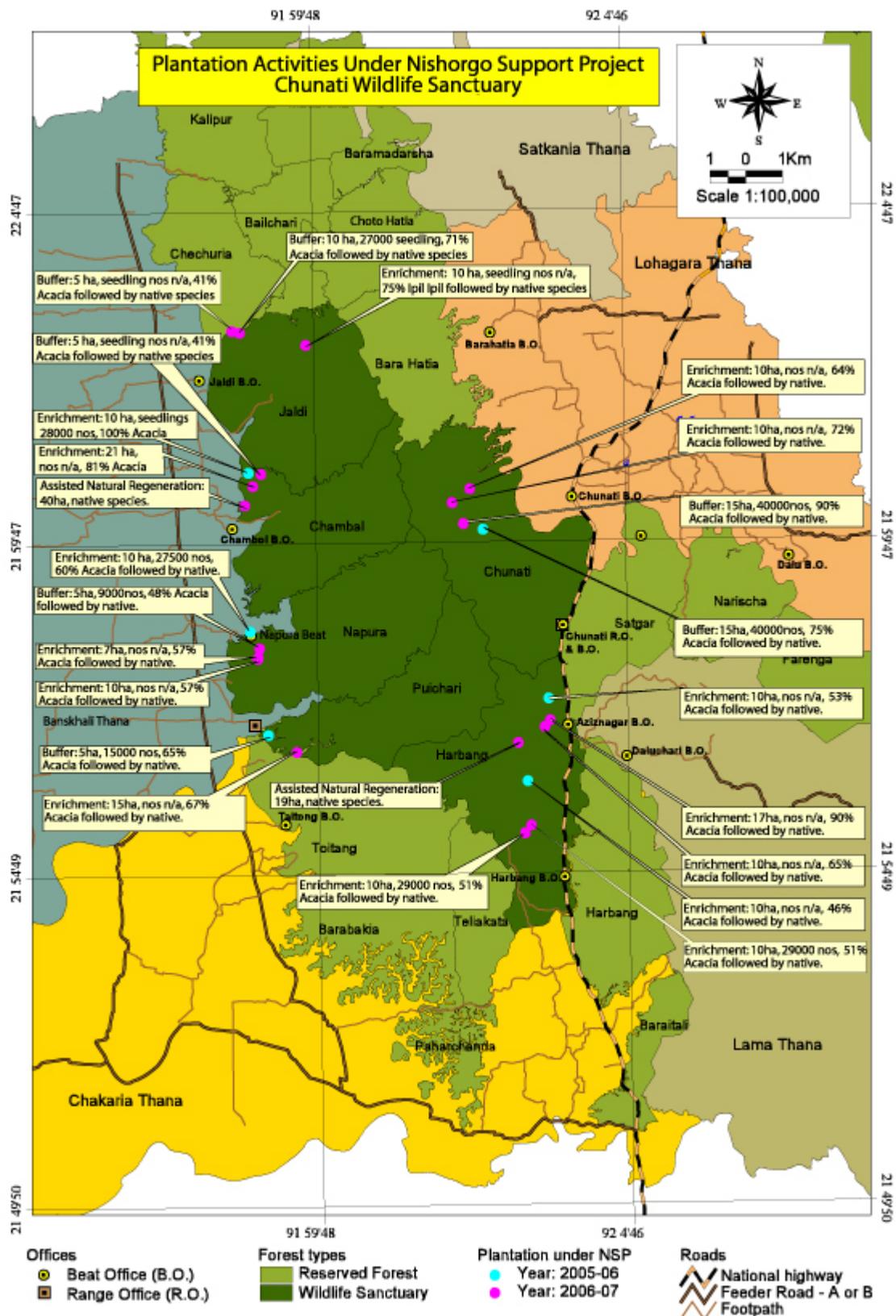


Figure 1: Location of Plantation Sites Raised under Nishorgo Support Project

5.8 Consultations with CMC Members

16. The planted sites were selected by ACF after discussing with Forest Rangers and Beat Officers and later the CMC members were only informed after taking final decision.
17. Species were selected as per the suggestion from DFO and ACFs of WMNCD, Ctg.
18. Only few FUG and CPG members are involved as daily labor during plantation activities in the field.
19. However, forest villagers (although all are not directly involved with Nishorgo) are given priority in various plantation activities.

5.9 Problems and recommendations:

All the plantations are associated with a number of problems. The general problems and listed followed by recommendations as follows:

General problems:

1. The most immersing problem in future might arise in terms of future plantation conservation and/or utilization. As CWS is a protected area so enrichment plantation should be retained and hence no possibilities of future felling. But, local FD officials are allocating certain amount (e.g. one ha for each person) of enrichment plantation to the local people as participants through oral negotiation for protection purpose. Those selected people's are developing and protecting plantations by their own costs/resources. What will happen after certain period of time when the trees in enrichment plantation areas will become mature?
2. Range Officers, Beat Officers, & Foresters involved in nursery and plantation activities have limited knowledge about methods of buffer and enrichment plantation (species composition) guidelines as prescribed in the management plan of TGR.
3. Limited knowledge on silviculture of indigenous species (when to collect seed, seed treatment, germination methods, nursery techniques) resulting in dependency on exotic species like Acacia..
4. Timing of budget release creates problems.
5. Grazing has seen the most important visible problem which may significantly hamper the success of plantation.

General recommendations:

1. Future tenural conflicts in terms of share of enrichment plantation output should be clearly explained.
2. Immediate (precise) decision should be taken about what we will do with huge Acacia spp. especially planted in core areas (i.e. Enrichment plantation areas).
3. Quick or early release of budget.
4. Training of BOs & ROs in silviculture of native species, nursery & plantation techniques, management prescriptions.
5. Encourage development of nurseries to grow local indigenous species.
6. Grazing can be controlled by appointing watcher(s) or stall feeding of the grazed animals (e.g. Cow, Goat, etc.).
7. Rhizome planting should be advised instead of seedlings from seed in case of bamboo.

6. Conclusion

The overall status of the plantation is satisfactory in terms of stocking although a huge information gap remains regarding enrichment planting and buffer planting techniques. The field observation predicts an immediate need for training programs and awareness campaign on enrichment plantation program. Regular recordkeeping in plantation journal and monitoring of this plantation is of vital need for its successful establishment. CMC, CPG, FUG members should be more actively involved and hence requires more strong participation in every step of plantation activities thereby ensuring Co-management practice. All these steps might have significant positive impact on ongoing and future plantation success.