Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests and Park Services
Social Forestry and Extension Division

NORMS AND STANDARDS FOR NURSERY AND PLANTATION

(REVISED VERSION 2020)

Social Forestry and Extension Division
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Foreword

Since the establishment of the Department of Forests in 1952, the plantation program has been a priority program. It is one of the major programs of the Department that directly help achieve the Constitutional requirement of maintaining "a minimum of 60% of the total land under forest cover for all times to come." The requirement was first mentioned in the 1974 Forest Policy, which set the framework for scientific management of Bhutan's forests.

The plantation plays a crucial role in the sustainable management of forest resources, by maintaining the ecological balance in the watersheds. Today, the demand for forest resources is very high, as development an activity in the country has accelerated in the recent years. To manage the demand for forest resources such as timber, it is very important to manage our forests sustainably. Plantation is the only direct means to re-coupe barren, degraded; fire burnt and harvested forests in the watershed.

The Plantation Section in Social Forestry and Extension Division (SFED) is the lead agency on plantation in the country. Apart from providing the technical guidance and support in nursery raising and plantation, the agency plans and facilitates all plantations in the country.

Accordingly, considering the importance of the afforestation program and the ever-changing field situations, *the Norms and Standard for Nursery and Plantation 2016*was revised to validate its contents and to suit the needs of the changing field conditions. This *Norms and Standards for Nursery and Plantation 2020* is the revised version of the previous guideline developed by SFED, whereby provisions to deal with the shortfall in labor wage, cost estimation and technical clarity is incorporated.

The Department hopes that this revised *Norms and Standards for Nursery and Plantation 2020* shall be more helpful and practically applicable in the field with necessary incorporations made to curb challenge

(Lobzang Dorji)
Director
Department of Forest and Park Services

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User Guide

The Nursery and Plantation Norms and Standards were first devised in 1992 in order to guide the implementers in smooth execution of Nursery and Plantation activities across the country. Where ever possible, the conventional plantation shall not be entertained hereafter as it involves huge expenses to the Government.

The norms and standards is the base line for the approving authority to take decision on the implementation of Nursery and Plantation, without norms, it becomes difficult for the approving authority to make a concrete decision.

Therefore, a standard for various forestry activities relating to nursery and plantation has been prescribed which should be strictly followed and adhered. The activities involved for creation of nursery and plantation varies according to site and situation. It would not be proper to base estimates on a lump sum figure or on blanket ceilings.

The unit cost for different activities like seed collection, establishment of forest nursery, plantation creation and maintenance, fire line creation, fencing, land management, rootballing have been dealt with in separate chapters.

The implementers have to refer the particular chapter related to the concerned activity when preparing estimates for unit cost requirements. For the technical ease of the field staff, specific period of seed collection, sowing time, seed viability and treatment has also been incorporated.

The norms and standards have been designed based on the unit cost. Till now the technical sanctions are issued based on the man days, hereafter it shall be based on the unit cost.

Any activities related to engineering structures viz. check dams, road linkages, water channels, water tank, nursery care taker house, the estimate should be based on BSR, technical sanctioned for such activities shall be approved by the heads of the concern implementing agency.

How to Use

1. Do not pick up each and every item of work mentioned in this norms & standards. For example, if an estimate has to be prepared for a plantation, it is important to decide the type of plantation to be created. Plantation may be enrichment, wildlife habitat, normal, avenue, compensatory and industrial plantation etc. Also which method of plantation will be carried out, i.e. direct sowing, planting of bare root seedlings, planting of seedling produced in the polythene bags, planting root balled and rhizome plantation etc.

2. The first task is to determine the types of nursery or plantation to be established or maintained and pick up the items of work suited to each type.

3. Budgeting for seedling production depends upon its type such as direct sowing in the nursery bed, polythene or bare root seedlings. Therefore, the planner has to decide before planning and budgeting to avoid duplication.

4. The Territorial Forestry Division/Parks (DoFPS) jointly with implementing agency shall ensure to identify potential plantation sites as per the Section-8.1 (Seasonal calendar for plantation activity planning and implementation) prescribed in the plantation and Nursery M&E guidelines 2019.

5. The plantation site should be preferably a large area not less than 1 ha for economical reasons.

6. The Territorial Forestry Division/Parks (DoFPS) jointly in collaboration with the implementing agency shall arrange public consultations (if deemed necessary) prior to finalization of the potential plantation sites.

7. The proper handing taking over of the plantation sites (New creation and maintenance of old plantation sites) shall be done as per the user rights agreements (ToR) signed between the Territorial Forestry Division/Parks (DoFPS) and the implementing agency.

8. The implementing agency shall carry out detail field survey and prepare the estimates and submit to the DoFPS/Competent Authority for approval as per the plantation activity calendar prescribed in the plantation and Nursery M&E guidelines 2019.

9. The DoFPS/Competent Authority shall issue the technical sanction for the proposed afforestation activities latest by mid December.

10. The Funding Agency shall release the fund to the implementing agency as a deposit work latest by end of December.

11. The implementing agency shall acknowledge receipt of the fund to the funding agency.

12. The detailed accounts shall be maintained by the implementing agency. The accounts shall be audited by Royal Audit Authority at the office of implementing agency.

13. The implementing agency shall implement the activities only after obtaining technical approval and release of fund from funding agency.

14. The planting work shall be completed latest by end of July.

15. The DoFPS/funding agency shall monitor the plantation activity based on the approved technical sanction and Plantation M&E guidelines 2019.

16. After completion of the plantation, the implementing agency shall submit completion report to the respective TDs and Parks.

CHAPTER 1: SPECIFIC PEROID OF SEED COLLECTION AND SOWING

Seed collection and sowing time is described in this chapter as furnished in the Table 1. Before seed collection, collectors must clearly understand for what purpose seedlings will be planted. Based on its purpose seeds should be collected and store with utmost care and treatment. He/she should have adequate knowledge on seed collection especially on mother tree selection, seeds ripening and its dispersal time which differs from species to species. Seeds collected and sown before ripening or maturity are usually infertile and give poor germination or may not germinate at all.

The vernacular names of the species have also been incorporated for easy reference. The implementing agency has to plan in advance for particular species seed collection and collect accordingly.

Table 1. Specific period of seeds collection and sowing

SN	Scientific Name	Local Name	Collection Time	Sowing Time
1	*Abies densa*	Dungshing (Dz), Wangshing (Sh), Fir (Eng)	Oct-Nov	Feb-Mar
2	*Abrus precatorius*	Khai-ning roo (Sh), Lalgiri (Sh)		
3	*Acacia auriculiformis*	Jimshing (Dz), Lanungshing (Sh), Akashmoni (Lh)	Jan-Apr	Apr-May
4	*Acacia catechu*	Toeja (Dz/Sh), Khair (Lh)	Nov-Mar	Apr-May
5	*Acanthospermum hispidum*	Wrong robba (Sh), Starbur (Eng)		
6	*Acer campbellii*	Pchalam(Dz), Sermaling (Sh), Kapasi (Lh)	Nov-Dec	Mar-Apr
7	*Acer oblongum*	Chhibla shing (Dz), Phirphiri		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Lh),		
8	*Acer pectinatum*	Wongkha shing (Dzo), Semaling shawa sampa (Sh), Lekh kapasi (Lh), Maple (Eng)		
9	*Acrocarpus fraxinifolius*	Chashing (dz), Choktseshing (Sh), Mandaney (Lh)	Apr -May	Apr-May
10	*Actinodaphne obvata*	Runchey/ Runchey pat (Lh)		
11	*Actinodaphne sikkimensis*	Rudilo / sik siki (Lh)		
12	*Adina cordiflolia*	Halwashing (Dz), Anashing (Sh), Haldu (Lh)	Mar-June	Mar-Jun
13	*Aegle marmelos*	Men-Dhoma shing (Dz), Men-sey shing (Sh), bael (Eng)		
14	*Agapetes bhutanica*	Chemm metog (Dz), Frengma metog (Sh)		
15	*Agapetes saligna*	Amile/Ongarey (Lh)		
16	*Agapetes sepens*	Dhendroob metog (Dz), Dhendroob metog (Sh)		
17	*Aglaia spectabilis*	Laso shing (Dz), Phang shing (Sh), Lali or Amari (Lh)		
18	*Ailanthus grandis*	Pekashing(Dz/Sh), Gokul (Lh)	April -May	April-May
19	*Alangiium Chinese*	Luma shing (Dz), Benthong shing (Sh), Okane or Akhane (Lh).		
20	*Albizia lebbeck*	Prekprekshing (Dz), Sershing	Dec-Feb	Mar-Apr

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Sh), Kalo siris (Lh)		
21	*Albizia procera*	Sekpalashing (Dz), Khirthangshing (Sh), Seto siris (Lh)	Dec-Jan	May-Jun
22	*Albizia sherriffii*	Lam shing (Dz), Lhari siris (Lh)		
23	*Alcea rosea*	Haloong metog (Dz), Haloong metog tsalo (Sh), Hollyhock (Eng)		
24	*Alcimandra cathcartii (Michelia cathcartii)*	Kha shing (Dzo), Kar shing/Chhampey shing (Sh),Tite champ (Lh)		
25	*Alnus nepalensis*	Gamashing (Dz), Gamoshing (Sh), Utis (Lh)	Dec-Mar	Mar-Apr
26	*Ammora wallichii*	Lasoshing (Dz), Phangshing (Sh), Lali (Lh)	Mar-May	Apr-May
27	*Anthocephalus cadamba*	Kadamshing (Dz), Kadam (Lh)	July-August	July-Aug
28	*Aquilaria malaccensis (Aquilaria agallocha)*	Aarnag (Dz), Aarnag (Sh), Agar (Lh), Eagle wood or Aloe wood		
29	*Aquilaria sinensis*	Agoor (Dz), Agoorshing (Sh), Agar (Lh), Eagle wood or Aloe wood (Eng)		
30	*Artocarpus heterophyllus*	Damtse (Dz), Dremlingshing (Sh) /Jackfruit (Eng)	June-July	July
31	*Artocarpus*	Dramday (Dz),	Jun-Aug	July-Aug

SN	Scientific Name	Local Name	Collection Time	Sowing Time
	lacucha	Badahar (Lh)		
32	*Aquilaria malaccensis*	Agoor (Dz), Aghori (Lh), Eagle wood (Eng)	Mar-June	Mar-June
33	*Aster albencens*	Khandro metog (Dz), Khandro metog (Sh)		
34	*Aster diplostephioides*	Men metog (Dz), Men metog (Sh)		
35	*Azadirachta indica (Melia azadirachta)*	Ja shing (Dz), Ja shing or Neyra shing (Sh), Bakaina (Lh), Neem tree (Eng)		
36	*Bambusa balcooa*	Zhoo shing (Dz), Sho (Sh), Dhanu bans (Lh)		
37	*Bambusa calvata*	Pag shing (Dz), Lee shing (Sh), Chile bans (Lh)		
38	*Bambusa nutans*	Jhu shing (Dz), Soh (Sh), Mal bans (Lh)		
39	*Bambusa tulda*	Jhu shing (Dz), Soh (Sh), Singhane bans (Lh)		
40	*Bambusa vulgaris*	Soh (Sh), Teli bans (Eng)		
41	*Bauhinia purpurea*	Zibzibshing (Dz), Pekpekshing (Sh) Tanki (Lh)	Feb-Mar	May-June
42	*Bauhinia variegate*	Ruchashing (Dz), Balingshing (Sh), Koiralo (Lh)	Mar-May	May-June
43	*Belamcanda chinesis*	Joen shing metog (Dz), Tyang patare (Lh)		
44	*Benthamedia capitate*	Phoitse (Dz), Namitpashing	Oct –Dec	Feb-Mar

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Sh), Ram katar (Lh)		
45	*Betula utilis*	Latap (Dz), Chharshing (Sh), Bhojpatra (Lh)	Aug-Oct	Jan-Mar
46	*Betula alnoides*	Taapshing (Dz), Chharshing (Sh), Saur (Lh)	Oct-Feb	Nov- Mar
47	*Bischofia javanica*	Chumshing (Dz), Kainjal (Lh)	Dec - March	Jan-Apr
48	*Boehmeria rugolosa*	Dhong-tsong shing (Sh), Dar (Lh)		
49	*Bombax ceiba*	Pemagayser (Dz/Sh) Simal (Lh)	Mar-May	Apr-May
50	*Bridelia retusa*	Trretashing (Dz), Menchashing (Sh), Gayo (Lh)	Oct-Nov	Mar-Apr
51	*Buddleja asiatica*	Kangshing (Dz)		
52	*Caesalpinia decapetala*	Tatse tsang/tsang-gi metog (Dz)		
53	*Callicarpa arborea*	Khalema (Dz), Jeenlab sey shing (Sh), Guenla (Lh)		
54	*Callicarpa rubella*	Nangay waam (Dz), Jeenlab sey shing (Sh)		
55	*Caltha scaposa*	Gotham ser metog (Sh)		
56	*Camellia japonica*	Yangchen metog (Dz), Yangchen metog(Sh)		
57	*Camellia kissi*	Yangchen metog (Dz), Yangchen metog (Sh), HInguwa (Lh)		
58	*Canna speciose*	Ashoom lagametog (Sh)		
59	*Carduus acanthoides*	Zoo metog ()		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
60	*Carpinus viminea*	Rutoshing (Dz), Lung shing (Sh)	July-Oct	Feb-Mar
61	*Cassia fistula*	Chakajumshing (Dz), Dhongkoshing (Sh), Rajbriksha/ Sunalo (Lh)	Mar-Apr	Apr-Mar
62	*Castanea sativa*	Tsha-tshee shing (Dz), Tsha-tshee shing (Sh), Sweet chest nut/ Spanish chest nut (Eng)		
63	*Castanopsis armata*	Sokey (Dz), Tshai shing (Sh), Patle kotus (Lh)		
64	*Castanopsis clarkei*	Tshai shing sokar (Sh), Patle katus (Lh)		
65	*Castanopsis hystrix*	Sokeyshing (Dz), Tshaishing sonag (Sh), Katus (Lh)	Oct-Nov	Dec- Jan
66	*Castanopsis Indica*	Sokey (Dz), Tshai shing (Sh), Aule katus (Lh)		
67	*Castanopsis lanceifolia*	Tshai shing (Sh), Patle katus (Lh)		
68	*Castanopsis tribuloides*	Thomsokey (Dz), Thongpashing (Sh),Musrey katus(Lh)	Nov-Jan	Mar-Apr
69	*Cedrus deodara*	Shubdarshing (Dz), Deodar (co), Cedar (Eng)	Oct-Dec	Dec-Jan
70	*Catunaregam longispina (Randia dumetorum)*	Shoshoma zoo shing (Sh)		
71	*Celtis australis*	Sokum (Dz), Sogsogpashing (Sh), Khari (Lh)	Oct-Dec	March

SN	Scientific Name	Local Name	Collection Time	Sowing Time
72	*Celtis tetrandra*	Sok-sokpa shing or phantang shing (Sh)		
73	*Cephalostachyum capitatum*	Jhi (Dz), Soh (Sh), Dulloo		
74	*Choerospondias axillaris*	Charashing (Dz), Throongchung (Sh), Lapsi (Lh)	Nov-Feb	Mar-Apr
75	*Chukrasia tabularis*	Chuzim, (Dz), Checkrasi (co)	Mar-June	May-Jun
76	*Cinamomum camphora*	Peomenshing (Dz), Kapur (Lh), Camphor (Eng)	Sep-Nov	Feb-Mar
77	*Cinamomum cassia*	Shingtsa (Sh)		
78	*Cinamomum glaucescens (Cinamomum cecicodapne)*	Shingtsazim (Dz), Durkashing (Sh), Maligari (Lh)	Oct-Nov	Mar-Apr
79	*Cirsium souliei*	Changtsher metog (Dz), Zomboo metog (Sh)		
80	*Coriaria napalensis*	Limphu shing (Dz), Thabshing shing (Sh)		
81	*Corydalis nigro*	Sokey (Dz),Tshai shing (Sh), Lekh katus (Lh)		
82	*Cryptomeria japonica*	Jatsenshing (Dz), Dhongkala Shing (Sh) ,Cryptomeria (Co)	Oct-Nov	Jan-Mar
83	*Cupressus cashmeriana*	Tsendhey/Chendhey (Dz), Tsendhen or chen shing (Sh), Dhupi (Lh), Cypress (Eng)		
84	*Cupressus*	Tsendhey or		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
	corneyana	chendhey (Dz), Tsendhhen or Chen shing, Weeping cypress (Eng)		
85	*Cupressus himaliaca*	Tsenden (Dz), Tsendenshing (Sh), Dhupi (Lh)	Oct-Nov	Nov-Jan
86	*Cupressus torulosa*	Tsenden (Dz), Tsendenshing(Sh), Dhupi (Lh)	Dec-Mar	Feb-Mar
87	*Curcuma aromatic*	Dum or Doem (Dz), Doima metog (Sh)		
88	*Dahlia imperialis (white/purple)*	Dhuetsee metog (Dz), Dhuetsee metog (Sh)		
89	*Dahlia pinnata (yellow/orange)*	Dhuetse metog (Dz), Dhuetsee metog (Sh)		
90	*Dalbergia sissoo*	Sissooshing (Dz), Sisoo (Lh)	Mar-May	Feb-April
91	*Duabanga grandiflora*	Patangshing (Dz), Grandanglashing (Sh) Lampatey (Lh)	Nov-Feb	May- Jun
92	*Daphne anrantica*	Dhey shing (Dz), Shogo shing (Sh)		
93	*Daphne bholua*	Dhey shing/Dheynap (Dz), Shogo shing (Sh), Kagate (Lh)		
94	*Daphnephyllum himalense*	Jurooshing (Dz), Aawashing (Sh), Lal Chandan (Lh)	Nov-Dec	Jan-Mar
95	*Daphniphyllum Chartaceum*	Juroo shing (Dz), Aawa shing (Sh), Lal chandan (Lh)		
96	*Dendrobium*	Norbu metog (Dz),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
	nobile	Norbu metog (Sh)		
97	*Dendrocalamus giganteus*	Jasumang dhemchharing (Sh), Dhungree bans or rachhasi bans (Lh)		
98	*Dendrocalamus hamiltonii*	Pag shing (Dz), Lee shing (Sh), Tama bans (Lh)		
99	*Dendrocalamus hookeri*	Pag shing (Dz), Lee shinhg (Sh)		
100	*Dendrocalamus sikkmensis*	Zhang (Dz), Dhemchharing (Sh), Dhungre bans (Lh)		
101	*Dendrocalamus spp.*	Bamboo (Co)	Rhizome	May – Jun
102	*Digitalis purpurea*	Lhamo metog (Dz), Lhamo metog (Sh), Fox glove (Eng)		
103	*Dillenia indica*	Abee-dhoro shing (Sh), Panchphal or Panchphale (Lh)		
104	*Diospyros kaki*	Aanday shing (Dz), Aanday shing (Sh), Chinese persimmon or Chinese date plum (Eng)		
105	*Diospyros lotus*	Guendoom shing (Dz), Aama-dhongpo sey or Aamley debu shing (Sh), Date plum (Eng)		
106	*Diploknema butyracea*	Yika shing (Dz), Peen shing or		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
	(Aesandra butyracea)	Pheen shing (Sh), Chiuri (Lh)		
107	*Duabanga grandiflora (D. sonneratioides)*	Patang shing (Dz), Bakaling shing or Grandangla shing (Sh), Lampatey (Lh)		
108	*Duhaldea cappa (Inula cappa)*	Khee-thruiwa shing (Sh), Tamaikhu (Lh)		
109	*Eleacarpus lanceifolius*	Quequeshing (Dz), Gashathungshing (Sh), Badrasey (Lh)	Nov-Feb	May –Jun
110	*Elaegnus infundibularis*	Chhongbling shing (Sh), Gweli (Lh)		
111	*Elaegnus parvifolia*	Bji (Dz), Dhang-boor-zoo or Dhang-boor-say shing (Sh), Gweli (Lh)		
112	*Emblica officinalis (Syn. Of Phyllanthus emblica)*	Omla shing (Dz), Chhorgen say shing (Sh), Amala (Lh)		
113	*Enkianthus deflexus*	Shing marp (Dz), Shing morab (Sh), Sindure or khorsane (Lh), Flame of forest (Eng)		
114	*Epilobium conspersum*	Namsey metog (Dz), Namsey (Sh)		
115	*Erythrina arborescens*	Chaseeshing (Dz), Kharshing (sh), Faledo (Lh)	June-Aug	Apr-Jun
116	*Erythrina variegate*	Thasachasee (Dz), Kharshing (Sh) Faledo (Lh)	June-Aug	Apr-May

SN	Scientific Name	Local Name	Collection Time	Sowing Time
117	*Euonymus grandifloras*	Zheepa metog shing (Sh)		
118	*Euonymus monbeigii*	Druk shing (Dz), Druk shing (Sh)		
119	*Euonymus tingens*	Nga-pa metog (Sh)		
120	*Eurya cerasifolia*	Khamgoey (Dz), Khoober shing shawa zeeb zeeb or Khuberbu shing (Sh), Bara Jhingni (Lh)		
121	*Exacum hamiltonii*	Geethri metog (Dz)		
122	*Exbucklandia populnea (Bucklandia popunea)*	Chenjushing (Dz), Lemshing (Sh), Pipli (Lh)	Dec-Mar	Mar-Apr
123	*Ficus roxburghii (F. auriculata)*	Bakushing (dz), Chongmashing (Sh)Nebaro (Lh)	Jun- Sep	July- Aug
124	*Ficus benghalensis*	Brong shing (Sh), Bar or barahar (Lh), Banyan tree (Eng)		
125	*Ficus benjaminina*	Rui shing (Sh), Kabra (Lh)		
126	*Ficus concinna*	Phy shing (Sh),		
127	*Ficus cyrtophylla*	Sang sokpa (Sh), Kareto/ Kasru (Lh)		
128	*Ficus drupacea*	Jaba shing (Sh)		
129	*Ficus elastic*	Brong shing (Sh), Labar (Lh), Indian rubber 2tree (Eng)		
130	*Ficus neriifolia*	Rui shing (Sh), Dudhila (Lh)		
131	*Ficus oligodon*	Baku shing (Dz), Chongma shing (Sh), Timil (Lh)		
132	*Ficus religiosa*	Jangchubshing	Apr - May	May-Jun

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Dz/Sh), Pipal (Pipal)		
133	*Ficus infectoria*	Samda (Dz), Wangom (Sh), Kabra (Lh)	Cutting	June-July
134	*Ficus semicordata (F. cunia)*	Ridangshing (dz), Barachongma (Sh) Khanew (Lh)	July-Aug	July-Aug
135	*Ficus subulata*	Chongma shing (Sh)		
136	*Ficus virens (F. infectoria)*	Samda (Dz), Wangom or phi shing (Sh), Kabra (Lh)		
137	*Firmiana colorata (Sterculia)*	Fraang shing (Sh), Seto odal (Lh)		
138	*Fraxinus floribunda*	Draythub (Dz), Lakuri (Lh) , Ash tree (Eng)	Sep-Oct	Mar-Apr
139	*Fuchsias magellanica*	Chhoe-dree metog (Dz), Chhoe-dree metog (Sh), Gantee full (Lh)		
140	*Gaultheria semi-infera*	Shagshing-ma shing (Sh)		
141	*Gentiana loureirii*	Kezang metog (Sh)		
142	*Gentiana urnula*	Keekhor metog (Dz), Keekhor metog (Sh)		
143	*Gmelina arborea*	Gamarshing (Dz), Kholomshing (Sh), Khamari (Lh)	Apr-June	Apr-Jun
144	*Haldina cordifolia (Adina cordifolia)*	Halwa shing (Dz), Ana shing (Sh), Karam or Haldu (Lh)		
145	*Helianthus annuus*	Nyim gangshar (Dz), Nyee-meen metog (Sh)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
146	*Helichrysum braceteatum*	Shogo metog (Sh)		
147	*Helicia nilagirica*	Potala shing (Dz), Potala shing/Photor shing (Sh), Bandarey/Bandare (Lh)		
148	*Helixanthera ligustrina (Loranthus ligustrinus)*	Ja shing (Dz), Khai-ning shing (Sh)		
149	*Hibiscus rosa-sinensis*	Peydher metog (Dz), Peydher metog (Sh)		
150	*Hibiscus syriacus*	Kuendhoen metog (Dz), Kuemdhoen metog (Sh)		
151	*Hovenia acerbia*	Pumoo rooto (Dz), Froomtegpa shing (Sh), Bangikath or Bunge kat (Lh)		
152	*Hydrangea macrophylla*	Dosem metog/ dhorsem metog (Sh), Basak (Lh)		
153	*Hyptianthera stricta*	Shayung warong shing (Sh), Akle kat or Haldi kat (Lh)		
154	*Impomoea alba*	Dhawa metog (Dz), Dhawa metog (Sh), Moon flower or Good night flower (Eng)		
155	*Impomoea pupurea*	Nga-dro metog (Dz), Nga-dro metog (Sh), Morning glory (Eng)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
156	*Impomoea turbinate*	Chhalang metog (Sh)		
157	*Iris bulleyana*	Joenshing metog balingmeen (Sh)		
158	*Iris decora*	Boraang joenshing metog (Sh)		
159	*Iris goniocarapa*	Boraang joenshing metog (Sh)		
160	*Iris kemaonensis*	Fuga joenshing metog (Sh)		
161	*Iris lacteal*	Joenshing metog zemo		
162	*Iris potaninii*	Joenshing metog serboo		
163	*Jacaranda mimosifolia*	Jakashing (dz), Jacaranda (co)	Feb-Mar	Mar-Apr
164	*Juglans regia*	Tashing (Dz), Kheshing (Sh), Okhar (Lh)	Sep-Dec	Feb-Mar
165	*Juniperus pseudosabina*	Shoop shing (Dz), Shoogpo shing (Sh), Dhupi (Lh), Black juniper (Eng)		
166	*Juniperus recurve*	Shupshing (Dz), Shokpashing (Sh), Dhupi (Lh), Weeping blue Juniper (Eng)	Apr-June	Apr-June
167	*Juniperus squamata*	Shoop shing (Dz), Shookpo shing (Sh), Dhupi (Lh), Weeping blue juniper (Eng)		
168	*Kniphofia caulescens*	Pakar metog marp (Dz), Pakar metog tsalo (Sh)		
169	*Kniphofia ensifolia*	Pakar metog (Dz), Pakar metog (Sh),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Red-hot poker (Eng)		
170	*Kniphofia uvaria*	Pakar metog serp (Dz), Pakar metog serboo (Sh), Red-hot poker (Eng)		
171	*Kydia calicina*	Chambaktangshing (Sh), Kubindey (Lh)	Dec-Mar	Mar-Apr
172	*Lagerstroemia hirsute*	Dongkashing (Dz), Baramshing (Sh), Jarul (Lh)	Jan-Mar	Apr-May
173	*Lagerstroemia parviflora*	Dongkashing (Dz), Baramshing (Sh), Sidha (Lh)	Jan-Mar	Apr-May
174	*Larix griffithii*	Zashi (Dz), Larch (Eng)	Oct-Nov	Mar-Apr
175	*Latana camara*	Shing singba (Sh), Barra mase (Lh), Lantana (Eng)		
176	*Leucaena leucocephala*	Tsa shing (Dz), Tsee shing (Sh), Ghans siris (Lh), Leucaena (Eng)	Nov-Jan	Apr-May
177	*Lindera heterophylla*	Chur(Dz), Lekh pepli (Lh)		
178	*Lindera melastomacea*	Sengkyermayshing (Sh)		
179	*Lindera neesiana*	Neng shing/Roo neng (Sh), Siltimur (Lh)		
180	*Lindera pulcherrima*	Sengkyermay shing (Sh), Sisi (Lh)		
181	*Lithocarpus dealbatus (Quercus dealbata)*	Shakor shing (Sh), Arkaula (Lh)		
182	*Lithocarpus*	Shakor shing (Sh),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
	elegans	Arkaula (Lh)		
183	*Lithocarpus fenestratus*	Thasa sokey (Dz), Shodhka Tshai shing (Sh), Arkaula(Lh)		
184	*Lithocarpus listeria*	Shakor shing (Sh), Arkaula (Lh)		
185	*Lithocarpus pachyphyllus*	Sokey (Dz), Tshai shing (Sh), Sungure (Lh)		
186	*Litsea cubeba (Lindera cubeba)*	Neng shing or Ekpa-see shing (Sh), Timur (Lh)		
187	*Litsea elongate*	Phamphal/Phusre (Lh)		
188	*Litsea glutinosa*	Kawala (Lh)		
189	*Litsea hookeri*	Dude lampate (Lh)		
190	*Litsea kingie*	Siltimur (Lh)		
191	*Litsea monopetala*	Sey chhangloo shing (Sh), Bonsum (Lh)		
192	*Litsea panamanja*	Painle Champ/Dudhi Lampati		
193	*Litsea sericea*	Geywe (Dz), Lekh siltimur (Lh)		
194	*Loranthus europaeus*	Khai-ning shing zemo (Sh)		
195	*Loranthus odoratus*	Khai-ning shing (Sh)		
196	*Luculia gratissima*	Tongdhen metog (Dz), Tongdhen metog (Sh), Gadauri or Dawari (Lh)		
197	*Lyonia ovalifolia(Pieris ovalifolia)*	Zentu shing (Dz), Shajula shing (Sh), Angeri (Lh)		
198	*Lyonia villosa*	Zentu shing		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Shajula shing zemo (Sh), Lekh angeri (Lh)		
199	*Macropanax dispermus*	Gu shing or Goo shing (Sh)		
200	*Maesa indica*	Sechum shing (Dz), Bilaune or Kanchirna or Phiksangme (Lh)		
201	*Mangifera indica*	Aamchukuli (Dz), Aamshing (Sh), Amp (Lh)	May-Aug	July-Aug
202	*Magnolia campbellii*	Khashing (Dz), Karshing (Sh), Ghoge champ (Lh)	Aug-Sept	Sept-Oct
203	*Mangifera indica*	Aam chukuli or Aar-ma (Dz), Aam or Amm (Sh), Amp (Lh), Mango (Eng)		
204	*Meconopsis grandis (National flower of Bhutan)*	Euit-pel metog hoem (Dz), Euit-pel metog yengloo (Sh), Blue poppy (Eng)		
205	*Meconopsis sherriffii*	Euit-pel metog (Dz), Euit-pel metog (Sh),		
206	*Megacodon stylophorus*	Garpa metog (Sh)		
207	*Melastoma normale*	Tekaling shing or Mizuma laga zemo (Sh), Angarey (Lh)		
208	*Melocanna baccifera*	Soh chung (Sh), Philim bans/Lahure bans (Lh)		
209	*Mesua ferrea*	Chag shing (Dz), Per shing (Sh),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Nagersuri (Lh), Iron wood (Eng)		
210	*Melia azedarach*	Jashing (Dz), Neyrashing (Sh), Bakaina (Lh)	Nov-Mar	Mar-July
211	*Michelia champaca*	Kashing (Dz), Karshing (Sh), Aule Champ (Lh)	July-Aug	July-Aug
212	*Michelia doltsopa (M. excelsa)*	Khashing (Dz), Karshing (sh), Rani Champ/Seto champ (Lh)	Aug-Sept	Sept -Oct
213	*Michelia kisopa*	Kha shi (Dz), Kar shing/Chhampey shing (Sh), Champ (Lh)		
214	*Michelia punduana*	Champ (Lh)		
215	*Michelia valutina*	Champ (Lh)		
216	*Mirabilis japala*	Kaling metog (Sh), Four o'clock or Marvel of Peru		
217	*Morus alba*	Sha-khongma shing (Sh), Kimbu (Lh), White mulberry (Eng)		
218	*Morus australis*	Sanu kimbu (Lh), Mulberry (Eng)		
219	*Morus laevigata (M. macroura)*	Tshendhey (Dz), Sengdenshing (Sh), Kimbu (Lh)	Mar-Apr	Mar-Apr
220	*Musa balbisiana*	Ngala shing (Dz), Lai shing (Sh), Banana tree (Eng)		
221	*Musa griersonii*	Tsheymai ngala shing (Dz), Borang lai shing (Sh), Wild banana tree (Eng)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
222	*Musa sikkimensis*	Ngala shing (Dz), Lai shing (Sh), Banana tree (Eng)		
223	*Nelumbo nucifera*	Pedh-tsa metog (Dz), Pedh-tsa etog (Sh), Sacred bean or Egyptian lotus (Eng)		
224	*Neolamarckia cadamba (Anthocephalus cadamba)*	Puti shing (Dz), Puti shing (Sh), Kutki or kutaki (Lh)		
225	*Nyssa javanica*	Lai-mom-nang shing (Sh), Lekh chilaune(Lh)		
226	*Oroxylum indicum*	Champaka (Dz), Namkaling metog (Sh),Totola (Lh)	Dec-Feb	Feb-Mar
227	*Osbeckia capitate*	Pangthang metog (Sh)		
228	*Osbeckia nepalensis*	Tekaling shing (Dz),		
229	*Osbeckia stellate*	Ardongmo shing (Sh), Lal angeri (Lh)		
20	*Parasassafras confertiflora*	Shing-mar (Dz), Singsee/Selung shing (Sh), Kalo bori (Lh)		
221	*Pedicularis bicornuta*	Sheesha metog (Sh)		
222	*Pedicularis tithymaliodes*	Lawang metog (Sh), Slipper-flower (Eng)		
223	*Pelargonium zonale*	Sazam metog (Dz), Kho metog (Sh)		
224	*Persea Americana*	Japan golee (Sh), Avocado pear (Eng)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
225	*Persea bootanica*	Golee or Goosey shing (Dz), Golee shing (Sh), Avocado		
226	*Persea clarkeana*	Pra-golee shing (Sh), Chipli kawla or seto kawla (Lh)		
227	*Persea duthiei*	Mitsu shing (Dz),		
228	*Persea glaucescens*	Bhale caulo/Kawla (Lh)		
229	*Persea kurzii*	Seto kawla (Lh)		
230	*Percea fructifera (Machilus edulis)*	Gulishing (Dz), Lapche kawla/ Phuntse (Lh)	Nov-Jan	Feb-Mar
231	*Persea odoratissima*	Matchu shing (Dz), Sha-golee shing (Sh), Lali kawla (Lh)		
232	*Phoebe altenuata*	Theinab (Dz),Angaray (Lh)	Sep-Oct	Jan-Feb
233	*Phyllanthus emblica (Emblica officinalis)*	Omla shing (Dz), Chhorgen say shing (Sh), Amala (Lh)		
234	*Picea spinulosa*	Ba shing (Dz), Ba shing (Sh), Kalo salla (Lh), E.Himalayan Spruce (Eng)	Sep-Nov	Feb-Mar
235	*Pieris Formosa*	Kheb-chhey (Dz), Dhoog shing (Sh), Balu (Lh)		
236	*Pinus bhutanica*	Druggi Tongphu (Dz), Drukpa chang shing (Sh), Bhutan pine (Eng)		
237	*Pinus roxburghii*	Thetongphu (Dz), Roinashing (Sh), Dhup(Lh),	Jan-Mar	Feb-Mar

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Chirpine (Eng)		
238	*Pinus wallichiana*	Tongphu (Dz), Changshing (Sh),Salla/Dhupi (Lh) Bluepine (Eng)	Sep-Nov	Feb-Mar
239	*Pipper betleoides*	Panni/ Ratah (Dz), Paan/Shing paan (Sh), Pan (Lh), Betle leaf plant (Eng)		
240	*Pipper betula*	Panni or Ratah (Dz), Paan/shing paan (Sh), Pan (Lh), Betle leaf plant (Eng)		
241	*Piper hamiltonii*	Tshemai panni (Dz), Boraang paan (Sh), Jangli pan (Lh),		
242	*Platanus orientalis (P.hispanica)*	Goem shing (Dz), Sheebeen shing (Sh)		
243	*Pleurospermopsis sikkimensis*	Mulai shing (Sh)		
244	*Poikilospermum lanceolatum*	Roo shing (Dz), Roo shing (Sh)		
245	*Poikilospermum naucleiflorum*	Roo shing (Dz), Roo shing (Sh)		
246	*Populus ciliate*	Kashing (Dz), Ka shing (Sh), Pipal patey (Lh) Poplar (Eng)	Apr-June	June-July
247	*Populus rotundifolia*	Ka shing chhung-ku (Dz)		
248	*Populus tremula*	Ka shing barma (Dz/Sh)		
249	*Primula capitate*	Toh-key metog (Dz), Jabu metog		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Sh),		
250	*Primula denticulate*	Dotched metog (Dz), Goorgoor metog (Sh), Simphul (Lh), Drumstick primrose (Eng)		
251	*Primula gracilipes*	Sa metog (Sh)		
252	*Primula munroi*	Yeshey metog (Dz/Sh),		
253	*Primula sikkimensis*	Chang chang metog (Sh)		
254	*Prunus cerasoides*	Boraang lengshing/Drem lengshing (Sh)		
255	*Prunus dulcis*	Khamboo (Dz), Leng shing/Lengsey shing (Sh)		
256	*Prunus persica*	Khamboo shing (Dz),Leng sey shing (Sh), Aru (Lh), Peach/Nectarine (Eng)		
257	*Prunus nepalensis*	Khamgoshing (Dz/Sh)), Aru-patey (Lh)	Oct-Dec	Mar-Apr
258	*Pteropsersum acerifolium*	Dhashom (Dz),Mongnanglos hinh (Sh) Hatipaley (Lh)	June-July	July-Aug
259	*Pyrus communis*	Lee/dri-lee (Dz), Leetong (Sh), Naspati (Lh), Pear (Eng)		
260	*Quercus acutissima*	Thomp shing (Dz), Thongpa shing (Sh)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
261	*Quercus glauca*	Thomp shing (Dz), Thongpa shing (Sh), Musre phalant (Lh)		
262	*Quercus griffithii*	Sissishing (Dz), Bainangshing (Sh), Khasru (Lh), Oak (Eng)	Nov-Feb	Feb-Mar
263	*Quercus lanata*	Ghum (Dz), Beytsenangshing (Sh)	Nov-Dec	Feb-Mar
264	*Quercus lamellose*	Bangkashing/Thomp sokey (Dz), Fangkoimashing, (Sh), Bajranth (Lh)	Oct-Dec	Feb-Mar
265	*Quercus leucotrichophora (Q. incana)*	Ghoom (Dz), Betsi-nang shing (sh)		
266	*Quercus oxyodon*	Thomp shing(Dz), Thongpo shing(Sh)		
267	*Quercus semicarpifolia*	Bjishing (Dz), Beytsenangshing (Sh), Khasru (Lh), Oak (Eng)	Jun - Aug	July-Aug
268	*Quercus semiserrata*	Thomp shing (Dz), Thongpo shing (Sh)		
269	*Quercus senescens*	Bji shing (Dz), Betsi-nang shing (Sh)		
270	*Quercus thomsoniana (Q. lineata)*	Bji shing (Dz), Betsi-nang shing (Sh), Phalant (Lh)		
271	*Randia dumetorum*	Shoshoma zoo shing (Sh), Maidalu or maidal (Lh)		
272	*Ranunculus sceleratus*	Dhamgi metog (Dz),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
273	*Rheum nobile*	Chhukha metog (Dz/Sh)		
274	*Rhododendron anthopogon*	Dhalee metog (Dz/Sh), Dhupi (Lh)		
275	*Rhododondron arboretum*	Aetoh metog (Dz), Zhu-daangshing (Sh), Gurans/Gurass (Lh)	Aug-Mar	Mar-Apr
276	*Rhododendron barbatum*	Tag shing (Dz/Sh), Lal chimal (Lh)		
277	*Rhododendron Bhutanese*	La-gee Aetoh metog (Dz), Laga Zhu-dhaang karpo (Sh),		
278	*Rhododendron campanulatum*	Aetoh metog karp (Dz), Zhu-dhaang karpo (Sh), Nilo chimal (Lh)		
279	*Rhododendron campylocarpum*	Aetoh metog sep (Dz), Zhu-dhaang metog serboo (Sh)		
280	*Rhododendron falconeri*	Khangley metog (Dz/Sh), Korlinga (Lh)		
281	*Rhododendron grande*	Tshewang metog (Dz/Sh), Patle korlinga (Lh)		
282	*Rhododendron griffithianum*	Tag-shar metog (Dz/Sh), Seto chimal (Lh)		
283	*Rhododendron hodgsonii*	Aetoh metog (Dz), Zhu dhaang metog (Sh), Korlinga (Lh)		
284	*Rhododendron kendrickii*	Aetoh metog (Dz), Zhu dhaang metog (Sh)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
285	*Rhododendron kesangiae*	Tala metog (Dz/Sh)		
286	*Rhododendron keysii*	Kidhpa metog (Dz/Sh)		
287	*Rhododendron lepidotum*	Dhalee metog (Dz/Sh), Bhale sunpate (Lh)		
288	*Rhododendron neriiflorum*	Zhu-dhaang metog (Sh)		
289	*Rhododendron nivale*	Dhalee metog (Dz/Sh)		
290	*Rhododendron neveum*	Aetoh metog (Dz), Zhu-dhaang metog (Sh)		
291	*Rhododendron primulaeflorum*	Dhalee metog (Dz/Sh)		
292	*Rhododendron succothii*	Aetoh metog (Dz), Zhu-dhaang metog (Sh)		
293	*Rhododendron thomsonii*	Khempa metog (Dz), Khempa metog (Sh)		
294	*Rhus chinensis (R. javanica)*	Choka shing (Dz), Robtang shing (Sh), Bhakimlo (Lh)		
295	*Rhus hookeri*	Jarsee shing or jar shing (Sh), Khag bhalayo (Lh)		
296	*Rhus panicula*	Choka shing (Dz), Prekoptang shing (Sh)		
297	*Rhus succedanea (R. accuminata)*	Sey shing (Sh), Rani bhalayo (Lh)		
298	*Rhus verniciflua*	Shey shing (Sh)		
299	*Ricinis communis*	Chagmala shing (Sh), Reri (Lh), Castor oil plant (Eng)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
300	*Robinia pseudoacacia*	Chhashing (Dz), Robinia (Co)	Oct-Dec	Feb-Mar
301	*Rosa sericea*	Sew metog (Dz), Sewai metog (Sh), Sisi (Lh)		
302	*Rumex sceleratus*	Dhamgi metog (Dz)		
303	*Salix babylonica*	Changmashing (Dz/Sh),Weeping Willow (Eng)	Apr-May	Apr-May
304	*Salix lindleyana*	Jowodhoor shing changma (Dz/Sh),Black mountain willow (Eng)		
305	*Salix salwinesis*	Changma shing (Dz,Sh), Wollow (Eng)		
306	*Salix sikkimensis*	Langma shing (Sh)		
307	*Salix wallichiana*	Langma shing (Dz/Sh)		
308	*Sapindus mukorossi*	Nakapani (Dz), Kilingshing (Sh), Ritha (Lh)	Sep-Feb	Apr-May
309	*Sapindus rarak*	Nakupanu (Dz), Killing shing (Sh), Ritha (Lh)		
310	*Saurauja nepaulensis*	Mangmadom (Dz), Nyabjala shing or mingdhormu (Sh) Gogun (Lh)	Mar-Apr	Mar-Apr
311	*Scurrula elata (Loranthus elatus)*	Ja shing (Dz), Khaining shing or Khaining shabu (Sh), Aijeru (Lh)		
312	*Scurrula parasitica (Loranthus scurrula)*	Khaining shing (Sh), Aijeru (Lh)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
313	*Senecio raphanifolius*	Shersho metog (Dz/Sh)		
314	*Schima wallichii*	Puyamshing (Dz), Zalashing (Sh), Chilauney (Lh)	Jan-Apr	Apr-May
315	*Shorea robusta*	Gotenshing (Dz), Sal shing (Sh), Sakhua (Lh)	May- Jun	May-June
316	*Solanum pseudocapsicum*	Joorusey shing (Sh), Jerusalam cherry (Eng)		
317	*Sorbus matsumurana*	Lashing tsalo (Sh)		
318	*Sorbus microphylla*	Tsema shing (Sh), Sanu pasi (Lh)		
319	*Sorbus thibetica*	Cha sokey (Dz), Zala tsai shing (Sh)		
320	*Spondias pinnata*	Bochong shing/Ambar shing (Sh), Amaroo/amaro (Lh)		
321	*Sterculia villosa*	Phraang shing (Sh), Odal (Lh)		
322	*Stereaspermum suaveolens*	Tsarimshing (Dz), Aboshing (Sh) Parari (Lh)	Dec-Jan	June-July
323	*Stilbanthus scandens*	Barjen shing (Sh)		
324	*Symplocos glomerata*	Dhomzim (Dz), Zeem shing (Sh), Kholme/ Kalokrhani (Lh)		
325	*Symplocos lucida (S. theifolia)*	Dhomm shing (Dz), Dhomma shing (Sh)		
326	*Symplocos paniculata*	Pangtse shing (Dz/Sh)		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
327	*Symplocos samuntia*	Dumbu shing (Dz), Aule Kharane (Lh)		
328	*Symplocos theaefolica*	Pangtse shing (Dz/Sh)		
329	*Syzygium cumini*	Nyeshing (Dz), Mentsu or Mentse sey shing Sh), Jamuna (Lh)	Jun -Aug	July-Aug
330	*Syzygium venosum (Eugenia frondosa)*	Mitsu shing(Sh)		
331	*Tagetes minuta*	Dreem metog (Dz), Sheyree metog (Sh), Saypatri (Lh), Mexican marigold (Eng)		
332	*Tagetes patula*	Seyshoo metog (Dz)		
333	*Talauma hodgsonii*	Khem (Dz), Kadering shing (Sh), Hare/Chiuri		
334	*Taxus baccata*	Hashing/Kerangshing (Dz/Sh), Yew (Eng)	Nov-Dec	Feb-Mar
335	*Tectona grandis*	Tsomarshing (Dz),Teak shing(Sh), Sogun (Lh),Teak (Eng)	Dec-Feb	Feb-Mar
336	*Teinostachyum dullooa*	Pag shing (Dz), Lee shing (Sh), Tokhre bans (Lh)		
337	*Terminalia alata (T. tomentosa)*	Ala shing (Dz), Baroo ata shing (Sh), Paka saj/ Pakhasaj (Lh)		
338	*Terminalia catappa*	Leykhuloong shing (Sh), Badam (Lh), Indian almond		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		(Eng)		
339	*Terminalia myriocarpa*	Bupshing (Dz), Bakhaloshing (Sh), Panisaj (Lh)	Dec-Jan	Mar-Apr
340	*Terminalia tomentosa*	Alashing (Dz), Pakhasaj (Lh)	Oct-Dec	Apr-May
341	*Terminalia bellerica (T. bellirica)*	Baru (Dz/Sh),Barra (Lh)	Nov-Feb	Feb-Mar
342	*Terminalia chebula*	Aru (Dz/Sh), Harra (Lh)	Dec-Mar	Feb-Mar
343	*Tetracentron sinense*	Yangdhar shing(Sh),		
344	*Tetradium fraxinifolium*	Dongmar shing (Dz), Khanakpa (Lh)		
345	*Tetrapanax papyrifera (Fatsia papyrifera)*	Khadong shing (Sh)		
346	*Thuja orientalis*	Yutashupshing (Dz), Mayurpankhi (Lh)Thuja (Co)	Oct-Dec	Oct-Dec
347	*Toona cilliata*	Chhunshing (Dz), Rawashing (Sh), Tooni (Lh)	Apr-June	May-June
348	*Tetrameles nudiflora*	Kadongshing (Dz),Maina (Lh)	May-Jun	Mar-Apr
349	*Tetradium fraxinifolium*	Dongmarshing (Dz), Khanakpa (Lh)	Nov-Feb	Dec-Feb
350	*(Evodia fraxinifolium)*			
351	*Trema politoria*	Sokum (Dz), Sengsegpa shing/sengsogpa (Sh), kuail (Lh)		
352	*Trevesia palmate*	Togmalaga shing (Sh), Phutta (Lh)		
353	*Tricyrtis maculate*	Gentshay (Dz),		

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Thogsoom metog (Sh)		
354	*Tripterospermum nigrobaccatum*	Tseelingma metog (Sh)		
355	*Tripterospermum volubile*	Tseelingma metog (Sh)		
356	*Tropaeolum majus*	Metog shawa kheerkheer (Sh), Nasturtium/Indian cress (Eng)		
357	*Tsuga dumosa (T. brunoniana)*	Bashing/Sey shing (Dz), Wanglashing (Sh), Tengre salla (Lh), Himalayan Hemlock (Eng)	Nov-Dec	Mar-Apr
358	*Viburnum cylindricum*	Nomshing/Yumling shing (Sh)		
359	*Viscum album*	Shing-ney (Dz/Sh), Harchur (Lh), Mistletoe (Eng)		
360	*Viscum nepalense*	Nya-shing thueb (Dz), Nyai-shing jorma (Sh), Harchur (Lh)		
361	*Wendlandia puberula*	Basha warong shing/Gongjagpa shing (Sh), Kangya phul (Lh)		
362	*Wisteria sinensis*	Kuentsho metog roo (Sh), Chinese wisteria (Eng)		
363	*Wrightia arborea*	Raba warong shing (Sh), Khirra (Lh)		
364	*Zanthoxylum acanthopodium*	Dreytsang (Dz), Hagee zoo (Sh), Boke timur (Lh)		
365	*Zanthoxylum armatum.*	Thingngeyshing (Dz), Khaigee/ Geshing (Sh), Bale	June-Aug	Mar-Apr

SN	Scientific Name	Local Name	Collection Time	Sowing Time
		Timbur (Lh)		
366	*Zanthoxylum bungeanum*	Thing-ngey (Dz), Song-gee/Gee shing (Sh), Timur (Lh)		
367	*Zanthoxylum tomentellum*	Thing-ngey shing (Dz), Gee shing (Sh)		
368	*Zinnia elegans*	Mendha-rawa metog (Sh)		
369	*Zinnia peruviana*	Mendha-rawa metog (Sh)		
370	*Zizyphus jujube*	Tsoshing(Dz), Bayer (Lh)	Dec-Mar	Feb-Mar
371	*Zizyphus incurve*	Tsho shing (Dz), Khangkharee shing (Sh)		
372	*Zizyphus mauritiana*	Tsho shing (Dz), Khangkharee shing (Sh), Baer (Lh)		

CHAPTER 2: SEED TREE SELECTION, SEED COLLECTION AND EXTRACTION

In this chapter, the approximate numbers of seeds per kg for different trees speciesand itsunit cost for the seed collection are described. Tree species which are either found in Bhutan or have been tried in plantation in the past are listed in the table below. The rates of seed at the international seed distributor centers have also been compared while fixing the unit cost depending on their size and availability in the nature.

The quality of nursery seedlings greatly depends on the quality of seeds collected. As such, seeds should be collected from the locally available selected trees (plus trees). Plus trees are those trees which are middle aged to near maturity, dominant, vigorously growing, having good form, straight cylindrical boles, clean stems, good crown development, free from diseases and infections. Therefore, collectors should avoid seed collection from young, over mature, abnormal, disease and insect infested trees to ensure quality seedling production.

Table 2. Unit cost for seed collection and extraction

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
1	*Abies densa*	Fir	16,700	1	Nu. 5,000
2	*Acacia auriculiformis (CS)*	Akashmoni	40-50,000	1	Nu. 1,500
3	*Acacia catechu (P)*	Khair	32-40,000	1	Nu. 1,000
4	*Acer campbellii (CS)*	Kapasi	15-20,000	1	Nu. 3,000
5	*Acrocarpus fraxinifolius (P)*	Mandaney	32,000	1	Nu. 2,000
6	*Adina cordiflolia*	Haldu	1,100,0000	1	Nu. 2,000

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
7	*Aesandr.a butyracea (Fr)*	Yika	450	5	Nu. 1,000
8	*Ailanthus grandis (P)*	Gokul	1,700	1	Nu. 1,000
9	*Albizia lebbeck*	Kalo siris	8-15,000	1	Nu. 1,500
10	*Albizia procera*	Seto siris	15-21,000	1	Nu. 2,000
11	*Alnus nepalensis*	Gamashing, Utis	570,000	1	Nu. 2,500
12	*Ammora wallichii (CS)*	Lali	132-155,000	1	Nu. 500
13	*Anthocephalus cadamba*	Kadam	9-10,0000	1	Nu. 1,000
14	*Artocarpus champlasa*	Latar	700-1,800	1	Nu. 1,500
15	*Artocarpus heterophyllus*	Damtse/ Jackfruit	100-150	1	Nu. 1,000
16	*Artocarpus lacucha*	Badhar	6,000	1	Nu. 1,500
17	*Bauhinia purpurea (CS)*	Tanki	3-4,000	1	Nu. 1,500
18	*Bauhina variegate*	Tanki	2-3,000	1	Nu. 1,500
19	*Benthamedia capitata per kg (Fr)*	Phoetse	80-100	1	Nu. 50
20	*Betula utilis (Fr)*	Brich/ latap	1,500,000	1	Nu.1,000
21	*Betula alnoides (Fr)*	Birch	5,000,000	1	Nu. 1,000
22	*Bischofia javanica*	Kainjal	60-100,000	1	Nu. 2,000
23	*Bombax ceiba (CS)*	Simal	21-38,000	1	Nu. 2,500
24	*Bridelia retusa*	Gayo	15-18,000	1	Nu. 2,000
25	*Carpinus viminea*	Rutoshing	-	1	Nu. 3,000
26	*Calamus spp.*	Cane	-	1	Nu. 2,500
27	*Cassia fistula*	Rajbriksh	6,300	1	Nu. 1,000

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
	(CS)				
28	*Castanopsis hystrix (CS)*	Sokey,Chest nut	3-350	1	Nu. 250
29	*Castanopsis tribuloides*	Wild chest nut	200	1	Nu. 250
30	*Cedrus deodara*	Deodar	7,900	1	Nu. 4,000
31	*Celtis australis*	Khari	4500 – 11,000	1	Nu. 2,000
32	*Choerospondias axillaris(s)*	Lapsi	150	1	Nu.250
33	*Chukrasia tabularis (CS)*	Chuckrasi	1,000,000	1	Nu. 1,500
34	*Cinamomum camphora*	Camphor, Kapur	5-11,000	1	Nu. 2,000
35	*Cinamomum glaucescens*	Maligari	2,000	1	Nu. 2,000
36	*Cupressus corneyana (CS)*	Tsenden	1-250,000	1	Nu. 5,000
37	*Cupressus torulosa (CS)*	Tsheden	250,000	1	Nu. 5,000
38	*Callistemom lanceolatus*	Bottle brush	-	1	Nu. 2,500
39	*Dalbergia sissoo (P)*	Sissoo	50,000	1	Nu. 500
40	*Duabanga grandiflora (Fr)*	Lampatey	100,000	1	Nu. 250
41	*Dorcynia indica*	Monkey apple	20000	1	Nu. 500
42	*Eleacarpus spp (S)*	Badrasey	150 –200	1	Nu. 250
43	*Eleacarpus varuna)*	Rudrax	-	1	Nu. 1,500
44	*Eleacarpus lancifolous*		143		
45	*Erythrina arborescens (CS)*	Coral tree	2,000	1	Nu. 500
46	*Erythrina*	Coral tree	2,000	1	Nu. 500

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
	variegata (CS)				
47	*Erythrina suberosa (CS)*	Coral tree	2,000	1	Nu. 500
48	*Exbucklandia populnea*	Pipli	200,000	1	Nu. 2,500
49	*Ficus roxburghii (Fr)*	Fig	8,000,000	1	Nu. 165
50	*Ficus religiosa (CS)*	Pipal/ Jangchub	2,000,000	1	Nu. 3,000
51	*Ficus semicordata (Fr)*	Khanew	1,000,000	1	Nu. 500
52	*Fraxinus floribunda*	Ash tree	7,400	1	Nu. 2,000
53	*Gmelina arborea (CS)*	Gamari	2,000	1	Nu. 1,000
54	*Gordonia exelsa*	Rhambi	-	1	Nu. 500
55	*Jacaranda mimosifolia*	Jacaranda	50,000	1	Nu. 1,500
56	*Juglans regia (S)*	Walnut (hard shell)	60-100	1	Nu. 250
57	*Juniperus recuvera*	Junifer	3,600	1	Nu. 5,000
58	*Kydia calicina*	Kubindey	2,000,000	1	Nu. 2,500
59	*Lagerstroemia hirsute*	Jarul	120,000	1	Nu. 1,000
60	*Lagerstroemia parviflora*	Sidha	3,600	1	Nu. 500
61	*Larix griffithii (CS)*	Larch	100,000	1	Nu. 5,000
62	*Leucaena leucocephala*	Leucaena	22-26,000	1	Nu. 2,500
63	*Mangifera indica (S)*	Mango (wild)	20-30	1	Nu. 250
64	*Magnolia campbellii*	Karshing	11348	1	Nu. 2,500
65	*Melia*	Bakaina	1,500	1	Nu. 250

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
	azedarach (Fr)				
65	*Michelia champaca (CS)*	Champ	100000	1	Nu. 1,500
67	*Michelia doltsopa (CS)*	Rani Champ	6000-8000	1	Nu.1,500
68	*Mintse (No scientific name)*	Mintse	2000	1	Nu. 1,000
69	*Morus lavigata (CS)*	Tshendey	4-500,000	1	Nu. 5,000
70	*Nyssia javanica*	Lek Chilauney	-	1	Nu. 500
71	*Oroxylum indicum (CS)*	Champaca	10-15,000	1	Nu. 500
72	*Percea fructifera (Fr)*	Gulishing	216	1	Nu. 100
73	*Phoebe altenuata*	Angaray	250-300	1	Nu. 1,500
74	*Picea spinulosa (CS)*	Spruce	64,000	1	Nu. 4,000
75	*Pinus roxburghii (CS)*	Chirpine	12,000	1	Nu. 2,500
76	*Pinus wallichiana (CS)*	Bluepine	21,400	1	Nu. 2,500
77	*Prunus nepalensis (Fr)*	Aru-pati	1,400	1	Nu. 1,500
78	*Pteropsersum acerifolium*	Hatipoile	3600	1	Nu. 1,500
79	*Quercus griffithii*	Sissi	1310	1	Nu. 160
80	*Quercus lanata*	Ghum	170	1	Nu. 250
81	*Quercus lamellose*	Oak	900	1	Nu. 250
82	*Quercus semicarpifolia*	Bji shing	140	1	Nu. 3,000
83	*Rhododondron arboretum*	Aeto shing	1,200,000	1	Nu. 1,500
84	*Sapindus*	Nakapani	770-840	1	Nu. 500

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
	mukorossi				
85	*Sauruaia nepualensis*	Gogun	4-8,000,000	1	Nu. 2,500
86	*Schima wallichii (CS)*	Chilauney	300,000	1	Nu. 500
87	*Shorea robusta (WS)*	Sal	450-1000	1	Nu. 2,000
88	*Stereaspermum suaveolens*	Parari	27000	1	Nu. 2,500
89	*Syzygium cumini*	Nyesi	1-1,300	1	Nu. 1,000
90	*Taxus baccata*	Yew	8,000	1	Nu. 4,000
91	*Tectona grandis (Fr)*	Teak	1300-1500	1	Nu. 500
82	*Terminalia myriocarpa*	Panisaj	100,000	1	Nu. 1,500
93	*Terminalia tomentosa*	Pakhasaj	700	1	Nu. 1,000
94	*Terminalia arjuna*	Arjuna	-	1	Nu. 1,000
95	*Termenilla beleceria*	Baru	400-450	1	Nu. 1,000
96	*Termenilla Chebula*	Aru	150-220	1	Nu. 1,000
97	*Toona cilliata*	Tooni	550,000	1	Nu. 1,500
98	*Tsuga dumosa*	Hemlock	400,000	1	Nu. 5,000
99	*Zanthoxylum rhetsa*	Thingney	40-60,000	1	Nu. 500
100	*Zizyphus mauritiana (Jujuba)*	Bayer	7-1,800	2	Nu.250
101	*Rhizomes*				
102	*Bamboo Rhizome (large)*	Bamboo	Rhizome	1	Nu. 100
103	*Bamboo Rhizome (small).*	Bamboo	Rhizome	1	Nu. 50
104	*Calamus spp.*	Cane	Rhizome	2	Nu. 500

SN	Scientific Name	Common Name	Aprox. No of Seeds/Kg.	Qty (Kg)	Unit Cost/Kg
105	*Cuttings*				
106	*Vibernum spp*	Asarey	Do		Nu. 500
107	*Jatropha carcus*	Hedge cadam	-		Nu. 500
108	*Vitex nugando*	Vitex/Simali	-		Nu. 500
109	*Erythiana spp*	Phaledo	-		Nu. 500
110	*Hibiscus spp*	China Rose	-		Nu. 500
111	*Sapium insignia*	Akha taruwa	-		Nu. 500
112	*Euphorbia*	Lal pattti	-		Nu. 500
113	*Ficus species*	Ficus	-		Nu. 500
114	*Stumps preparation in nursery*				
115	*Tectona grandis*	Teak	-		Nu. 500
116	*Gmelina arborea*	Gamari	-		Nu. 500

The cuttings are basically recommended for bio engering works.

S = Stone,
CS = Clear Seeds,
Fr = Fruits,
P = Pods,
WS = Winged Seeds.

CHAPTER 3: FOREST NURSERIES

3.1. Nursery

The norm for nurseries has been prepared based on activities being implemented in standard forest nurseries. The norms provided in this book are mostly through the case studies and feedbacks from the implementing agency, where nursery raising has been practiced since long time back. Clear-cut information about working tools, equipments, polythene tube, top soil, leaf mould, sand, beds and numbers of seedlings per beds are also described. Those civil and electrical structural works in establishment nursery, it should be based on the Bhutan Standard Rates (BSR) and technically sanctioned should be approved by the head of the respective organization.

3.1.1. Site Selection

The selection of an appropriate nursery site is the most important decision affecting the efficient production of good quality plants. Wherever possible, following criteria should be applied while selecting sites for establishing nurseries.

Under ideal condition the site should be:

1) As close as possible to water source,
2) Accessible by motor-able road (if possible),
3) Nearby the settlement or within the vicinity of field staff;
4) Centrally located,
5) As flat land as possible or having not be more than 30% slope,
6) Close to planting sites to reduce carrying and handling damage,
7) Favorable slope and aspect. In the lower elevations, north facing slopes are suitable and for higher elevations,

warmer southern slopes are favorable for establishment of nurserie,

8) Fertile, free from big boulders and have deep soil. Soil should be well drained and sandy loam or loam. Clayey soils should be avoided as the aeration and drainage is poor.

The above criteria are general and can be modified according to the site and local climatic conditions.

3.1.2. Layout and Planning

It is necessary to have proper planning and lay out while preparing nursery beds. As far as possible, the nursery beds should be laid along the contour and the beds should be oriented from East to West (facing easterly aspect).

3.1.3. Essential Materials

Purchase of following items may be considered essential for the nursery seedlings production.

1) Shading and fencing materials like thatch grass, bamboo mats, green nets, wooden poles, bamboo poles, fencing post, nails, barbed wires and binding wires are essential materials.
2) If some items like thatch grass, bamboo mats are not available within that locality, but have to be purchased. In this case there should not be duplication in cost by adding unit cost required for collection of these materials.
3) Irrigation equipment like polythene pipe, sprinkler, rose can, water pump, water tank, etc.
4) Soil, sand, top soil, leaf-mould, manure, and boulders, hollow blocks, bricks.
5) Fertilizers, rooting hormone, compost, decomposed manure etc.

6) The implementing agency should judge and decide the actual requirement of tools. However, the standard requirement of tools has been recommended as given in table below and life of tools is for five years:

Table 3.Tools for nursery work (1 Hectare) (Life of the tools is considered to be 5 years)

SN	Name of tools	Standard no. of tools
1	Pick-axe	5
2	Fork	5
3	Spade	5
4	Shovel	4
5	Sickle	5
6	Axe	1
7	Rose-can	4
8	Pan (Karai)	4
9	Sieving Net	2
10	Water sprinkler	2
11	Measuing tape	1
12	Rake	4
12	Hammer (5 Kg)	1
13	Claw hammer	2
14	Hand-saw	1
15	Weeding hoe	5
16	Knife (Patang)	3
17	Pruning scissors	2
18	Wheel barrow	3
19	Crow bar	3
20	Chemical sprayer	1
21	Hook crow bar	1
22	Seedling tray for loading/transportation	10
23	Seed tray	50
24	Hand trowel	2
25	Grass cutter machine	1
26	Power Chain	1
27	Secauteur	5

3.1.4. Fencing of Nursery

Six stranded barbed wire should be provided for fencing nursery with cross wire wherever necessary. The recommended gap between the fencing posts is 2m. The fencing materials should be based on the type of nursey and depending upon the locally available materials.

3.1.5. Types of Nursery Beds

Raised Bed

It is raised 15-20cm above the ground; it is commonly practiced in Bhutan.

Sunken Bed

Set below the main level of the ground. It depends upon the geographical/ topographical features and climatic conditions of the area, prone to dry, arid conditions, such as desert climates. The gap between bed to bed should not be less than 1m, in order to have convenient working environment for all nursery works like weedings and watering etc.

3.1.6. Edging of Nursery Beds

Edging with wooden materials is recommended for the nursery beds that have to be maintained for less than 3 years (temporary) and the stone/ brick for more than 3 years (permanent). This has to be decided by the field officers based on the type of nursery to be raised during planning and budgeting.

3.1.7. Standard Size of Bed

1) Full bed (12m x 1.2m),
2) Half bed (6m x 1.2 m),
3) Quarter bed (3m x 1.2m).

3.1.8. Poly Pot per Bed

The poly pots measuring 18cm diameter and above is not require keeping in the beds as it occupies large space. These size poly bags

are recommended to place in terraces or open ground for growing large saplings.

Large size saplings are recommended to rise in UV proof poly bags, as these materials are more durable and can be reused after transplanting the saplings. Number of poly pots accommodated in one full nursery bed is calculated as below.

Number of polypots in one bed =Area of bed/area of poly pot.

Table 4. Number of poly pots accommodated in the full beds

Sl.No	Diameter	Height	No of poly pot in 12m x1.2m.	No of poly pot/ Kg
1	6 cm	10 cm	3840	
2	7 cm	15 cm	3790	376
3	8 cm	12 cm	2866	
4	8 cm	15 cm	2866	257
5	8 cm	20 cm	2866	206
6	10cm	15 cm	1834	
7	15 cm	20 cm	815	
8	18 cm	25 cm	566	
9	20 cm	30 cm	458	38-63
10	30 cm	35 cm	203	
11	30 cm	50 cm		15
12	(UV) 45 cm	45 cm	50 nos	20

3.1.9. Quantity of Soil per Bed

It is very important for the implementing agency to know the quantity of top soil, leaf mould and sand required to produce required number of seedlings. The requirement soil, leaf mould and sand in the ratio of 1:2:3 mixtures is calculated based on the various size of the poly pots and tabulated below. The volume shown in the table is calculated on sieved materials. Thus, need to add 20%on the volume calculated in order to compensate the wastage during sieving.

Table 5. The total soil requirement in full size nursery beds

Sl.no	Ploy pot size (Diameter x Height)	Type of soil with ratio: 1:2:3 (Sand: Leaf mould: Topsoil).			
		Sand	Leaf mould	Top soil	No of poly pot
1	6 cm x 10 cm	7 cft	13 cft	19 cft	3840
2	7 cm x 15 cm	13 cft	26 cft	39 cft	3790
3	8 cm x 12 cm	10 cft	20 cft	31 cft	2866
4	8 cm x 15 cm	13 cft	26 cft	39 cft	2866
6	8 cm x 20 cm	17 cft	34 cft	51 cft	2866
7	10 cm x 15 cm	13 cft	25 cft	38 cft	1834
8	15 cm x 20 cm	26 cft	51 cft	77 cft	815
9	18 cm x 25 cm	21 cft	42 cft	64 cft	566
10	20 cm x 30 cm	25. cft	51 cft	76 cft	458
11	28 cm x 50 cm				203

3.2. Management Practices

3.2.1. Watering

Watering is necessary to keep the soil moist in order to promote germination and growth of seedlings. Water requirement varies from species to species. Two times watering in the initial stage (morning and evening). Once the seedlings establishes, the frequency of watering can be reduced (one time in alternate day) in morning or afternoon. However, in places where frost and damping off are seen, watering may be done in the morning. To reduce cost in watering, water tank should be placed in reasonable height in order to exert enough pressure to operate the water sprinklers.

3.2.2. Protection of Seeds

Selection of Mother Trees for Seed Collection

Seed collection should be done from matured, healthy, and free of diseases. To chose the right mother trees, remember this simple rule: “A tree’s off-spring will usually resembles its mother”. Therefore, chose the mother trees according to the purpose of plantations. Examples for choosing mother trees are cited below.

For timber trees species; mother trees should be straight with good form. For fodder; mother trees should be fast growing with many branches, having characteristic that grows new leaves quickly after fodder harvesting.

Seed Storing and Treatment

Seeds of some species require certain treatment/protections while storing and before sowing in the nursery beds. Protection and seed treatment varies from species to species. Protection of seeds can be done by some of the following methods:

1) Store only new, mature, healthy and well-dried seeds.
2) Keep seeds in dry and cool place to extend their viability.
3) Seeds easily re-absorb moisture. To maintain dryness, keep seeds in air-tight containers like tin cans or glass jars with tight fitting lids. Put in some moisture absorbing material. Dry wood ash, dry charcoal or small pieces of newspaper are all good.
4) Label the containers with the type of seed, date and place of collection.
5) Before storing in containers, mix with dry ash, a powdered seed of black pepper or neem leaves to protect seeds from insects and fungi.
6) Protect seeds from rodents and birds during storage.
7) Red lead, kerosene oil and camphor are used as repellants. About 1L of kerosene oil can be sprinkled over 20-30 kg of seeds.
8) Small sized seeds are mixed with ash, earth, cow dung, etc before sowing to protect them from being eaten by birds, insects, etc.

3.2.3. Shading

The seedlings of different species in the young stage demands shade and protection from frost, heat, rain-splash, hailstorm or snow, etc.

As such, the estimate for construction of shed for shading has to be prepared depending upon the locality and the characteristics of species proposed to be raised (example roof: Bamboo mat). It is recommended to have nylon roofing mat for nursery shed in high rainfall areas. For the permanent bed it is recommended to have permanent structure such as angle iron or GI pipes. The roofing should be constructed in slanting manner to drain off the rain water. There are different heights of the shade constructed in the field by different agencies. However it is recommended by the field implementers that a standard height of the nursery shade is required for convenience of the workers. It will also maintain the uniformity in estimation of the shade. The higher side of the shade's height should be 1.40 meter and lower 1.15 meter above the ground.

3.2.4. Weeding and Mulching

Efforts should be made to control weeds in nurseries. The weed growth can be lessened by burning leaf litter and other available debris over the seed bed before sowing. Regular hand weeding is required to keep the nursery weed free. Mulching sheet can be provided in the nursery to suppress the weeds and reduce the cost of weeding.

3.2.5. Nursery Caretaker

To ensure effective management of nurseries and produce quality planting stock, care taker is needed to be placed permanently. The responsibility of nursery caretaker includes weeding, cleaning, watering, minor repair of shed, fencing and transplanting of seedling.

3.2.6. Accommodation for Caretaker/Nursery Store

The forest nursery should have accommodation facility for the caretakers. This would facilitate them to actively engage in nursery activities to maintain quality nursery. The quality of accommodation will depend on type and size of the nursery. A store is also necessary for storing seeds and nursery equipment.

3.2.7. Soil Mixing Shed

Soil mixing shed is indispensable in all types of nursery. This will provide shelter to employees and protect from rain, heat and other natural calamities that hampers the work progress. It will also function as the storage house of top soil, leaf mould and sand etc. Further prevent washing off of materials and soil nutrients.

3.2.8. Transportation of Materials

Cost for transportation of materials will depend on different modes of transport and the distance involved. Accordingly estimates should be prepared depending on the field situations. Normally in average one truck load carries 200 nos of fencing post of size 2m long 12-15 cm diameter, 3000 numbers of bricks, $8m^3$ of leaf mould, top soil and sand and berbed-wire 3500kgs per Truck load (average weight of 1 roll=30kgs)

3.2.9. Cost of Seedlings

The cost of seedlings will depend on age, size and type of seedlings. The cost of seedlings includes all the expenses required for production of seedlings till it reaches desirable size. The cost of seedling will be revised from time to time with the increase in production cost.

3.2.10. Organic Pest Control

It is advisable to adopt organic pest management in the forest nursery, as it is healthier for the environment. The organic pest management practiced are very basic and do not cause any harm to the environment. There are various types of methods to control pests and some simple methods are as below;

1) Neem oil solution insect repellent,
2) Garlic insecticide spray,
3) Chilli insecticide spray,
4) Mild liquid soap spray.

Organic Bio-pesticide

For preparing an organic bio-pesticide, above plants be chopped and wrapped in a muslin cloth. Rub a 5 gram of washing soap in 1 litre of water. Add a spoon of oil in the water and soak the muslin cloth in the mixture for an hour and apply on the aerial parts of the plants for effective effect.

- *Artemesia sp.* 1Kg or neem can also be used,
- 1 tsp oil,
- 5g washing soap (local),
- Muslin cloth,
- ½ Kg Chili, ½ Kg Garlic, ½ Kg Ginger,
- 1 Liter water.

3.2.11. Standard for Seedling Production in Nursery

The standard for nursery development for production of seedlings is calculated based on the unit cost per hectare. While preparing the estimate, the implementing agency should carefully analyze the site condition; select the work items and materials required from the table below.

Table 6. Unit cost for seedling production in nursery

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
1. Feasibility study					
1.1	Consultation meeting with relevant stakeholders	1	No	Nu. 8,000	
1.2	Site survey	1	Ha	Nu.1,000	
1.3	Land demarcation	1	Event	Nu. 10,000	
1.4	Cost of pillars (1 site 8 nos)	1	No	Nu. 1,000	
2. Site clearance					
2.1		0.25	Ha	Nu. 7,500	Nu. 2,500
2.2		0.50	Ha	Nu. 15,000	Nu. 5,000
2.3		0.75	Ha	Nu. 22,500	Nu. 7,500

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
2.4		1.00	Ha	Nu. 30,000	Nu. 10,000
3. Hoeing of sites and removal of debris and boulder					
3.1		0.25	Ha	Nu. 19,000	Nu. 7,500
3.2		0.50	Ha	Nu. 37,500	Nu. 15,000
3.3		0.75	Ha	Nu. 56,500	Nu. 22,500
3.4		1.00	Ha	Nu. 75,000	Nu. 30,000
4. Layout and planning					
4.1		0.25-0.50	Ha	Nu. 2,500	
4.2		0.75- 1	Ha	Nu. 5,000	
5. Construction of terraces					
5.1	Construction of terraces manually or mechanical in sloppy area.	1	M^2	Nu. 114	Nu. 114
6. Leveling and dressing of beds					
6.1	Full bed 12m x 1.2m.	1	Bed	Nu. 250	Nu. 250
6.2	Half bed. 6m x 1.2 m.	1	Bed	Nu. 125	Nu. 125
6.3	Quarter bed. 3m x 1.2m.	1	Bed	Nu. 63	Nu. 63
7. Construction of edging by raising 15-20cm high with stone/hollow blocks/bricks.					
7.1	Cost of bricks (1 bed is)	1	No	Nu. 16	
7.2	Mechanical transportation of bricks (1 TL is 3000 nos).	1	T/L		As per the prevailing rate
7.3	Loading	1	No	Nu. 1	Nu. 3
7.4	Unloading and carriage of bricks to nursery site.	1	No	Nu. 1.50	
7.5	Edging around the beds with bricks 12m x 1.2m.	1	Bed	Nu. 1,500	Nu. 500
	Or				
8. Cost of hollow block, stone slabs, wooden posts					
8.1	1 bed is 64 nos (8cm x	1	No	As per the	As per the

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
	15cm)			prevailing rate	prevailing rate
8.2	1 bed is 76 nos (10cm x 15cm)	1	No	As per the prevailing rate	As per the prevailing rate
8.3	Loading	1	No	Nu. 3	
8.4	Unloading and carriage to the site	1	No	Nu. 3	
8.5	Mechanical transportation of hollow blocks (3000 nos per 1 T/L)	1	T/L	As per the prevailing rate	As per the prevailing rate
8.6	Edging around the beds with hollow blocks size 39cm x 19 cm x 19 cm. 1full bed is 68 nos.	1	Bed	Nu. 1,500	Nu. 500
	Or				
8.7	Purchase of stone slabs	1	T/L	As per the prevailing rate	As per the prevailing rate
8.8	Mechanical transportation of stone, unloading and carriage to the nursery site.	1	T/L	As per the prevailing rate	As per the prevailing rate
8.9	Edging around the beds with stone slab 12m x 1.2m.	1	Bed	Nu. 1,500	Nu. 500
	Or				
8.10	Collection of wooden post for edging (5 posts per bed) 6m long and 10 cm diameter	1	meter	Nu. 42	Nu. 42
8.11	Edging around the beds with wooden post, and bamboo poles 12 m x 1.2m	1	Bed	Nu. 500	Nu. 500

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
8.12	Transportation of wooden post	1	T/L	As per the prevailing rate	As per the prevailing rate
9. Soil. (Sand, Leaf mould, Top soil) with ratio of 1:2:3. for standard size bed					
9.1. Sand					
9.1.1	Royalty of sand.	1	T/L	Nu.50	Nu.50
9.1.2	Cost of sand, if directly procure from supplier.	1	T/L	As per the prevailing rate	As per the prevailing rate
9.1.3	Loading and unloading of sand	1	T/L	Nu. 1,500	Nu. 1,500
9.1.4	Mechanical transportation of sand	1	T/L	As per the prevailing rate	As per the prevailing rate
9.2. Leaf mould					
9.2.1	Royalty of leaf mould	1	T/L	Nu. 60	
9.2.2	Collection of leaf mould.	1	M^3	Nu. 1,470	Nu. 1,470
9.2.3	Manual carriage of leaf mould from collection site to road point	1	M^3	Nu. 735	Nu. 735
9.2.4	Costs of leaf mould if directly procure from supplier. (1 bed is $0.86M^3$)	1	M^3	As per the prevailing rate	As per the prevailing rate
8.2.5	Loading and unloading of leaf mould	1	T/L	Nu. 1,500	Nu. 1,500
9.2.6	Mechanical transportation of leaf mould	1	T/L	As per the prevailing rate	As per the prevailing rate
9.3. Top soil					
9.3.1	Royalty of top soil	1	T/L	Nu.110	Nu.110
9.3.2	Collection of top soil.	1	M^3	Nu. 490	Nu. 490
9.3.3	Manual carriage of top soil from collection site to road point	1	M^3	Nu. 490	Nu. 490

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
9.3.4	Cost of Top soil if directly procure from the supplier	1	M^3	As per the prevailing rate	As per the prevailing rate
9.3.5	Loading and unloading of top soil	1	T/L	Nu. 1,500	Nu. 1,500
10. Nursery shed construction. The higher side post height should be 1.70 M. The lower side post height should be 1.45 M.					
10.1	**Post (10 cm- 15cm diameter) per bed.** 1.70 M height is 4 nos 1.45 M height is 4 nos.				
10.2	**Poles (5-10 cm diameter) per bed.** 4 M long is 6 nos 1.4 M long is 26 nos.				
10.3	Royalty of post (1 bed: 3 m = 8 nos, 1=10 nos)	1	No	Nu. 6	
10.4	Felling, cross cutting, collection, debarking and carriage of post from source up to road point (1km distance). 1 bed is 8 nos 2 m long.	1	M	Nu. 42	Nu. 42
10.5	Felling, cross cutting, collection, debarking and carriage of post from source up to road point (1km distance). 1 no bed is 26 number poles with 2 m long of 10-15 cm diameter for nursery roofing.	1	M	Nu. 42 Fraternity unwavering	Nu. 42
10.6	Mechanical transportation of post for shed construction. 1 T/L is 200 nos.	1	T/L	As per the prevailing rate	As per the prevailing rate
10.7	Loading and unloading of post	1	T/L	Nu. 1,500	Nu. 1,500
10.8	Dressing of post.	1	No	Nu. 10	Nu. 10
10.9	Purchase of bamboo poles for shade	1	No	As per the prevailing rate	As per the prevailing

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
	construction from community forest/ Private forest/ nearby community.				rate
10.10	Loading and unloading of bamboo poles.	1	T/L	Nu. 1,500	Nu. 1,500
10.11	Mechanical transportation of bamboos. 200 numbers per T/L.	1	T/L	As per the prevailing rate	As per the prevailing rate
10.12	Purchase of cement fencing post	1	No	As per the prevailing rate	As per the prevailing rate
10.13	Mechanical Transportation of the post wooden post: 200/TL	1	T/L	As per the prevailing rate	As per the prevailing rate
10.14	Collection of bamboo materials including preparation of mats transportation up to nursery sites.	1	Bed	Nu. 2,500	
10.15	Purchase of Green Poly Nets instead of bamboo mats for shading. (14m x 3m)	1	M^2	Nu. 40	Nu. 40
10.16	Purchase of binding wires	1	Kg	As per the prevailing rate	As per the prevailing rate
10.17	Purchase of nails	1	Kg	As per the prevailing rate	As per the prevailing rate
10.18	Preparation of sheds by fixing poles & post with nails by providing bamboo mat in 12mx1.2m bed size	1	Bed	Nu. 1,500	Nu. 1,500
10.19	Repair and	1	Bed		Nu. 1,000

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
	maintenance of nursery shed in every two years				
11. Poly pot works and seed sowing					
11.1	Purchase of UV poly pot	1	Kg	As per the prevailing rate	As per the prevailing rate
11.2	Purchase of non-UV poly pot	1	Kg	As per the prevailing rate	As per the prevailing rate
11.3	Sieving and mixing of sand, manure and topsoil in the ratio1:2:3 and filling in the poly pots including arrangement in bed (No of poly pots)				
a)	6 cm diameter x 10 cm height	1	Pot	Nu. 1	Nu. 1
b)	15 cm diameter x 15 cm height	1	Pot	Nu. 2	Nu. 2
c)	15 cm diameter x 30 cm height	1	Pot	Nu. 2	Nu. 2
d)	18 cm diameter x 18 cm height	1	Pot	Nu. 2	Nu. 2
e)	18 cm diameter x 23 cm height	1	Pot	Nu. 3	Nu. 3
f)	20 cm diameter x 30 cm height	1	Pot	Nu. 7	Nu. 7
g)	24 cm diameter x 30 cm height	1	pot	Nu. 5	Nu. 5
h)	U V 45 cm diameter x 45 cm height	1	Pot	Nu. 13	Nu. 13
11.4	Sowing of seeds by dibbling with uniform spacing (number of mother beds)	1	Bed	Nu. 125	Nu. 125
11.5	Sowing of seeds by broadcasting and light covering with fine soil/mulch (No of mother beds)	1	Bed	Nu. 50	Nu. 50
11.6	Pricking out seedling from the mother bed	1	No	Nu. 1.50	Nu. 1.50

SN	Items of works	Qty	Unit	Unit cost (New creation)	(Unit cost) Maintenance
	and transplanting in the readily filled poly pot				
11.7	Seed treatment for hard shelled species such as Teak, Melia, Walnut, Gamari	50	Kg	Nu. 500	
12. Watering					
12.1	Watering with sprinklers	1	Bed	Nu.10	Nu. 10
12.2	Watering with rose cane	1	Bed	Nu. 25	Nu. 25
12.3	Watering with pipe	1	Bed	Nu. 8	Nu. 8
13. Weeding nursery beds including cleaning					
13.1	Temperate region	1	Bed	Nu. 170	Nu.170
13.2	Sub-tropical	1	Bed	Nu. 250	Nu. 250
14. Preparation of manure					
14.1	Making of pit (3m x 3m x 2m)	1	Pit	Nu.2,500	Nu. 2,500
14.2	Preparation of manure in pit	1	Pit	Nu.1,500	Nu. 1,500
15. Foot path					
15.1	Construction of foot path (1 m wide x 20 cm height)	1	M	Nu. 100	Nu. 100

CHAPTER 4: FOREST PLANTATION

The forest plantation plays a vital role in maintaining the sustainable supply of forest resources. It also balances the ecosystem, control landslides; improve water retention capacity, erosion and wildlife habitat and meet the requirement of the constitutional mandate of maintaining 60% forest coverage for all times.

However, with increasing population and rapid developmental activities, the pressure on forest resources (water, land, wild animals and minerals) has increased in the country. Annually 6,798 hectares of forests are deforested by various drivers. Owing to high rates of deforestation, the sustainability of forest is at risk.

The plantation is an integral component to revive such losses. Therefore, the priority has to be given to afforestation /reforestation programs. In this norm, main consideration is given to the types of plantation. The unit cost and methods of plantation will depend on different climatic, edaphic and geographic regions. For instance, the subtropical and temperate region, conifer and broadleaved will have differences in frequency of activity.

The appropriate method of plantation depending upon the factors has to be considered by the executing agency (Eg. large size pit in dry and rocky soils, terrace plantation in slope more than 45 degree). The cost for site clearance will be less in conifer comparing to broadleaved zone, because in conifer forest growths of obnoxious weeds are less.

For success of plantation, adequate fund provision has to be kept for maintenance (replacement of casualties and weeding). The 30% casualty replacement in the second year of 1st weeding, 20% in the third year and 10% in 4th and 5th year of plantation shall be eligible.

Fencing maintenance of 10% in 2nd year, 20% in 3rd, 30% in 4th and 5th year plantation should be carried out. The plantation with 70 % survival after five years shall be considered successful.

4.1. Categories of Plantation based on the Objectives

4.1.1. Afforestation in Barren and Degraded Areas

The plantation shall be carried out in the barren and degraded areas with native species to improve the ground cover and forest stock.

4.1.2. Rehabilitation of Fire Burnt and Landslide Areas

The forest fire poses a major threat to the sustainability of forest. It is the main driver causing deforestation and degradation in Bhutan. In 2017, 32incidences of forest fire were recorded affectingan area of 5,249 hectares. In order to minimize the forest fire incidences and damages, the choice of plant species plays a vital role. Therefore fire resistant plant species should be given due importance. The plantation in landslide prone areas must also be based on choice of species as some help in soil conservation and some do not. Therefore, deeprooted plants that anchor the soil should be planted in such areas.

4.1.3. Reforestation in Harvested Areas

DoFPs allots a huge volume of timber annually for various purposes. In 2017 around 244,233 $m^3$of timberswere allotted which indeed is a huge challenge to the sustainability of the forest resources.

4.1.4. Wildlife Habitat Improvement Plantation

Human activities that affect wildlife and their habitats are increasing, thereby affecting ecological niche and their behavior. Resulting to increase incidence of human wildlife conflicts directly affects the farming communities, (70% of the country's population dependent on agriculture farming).

Government has taken different remedial measuressuch aselectric fencing, livestockdrepredation and crop compensation. Yet the incidences related to human wild life conflict are increasing. Therefore, to mitigate the conflicts, plantation of fruits bearing trees, fodder trees and grasses have become an important component in the protected areas. In order to minimize disturbance to natural habitat, activities like site clearance, bush cutting, removal of debris are not required.

4.1.5. Urban Recreational Plantation

Most of the urban areas are seen without any recreational plantation. The Department in consultation with Thromdes, Dzongkhagsand relevant agencies shall plant ornamental trees or shrub to improve the asthetic value and beautify the cities and towns.

4.1.6. Compensatory Plantation

Large scale disturbance on the land of project area occurs due to various construction activities such as forest clearing, earth cutting, dumping of materials, quarrying of rocks etc. Because of its disturbance on the natural topography it may lead to land slides, soil erosion, and sedimentation and land degradation. Therefore, the adverse effects caused on the environment should be managed adequately. Also there is an immediate need to consider the compensatory plantation for high tension lines and road construction as it damages huge area of the forest.Compensatory plantations should be carry out on the degraded forests lands. The area of the plantation should be double of the forest areas affected.

4.1.7. Enrichment Plantation.

Bhutan has 71% of forest coverage applauded by the world community, but the functionality and health of the forest in many areas are observed to be very weak. For instance the water quantity

in many rivers especially during winter season is very low affecting adversely on the generation of hydro power across the country.

During monsoon season, the rainwater is discharged directly to the stream and rivers creating flash floods and high siltation at the hydro power dam sites. To mitigate the situation the enrichment plantation in the existing forest is very vital to ensure and regulate the discharge of adequate quality and quantity of water to our river systems in Bhutan.

4.1.8. Industrial Plantation

Bhutan Board Product Limited, Bhutan Carbide and Chemicals Limited, lease State Reserved Forest and consume the woods and do plantation. Under the industrial plantation, apart from value of timber, wood based derivatives, like agar, rose, sandal wood products, there is a need for the government to consider industrial plantations like agar wood plantation. This would have immense socio-economic and environment benefits

4.1.9. Plantation in Mining Sites

More than 4000 ha of forest area have been already taken up by mining operations across the country. Some of these mining sites are under operation and many are completed. Due to such mining operations the local environment is disturbed including wild life habitats and quality of water in the local streams and rivers. The Department of Geology and Mines has the provision of realizing environment restoration bond from the mining companies. It has been noted that such mining operated sites are left behind without appropriate environment restoration. Therefore there is an immediate need for the Government to make use of the available environment restoration fund in restoring the mining sites to its original environmental status through appropriate plantation.

4.1.10. Roadside Avenue Plantation

It is plantations that serve the purpose of beautifying roadside areas with a line of trees or shrubs. The government has taken initiative the high way widening, and more lateral roads coming and most of the roads will be used by locals and the tourists. For the foreign tourist it may not be appealing to travel across such road networks with full of scars without any vegetation. Such road conditions might discourage our tourist to visit Bhutan again, which would impact adversely on our hard currency revenue generation.

4.1.11. Watershed Protection Plantation

Hydro power revenue depends on the volume of summer and winter water levels. Constant flow of river with same volume will ensure the hydropower revenue generation graph. It will not have much fluctuation of electricity generation. Therefore, the protection of upstream water shed is important for hydro power and irrigation.

Due to global warming, untimely rainfall, flooding, land slides and wind storm has become commonwhich leads to scarcity ofwater for drinking and irrigation. To revive and stablise the flow of perianal water, the water source protection plantation programs are seen important. Locally available deciduous and semi-deciduous species are preferred.

4.1.12. Non-wood Forest Product Plantation

The non-wood forest product plantations not only help to enrich biodiversity but also uplift livelihood of the community. It also helps to protect water runoff and improve the infiltration capacity of water. So non wood forest plantation like bamboo, daphne, genshing, *Paris polyphylla*, Hypericum spp and other medicinal herbs etc; should be encouraged.

4.2. Site Survey

Area shoud be properly surveyed with the GPS and other equipments. Some patches of the land within proposed area may not be feasible for planting. In such circumtances, non feasible area should also be surveyed but exclude in the estimates. The surveyed area maps should be produced clearly along with the total area suitable for planting and also not feasible area. It is required to have comprehensive estimates to avoid dublication of the undone works.The estimates should be supported by brief write up of the proposed areas along with the map.

4.3. Slope

It is also necessary to consider the slope of the planting site. Depending upon the slope, the planting area has been classified into the following 3 categories:

1) Land with slope up to 22.55 degree or 50 % slope,
2) Land with slope up to 45 degree or 100 % slope,
3) Land with slope up to 60 degree or 130 % slope.

Consideration of slope is necessary where terraced plantations are being carried out. The cost of plantation will differ depending on the slope. The terrace plantation is recommended in dry areas with slope of 45 degree and above. To retain the moisture and control soil erosion/run off, the slope of the terrace should be inclined towards uphill side.

4.4. Soil

Physical properties of soil and surface condition have great effect on working cost. The sites may be rocky surface, hard soil, soft surface and sandy conditions etc. The top soil and leaf mould collection is necessary in the areas where plantation site is rocky in nature.

4.5. Site Clearance

The ground flora which consists of small trees, shrubs, bushes and herbs are comparatively more in broadleaf forest area than in conifer. Similarly, the growths of ground flora are more in the subtropical forests in comparison to the temperate zone. This has considerable effect on the cost because of difference in unit cost requirement for site clearance and soil preparation.The existing valuable trees found within the proposed areas should not be cleared. However the site clearance may not be required especially improvement of wildlife habitat plantation, watershed protection and land management.

4.6. Burning and Disposal of Debris

As far as possible, burning should be avoided to reduce forest fire and damages to surrounding existing trees. The debris may be stacked in lines or periphery of plantation areas.

4.7. Criteria for Selection of Species for Plantation

1) Choice of species depends upon the objective of the plantation.
2) Encourage indigenous/native species
3) As far as possible, introduction of exotic species should be avoided.
4) Monoculture plantation should also be avoided
5) The species having allelopathic effect should not be used in plantation.
6) The species should help in enriching local biodiversity.
7) The species recommended through practical research/trails should be given importance.
8) Consider ecological successions.
9) Wild fruit and fodder tree species in wildlife habitats improvement plantation.
10) Fire resistant plant species in fire prone areas.
11) Deciduous species in water catchment areas.

12) Soil binding species in land slide prone areas.

4.8. Alignment and Stacking

Alignment depends on the availability of existing plants and types of plantation. Usually for barren land plantation right method of alignment depending upon the objectives of plantation should be followed. Generally alignment is not necessary for wildlife habitat improvement, spring watershed protection plantation and enrichment plantation. Stacking with bamboo or branches of the trees with 1m long for temperate zone and 1.5 meter long for tropical respectively should be done. The stacking should also be done for refilled seedlings during maintenance.

4.9. Planting Tools

The implementing agency should decide the planting tools as best suited to the locations.

4.10. Spacing

The spacing between plant-to-plant depends on the type of species, growth rate and site conditions. It is also governed by the objective of plantation. The following spacings are commonly practiced within the country:

1) 2m X 2m - for commercial plantation with fast growing species (short rotation).
2) 2m X 2.5m - for dry areas.
3) 2.5m X 2.5m (standard)
4) 3m X 2.5m
5) 3m X 3m
6) 3.5m x 3.5 m - for large trees (long rotation)

4.11. Pit Size

Pit size is decided upon type of seedlings that are to be planted. If bare rooted seedlings are to be planted, their root lengths should be considered in the depth of the pits. On the drier sites, large sized pits

are recommended for retaining the moisture. This may also help in free rooting in the initial stage.

Table 7. Pit size with specification

Pit size for different types of soil		Diameter x Depth (small)	Remarks
1	Hard soil	20 cm x 30 cm	Bare root plantation
2	Hard soil	30 cm x 30 cm	Poly potted seedling plantation
3	Hard soil	30 cm x 45 cm	Poly potted seedling plantation
4	Hard soil	40 cm x 40 cm	Bush root balled plantation
5	Rocky soil	45 cm x 50 cm	Poly potted plantation
6	Hard soil	80 cm x 80 cm	Root balled tree plantation
7	Soft soil	20 cm x 30 cm	Bare root plantation
8	Soft soil	30 cm x 30 cm	Poly potted seedling plantation
9	Soft soil	40 cm x 40 cm	Bush root balled plantation
10	Soft soil	80 cm x 80 cm	Root balled tree plantation

Hard soil: so called because of the difficulty in tilting it. A fine texture soil, viz., clay or clay loam; characterized by low infiltration capacity, poor drainage and inadequate aeration.

Soft soil: A course texture soil, viz., sand or sandy loam, characterized by high infiltration and water holding capacity. Glossary of technical terms, FRI, Dehra Dun, 1983.

The pits should be dug in advance for weathering. The unwanted materials like stones and debris should be removed and filled with top soil during planting. Normally such activities have to be carried out in March-April before the rainy season (planting season).

4.12. Planting of Seeding

Right time for planting is also one important factor for success of the plantation. The planting should be completed before on set of monson month. The plantation should be completed by June.

4.13. Plantation Maintenance

Plantation maintenance refers to activities like fence repairing, replacement of dead saplings, weeding, cleaning, watering, etc. It should be carried out periodically to ensure success of plantations. In general, plantations take five years to get established. Among many factors, inadequate fund for plantation maintenance is one of the factors affecting the success of plantation. Government need to allocate adequate fund for the maintenance of plantation. The plantations have to be protected from domestic animals and wild life to avoid damages. In this estem, deployment of plantation caretaker is deemed necessary.

It is mandatory on the part of field offices/ funding agencies to carry out regular monitoring/ patrolling to ensure plantations are free from the biotic interferences and to carry out appropriate follow up actions. The plantations in the fire prone areas should have provision for creation and maintenance of fire lines/fire breaks.

4.14. Weeding and Clearing

The frequency of weeding or tending operation will be more in tropical and subtropical forests due to heavy growth of weeds, creepers and climbers. In all the regions one time clearing, weeding and mulching of whole area around the planted seedlings is required in same year of creation following the financial year.

The maintenance of plantation in tropical and subtropical regions from 1stto 5th year require two times clearing of whole area, one time weeding and mulching. The maintenance of plantation in temperate regions from 1st to 5th year require one time clearing of whole area, weeding and mulching following the financial year.

4.15. Sign Board

It is important that the forest nurseries and plantations should have signboard which contains information like: objective of plantation, type of plantation, species planted, total area, altitude, location/Division/Gewog, Dzongkhag, year of creation, funding agency. The informations in the form of sign boards are important aspect of maintaining records and for easy references in locating the plantations in the field. The agencies or communities raising plantations should follow the standard design of signboard to ensure uniformity (Figure 1).

Figure 1. Plantation sign board

Plantation sign board

- Background: **Green,**
- Lettering: **Yellow,**
- Size: **1.4mx1m.**

4.16. Plantation Journal

Plantation records are maintained in the form of plantation journals. The implementing agency must maintain plantation journal for each plantation site. The comprehensive guidelines developed and circulated by the Department for maintenance of plantation journals, should be followed strictly by all stakeholders. The plantation journals are very important in locating the plantations on the ground with the help of maps and its descriptions. It will also serve as a reference to carry out appropriate follow up on the plantations created in the past.

4.17. Tending Operation

The maintenance of plantation will be followed by a series of tending operations like climber cutting, pruning, removal of dead and dying species, sanitation operation thus to create healthy growing environment.

The executing agencies should keep budget provision for these activities. The tending operation will be carried out from the 6th year onwards till plantation attains the age of 10 years. The plantations after 11th year may require other silvicultural treatments.

Table 8. Unit cost required for plantation creation

SN	Items of works	Quantity	Units	Cost/Unit
1	Site selection			
2	Public consultation meeting for finalization of the site.	1	Event	Nu. 5,000
3	Surveying of the plantation area. Survey should be preferably done by using GPS. The estimates have to be submitted along with the map, coordinates and a brief write up explaining situation of the area. If few patches found not feasible to create plantation that falls within the survey area, it also must be clearly spelt in the estimates and map.	1.0	Ha	Nu. 1,000
		2 to 5	Ha	Nu. 2,000
		6 to 10	Ha	Nu. 3,000
		10 to 15	Ha	Nu. 4,000
		16 to 20	Ha	Nu. 5,000
		21 to 30	Ha	Nu. 6,500
		31 to 40	Ha	Nu. 8,000
		41 to 50	Ha	Nu. 9,000
		51 to 75	Ha	Nu. 10,000
		76 to 100	Ha	Nu. 13,000
4. Site clearing (Clearing, cutting and arrangement of debris in line along the periphery)				
a)	Broadleaf area	1	Ha	Nu. 10,000
b)	Conifer area	1	Ha	Nu. 7,500
5. Alignment and Staking				
5.1	Collection of bamboo or wooden stick of 2-3 cm diameter and1.5 m height. Alignment of lines and staking for all areas including transportation to plantation sites.	1	Stick	Nu. 3
6. Digging of pits				
6.1	**Digging of pits in rocky soil**			

SN	Items of works	Quantity	Units	Cost/Unit
	45 cm x 50 cm depth	1	Pit	Nu.
6.2	**Digging of pits in hard soil.**			
a)	20 cm diameter x 30 cm depth	1	Pit	Nu.16
b)	30cm diameter x 30 cm depth	1	Pit	Nu. 17
c)	40 cm diameter x 40 cm depth	1	Pit	Nu. 42
d)	45cm diameter x 50cm depth	1	Pit	Nu. 33
e)	80 cm diameter x 80 cm depth	1	Pit	Nu. 83
6.3	**Digging of pits in soft soil**			
a)	20 cm diameter x 30 cm depth	1	Pit	Nu. 12
b)	30cm diameter x 30 cm depth	1	Pit	Nu. 13
c)	40 cm diameter x 40 cm depth	1	Pit	Nu. 21
d)	40 cm diameter x 60 cm depth	1	Pit	Nu. 34
e)	80 cm diameter x 80 cm depth	1	Pit	Nu. 42
7. Terrace construction				
7.1	Making of terrace of 50 cm wide, 15cm deep along the contour at an interval of 2.5m.			
a)	In rocky/hard soil	1	M^2	Nu. 25
b)	In normal soil	1	M^2	Nu. 19
c)	Carriage of seeds to sowing site within 1km distance	1	Ha	Nu. 1,000
d)	Sowing of seeds in terraces with light soil coverage	1	Ha	Nu. 5,000
8. Cost of the seedlings				
8.1	The cost of seedling will be applicable if purchased from other nurseries. While preparing estimates for technical sanction, the seedling cost should not be reflected if seedlings are available in own nurseries to avoid duplication of cost. The cost of seedling will differ according to the size and species	1	No	As per prevailing rate.
8.2	Carriage of seedling from nursery to truck, loading, unloading and siding in shaded areas			
a)	Normal seedling(height 30-45 cm)	1	Seedling	Nu.2
b)	Medium size seedling (45-65cm)	1	Seedling	Nu. 4
c)	Large size seedling(above 65cm)	1	Seedling	Nu. 6
9. Transportation of the seedlings				
9.1	Mechanical transportation of seedlings from nursery to	1	Truck load	As per quotation

SN	Items of works	Quantity	Units	Cost/Unit
	nearest motor able road at planting site. No of seedlings in a truck will vary depending upon the size of poly pot. Average number of seedlings carried by a truck as below			
9.1.1	1 T/L is 1500 nos for normal seedlings			
9.1.2	1 T/L is 750 nos for medium size seedling			
9.1.3	1 T/L is 375 nos for large size seedlng.			
9.1.4	1 load of double cabin bolero carries 300 nos for normal seedling			
10. Planting of bare-root seedlings/stumps				
10.1	Uprooting of seedlings, packing in soaked gunny bags /hessian cloth, sacks etc into bundles of 10 seedlings each.	1	Bundle	Nu. 17
10.2	Carriage of seedlings up to planting site within 1 km distance	1	Nos	Nu. 2
10.3	Planting of seedlings in readymade planting pit	1	No	Nu. 7
10.4	Planting of stumps by making crowbar holes	1	Nos	Nu. 4
11. Planting of seedlings with ball of earth				
11.1	Uprooting of seedlings and packing in soaked gunny bags/hessian cloths.	1	No	Nu. 8
11.2	Carriage of seedlings up to planting site within1km distance	1	No	Nu. 2
11.3	Planting of seedling in readymade planting pit	1	No	Nu. 8
12. Planting of Poly potted seedlings				
12.1	Normal size seedling ranging from 7 cm-15 cm diameter	1	Nos	Nu.8
12.2	Medium size seedling ranging from 18 cm -30cm diameter	1	No	Nu.16
12.3	Large size seedling ranging from 30 cm-40 cm diameter	1	No	Nu 22
13. Making of thalies and seed sowing				
13.1	Carriage of seeds up to sowing	1	Ha	Nu. 1,000

SN	Items of works	Quantity	Units	Cost/Unit
	site within 1km distance			
13.2	Making thalies of 30cm diameter and 15cm depth. (Hard and soft soil)	1	Thallie	Nu. 10
13.3	Making thalies 45 cm diameter and 15 cm depth (Hard and soft soil)	1	Thalie	Nu. 15
13.4	Making thalies 60 cm diameter and 15 cm depth (Hard and soft soil)	1	Thalie	Nu. 20
13.5	Sowing of seeds in thalies with light soil cover	1	Thallie	Nu. 2
14. Water supply system				
14.1	In arid and dry region plantation, provision for watering the plants should be kept for better survival. The estimates for water supply should be prepared depending upon the site condition. The procurement of Sintex tank, water pump, pipes, and construction of concrete tank may be executed only if it is genuinely required.			
14.2	Cost of pipes	1	Roll	As per prevailing rate
14.3	Cost of Sintex tank	1	No	-do-
14.4	Cost of concrete tank construction	1	No	-do-
14.5	Cost of construction of pound	1	No	-do-
14.6	Water pump			-do-
15. Signboard				
15.1	Making and writing of signboard	1	No	Nu. 10,000
15.2	Fixing signboard	1	No	Nu. 1,000
16.Entry gate				
16.1	Making of style (Entry gate, staircase) excluding the materials.	1	No	Nu. 1,000

Table 9. Unit cost required for plantation maintenance

SN	Items of work	Qty	Unit	Cost/unit
1	**Maintenance in the same year of creation (1st Maintenance)**			
1.1	**Broadleaf area**			
a)	1st Weeding- clearing all over the area, weeding and mulching around plants (July-August)	1	Ha	Nu. 10,000
b)	2nd Weeding- clearing all over the area, weeding and mulching around plants (Sept-Oct)	1	Ha	Nu. 10,000
c)	3rd Weeding-(May-June) clearing all over the area, weeding and mulching around plants	1	Ha	Nu. 10,000
1.2	**Conifer area**			
a)	1st Weeding- clearing all over the area, weeding and mulching around plants (July-Sept)	1	Ha	Nu. 7,500
b)	2nd Weeding-weeding and mulching around plants (April-June)	1	Ha	Nu. 7,500
2	**Maintenance in second year of creation (2nd Maintenance)**			
2.1	**Fencing**			
a)	Fencing post requirement depends upon spacing that has been maintained between posts to post. The 10% of the total post and nails to be procured including repairs work.			
b)	Replacement of 10% fencing post	1	Post	Nu. 63
c)	Procurement of 10% nails	1	Kg	
2.2	**Weeding/cleaning**			
2.2.1	**Broadleaf area**			
a)	1st Weeding- weeding and mulching around plants (July-August)	1	Ha	Nu. 10,000
b)	2nd Weeding- clearing all over the area, weeding and mulching around the plants (Sept-Oct)	1	Ha	Nu. 10,000
c)	3rd Weeding-weeding around the plants (April-May)	1	Ha	Nu. 10,000

SN	Items of work	Qty	Unit	Cost/unit
2.2.2	**Conifer area**			
a)	1st Weeding- clearing all over the area, weeding and mulching around plants (May-June)	1	Ha	Nu. 7,500
b)	2nd Weeding- clearing all over the area, weeding and mulching around plants (July-Sept)	1	Ha	Nu. 7,500
2.3	**Casualty replacement-**After plantations there will certain percentage of casualties owing to the quality of planting materials and handling of seedlings. 30% casualty replacement will be accepted in the second year. ***Any plantation with more than 30% casualty should be justified and seek approval***.			
a)	Pit digging	1	Pit	Nu. 8
b)	Planting of seedlings	1	No	Nu. 8
3	**Maintenance in third year of creation. (3rd Maintenance)**			
3.1	**Casualty replacement**			
a)	20% casualty replacement will be accepted in third year			
3.2	**Fencing**			
a)	Replacement of 20% fencing post including repair	1	No	Nu. 63
b)	Procurement of 20% nails			
3.3	**Weeding/cleaning**			
3.3.1	**Broadleaf area**			
a)	1st Weeding- weeding and mulching around plants (March-April)	1	Ha	Nu.10,000
b)	2nd Weeding- clearing all over the area, weeding and mulching around the plants (June-July)	1	Ha	Nu.10,000
c)	3rd Weeding-weeding around the plants (October)	1	Ha	Nu.10,000
3.3.2	**Conifer area**			
a)	1st Weeding- clearing all over the area, weeding and mulching around plants (May-June)	1	Ha	Nu.5,000
b)	2nd Weeding-weeding and mulching around the plants (July-August)	1	Ha	Nu. 5,000

SN	Items of work	Qty	Unit	Cost/unit
3.4	**Casualty replacement**			
a)	Pit digging	1	Pit	Nu.8
b)	Planting	1	Pit	Nu.8
4	**Maintenance in fourth year of creation**			
4.1	**Fencing**			
a)	30% of fencing post replacement including repair works	1	No	Nu.63
b)	30% of nails to be procured	1	Kg	
4.2	**Weeding and Cleaning**			
4.2.1	**Broadleaf area**			
a)	1st weeding- weeding around the plants	1	Ha	Nu. 10,000
b)	2nd weeding- weeding around the plants	1	Ha	Nu. 10,000
c)	3rd weeding- weeding around the plants	1	Ha	Nu. 10,000
4.2.2	**Conifer area**			
a)	1st weeding- weeding around the plants	1	Ha	Nu. 5,000
b)	2nd weeding- weeding around the plants	1	Ha	Nu. 5,000
4.4	**Casualty replacement(10% in 4th year if required)**			
a)	Pit digging 10%	1	Pit	Nu. 8
b)	Planting 10%	1	No	Nu. 8
5	**Maintenance of 5th year of creation**			
5.1	**Fencing**			
a)	30% of fencing post replacement	1	No	Nu.120
b)	30% of nails to be procured	1	Kg	
5.2	**Weeding and Cleaning**			
5.2.1	**Broadleaf area**			
a)	1st weeding and mulching	1	Ha	Nu.10,000
b)	2nd weeding	1	Ha	Nu.10,000
c)	3rd weeding and mulching	1	Ha	Nu.10,000
5.2.2	**Conifer area**			
a)	1st weeding- weeding around the plants	1	Ha	Nu. 5,000
b)	2nd weeding- weeding around the plants	1	Ha	Nu.5,000
6	**Tending operation from 5th -10th Year**			

SN	Items of work	Qty	Unit	Cost/unit
6.1	**Climber cutting and removal of dead and unwanted plants**			
a)	Sub-tropical broadleaved area	1	Ha	Nu. 10,000
b)	Temperate broadleaf	1	Ha	Nu.5,000

Applicable for agencies following calendar year.

Table 10. No of seedling per hectare under different spacing

Sl. No	Spacing in meters	No. of seedlings
1	1.0 x 1.0	10,000
2	1.0 x 1,5	6,666
3	1.0 x 2.0	5,000
4	1.0 x 2.5	4,000
5	1.0 x 3.0	3,333
6	1.0 x 3.5	2,857
7	1.0 x 4.0	2,500
8	1.0 x 4.5	2,222
9	1.0 x 5.0	2,000
10	1.5 x 1.5	4,444
11	1.5 x 2.0	3,333
12	1.5 x 2.5	2,666
13	1.5 x 3.0	2,222
14	1.5 x 3.5	1,904
15	1.5 x 4.0	1,666
16	1.5 x 4.5	1,481
17	1.5 x 5.0	1,333
18	2.0 x 2.0	2,500
19	2.0 x 2.5	2,000
20	2.0 x 3.0	1,666
21	2.0 x 3.5	1,428
22	2.0 x 4.0	1,250
23	2.0 x 4.5	1,111
24	2.0 x 5.0	1,000
25	2.5 x 2.5	1,600
26	2.5 x 3.0	1,333
27	2.5 x 3.5	1.142
28	2.5 x 4.0	1,000
29	2.5 x 4.5	888
30	2.5 x 5.0	800
31	3.0 x 3.0	1,111

Sl. No	Spacing in meters	No. of seedlings
32	3.0 x 3.5	952
33	3.0 x 4.0	833
34	3.0 x 4.5	740
35	3.0 x 5.0	666
36	3.5 x 3.5	816
37	3.5 x 4.0	714
38	3.5 x 4.5	634
39	3.5 x 5.0	571
40	4.0 x 4.0	625
41	4.0 x 4.5	555
42	4.0 x 5.0	500
43	5.0 x 5.0	400
44	5.0 x 6.0	333

CHAPTER 5: BIO-ENGINEERING AND LAND MANAGEMENT WORKS

Bio-engineering techniques include use of livevegetation either alone or in conjunction with civil engineering structures and non-living material. It is carried out to reduce velocity of water flow, control soil erosion and enhance siltation of soil on slopes (Soil Erosion Control Manual, NSSC). This technique is used as a protective measure to stabilize the eroded areas and gullies by constructing check dams and planting of grasses, shrubs and trees. At times, bio-engineering works are deemed necessary to protect forest land from landslides and erosion, but field offices intending to take up bioengineering work has to carefully examine whether this intervention will bring any tangible impact and is cost effective in land reclamation.

Table 11. Unit cost required for bio-engering and land management works

SN	Items of work	Qty	Unit	Rate
1	**Cutting**			
1.1	Cutting and collection of 5cm-10 cm diameter and 1meter length live cuttings from forest and siding.			
a)	Thorn less	1	No	Nu. 4
b)	Thorny species	1	No	Nu. 5
c)	Manual carriage of cuttings from forest to road head within 1 km distance	1	No	Nu. 2
d)	Planting of cuttings including making of crowbar hole	1	No	Nu. 2
2	**Bamboo Rhizome**			
2.1	Uprooting, packing in gunny bags and siding of bamboo rhizomes			
a)	Small bamboo	1	No	Nu. 25
b)	Large bamboo	1	No	Nu. 100
2.2	Manual carriage of bamboo rhizome from forest to road head within 1km distance			
a)	Small bamboo	1	No	Nu.12

SN	Items of work	Qty	Unit	Rate
b)	Large bamboo	1	No	Nu. 50
2.3	Manual carriage of bamboo rhizome from road head to planting site within 1km distance			
a)	Small bamboo	1	No	Nu. 12
b)	Large bamboo	1	No	Nu. 50
c)	Digging pit of 40 cm diameter x 50 cm depth for bamboo rhizome planting	1	No	Nu. 25
d)	Planting of Bamboo Rhizome	1	No	Nu. 17
3	**Grass slip**			
3.1	Collection of grass- 5 kg/bundle	1	Bundle	Nu.100
3.2	Carriage of grass within 1km distance	1	Bundle	Nu.10
3.3	Planting of grass	1	Bundle	Nu.10
3.4	Collection of grass slip of 30cm x 30 cm	1	Sq.ft	Nu. 10
3.5	Carriage of grass slips within 1km distance	1	Sq.ft	Nu. 10
3.6	Making of hedgerows and planting grass slips.	1	Sq.ft	Nu. 10
4	**Wildings**			
4.1	Uprooting, wrapping in gunny bags and collection	1	No	Nu. 5
4.2	Manual carriage of wildings from forest to road head and from road to site within 1km distance	1	No	Nu. 2
5	**Check Dams**			
5.1	Dry rubble stone check dam			
5.2	Collection of stones of 1 cu.m within 15m-20m distance	1	M^3	Nu. 1,000
5.3	Carriage of stones 1 cu.m within 15m-20m distance	1	M^3	Nu. 1,000
5.4	Construction of check dam of 1 cu.m	1	M^3	Nu. 1,000
5.5	Construction of check dam with dressed stone of 1 cu.m (**Case study from NRDCL)**	1	M^3	Nu. 2,000
6	**Log check dams**			

SN	Items of work	Qty	Unit	Rate
6.1	Cutting and collection of logs	1	M^3	Nu. 1,500
6.2	Carriage of logs within 1 km	1	M^3	Nu. 2,000
6.3	Construction of log check dams of 1 cu.m	1	M^3	Nu. 3,000
6.4	Construction of live check dam	1	No	Nu. 1,500
7	**Construction of large structures stone, log and live check dams for large scale and land management campaigns**			
7.1	Mechanical transportation of any materials required for bio engineering			As per prevailing rate
8	**Cost of cuttings/bamboo rhizome/grass slip if it's to be purchased**			As per prevailing rate
9	**Royalty for wilding, post, poles, stones and etc.**			As per prevailing rate

CHAPTER 6: CREATION OF FIRE-LINE

Plantation is the only way to recoup and rehabilitate the degraded forest areas to sustain our forest produce and ecosystem to maintain ecological balance in perpetuity. The Royal Government of Bhutan has accorded adequate emphasis on plantation programs and has been investing huge amount of money for establishment and management of forest nurseries and plantations every year. Among various drivers causing deforestation, forest fire causes major damage to both natural and planted forests.

Therefore, appropriate preventive measures should be adopted to protect plantations from fires. Fire line creation is one of measure to protect the nurseries and plantations from forest fires.

Young plantations in the conifer zones and drier areas are more susceptible to forest fire damages, while there is less possibility of forest fire in broadleaf forest. The concerned implementing agencies should undertake precautionary measure by creating or maintaining fire lines around the plantations to protect from fire damages.

As a follow up action, the implementing agency should:

1) Make this protection activity a regular feature,
2) Keep adequate budget provision for making fire lines in fire prone areas
3) Prepare estimates for fire line creation and maintenance based on the norms described in this chapter,
4) Create/maintain fire line timely before the start of drought and fire season,
5) Regularly maintain the existing fire lines,
6) Procure basic firefighting tools and equipments,

7) Keep budget provision for training staff and local communities (for those areas which falls in high fire hazard areas),
8) Fire lines are not recommended in areas where there is no effect.

Table 12. Unit cost required for fire line (average width 5 meters)

SN	Items of work	Quantity	Unit	Rate	Remarks
1	Creation of fire line in broadleaf zone with an average width of 5 meters	1	M^2	Nu. 5	New
2	Creation of fire line in Conifer Zone with an average width of 5 meters	1	M^2	Nu. 3	New
3	Maintenance of of fire line construction in board leaf zone width of 5 meters	1	M^2	Nu. 3	Maintenance
4	Maintenance of fire line in conifer zone width 5 meters	1	M^2	Nu. 2	Maintenance

CHAPTER 7: PLANTATION FENCING

7.1. Fencing

Biotic interference like livestock grazing and wildlife causes extensive damage to plantations. Therefore, it is essential to fence the plantation areas to prevent grazing and browsing damages to the plantations.

Fencing is a high cost component among the activities associated with creation of forest plantation and nurseries. Therefore, the implementing agency should always be mindful in estimation of materials for fencing. It will help on procuring accurate quantity of materials.

It is a universal truth that the results of any plantations or nurseries with fencing are more successful than without fencing. However, budget is always a constraint. As such, efforts should be made to avoid fencing in areas that has natural barriers.

7.2. Alignment of Fencing

Alignment of fencing is another factor which determines the cost. Wrong judgment during the alignment will increase the cost unnecessarily. The field staff involved in survey work should not avoid the natural supports like broken, dead or inferior trees which fall in the alignment. These can be used as fencing posts. If the alignment passes through steep or rocky areas from where animals cannot enter the plantation area, such portion could be excluded from fencing

Cost of fencing using other materials may be based on actual field situation. Requirement of fencing materials like barbed wire, fencing poles, U nails should be based on the actual perimeter of the plantation sites and not on the theoretical calculated tables.

7.3. Barbed Wire Fencing

While preparing the estimates, the implementing agency should select the relevant activity from the table below. It is also necessary to decide the spacing of posts and number of barbed wire strands to be provided. The quantity of fencing material requirement including pit digging will depend on shape and size of the plantation area.

Thus calculation of fencing material requirement must be done based on the actual perimeter measured on the ground. Calculation of estimates for natural barriers which serves as fencing should be avoided. E.g. Cliff, river, gully etc.

The implementing agency intending to go for iron fencing should provide proper justification for using iron posts instead of wooden.

Table 13. Unit cost required for barbed wire fencing

SN	Items of work	Qty	Unit	Rate
1	Royalty for fencing	1	No	Nu.6
2	Felling, cross cutting, collection, debarking and carriage of fencing post (2m long, 12-15 cm diameter) from source to road point within 1km distance.	1	Post	Nu. 83
3	Purchase of fencing post from NRDCL	1	Post	Nu. 45
4	Purchase of Iron Post/Cement fencing post.	1	Post	As per prevailing rate
5	Dressing of post	1	Post	Nu. 10
6	Application of preservative	1	Post	Nu. 10
7	Mechanical transportation of fencing post, barbed wire and U Nails from source to plantation sites. One truck load carry 200 numbers of post.	1	T/L	As per prevailing rate
8	Loading and unloading of fencing post including siding	1	T/L	Nu. 500
9	Manual carriage of fencing post	1	No	Nu. 25

SN	Items of work	Qty	Unit	Rate
	from road head to pit site(within 1km distance)			
10	Pit digging and erection of posts with pit size of 45cm deep x 20cm diameter.	1	No	Nu. 25
11	Fixing and stretching of barbed wire including carriages up to working sites and putting U Nails.			
a)	100 meters 4 strand(9 inch apart)	1	M	Nu. 25
b)	100 meters 5 strands	1	M	Nu. 30
c)	100 meters 6 strands	1	M	Nu. 35
12	Manual carriage of barbed wire and U Nails(within 1 km distance)	1	Kg	Nu.3
13	Cost of barbed wire	1	Kg	
14	Cost of U Nail	1	Kg	
15	Cost of Nails	1	Kg	
16	Cost of preservatives,(coal tar, brush etc)	1	Kg	

7.4. Fencing using other Materials

(Tree guard, bamboo mat enclosures, etc). Avenue plantations are created for its recreational and aesthetic values. It is mostly practiced in towns and cities, roadsides, in the premises of Dzongs, offices and other structures. Such plantation requires extra care and entails many activities which are different from normal plantations like bigger pit size, construction of concrete structures (cubicles), making of tree guard or bamboo mat enclosures for fencing, watering, etc

Table 14. Unit cost required for fencing using other materials

Sl.No	Items of work	Unit	Qty	Rate	Remarks
1	Making tree guard in pyramidal/desirable shapes with collection of sticks	Plant	1	Nu. 100	
2	Making of enclosure with bamboo mats excluding the materials – 10 plants	Plant	1	Nu. 50	

Sl.No	Items of work	Unit	Qty	Rate	Remarks
3	The tree guard and bamboo mat enclosures are provided in places where barbed wire fencing is not feasible or uneconomical and where individual plant requires protection Eg. Avenue, Micro-site, Patch plantation. In case concrete structures are to be constructed for avenue, the cost estimated by Regional/Dzongkhag engineer should be followed				

Note: Any activities not covered in this norm shall be taken up through special approval

7.5. Requirement of Fencing Material (strands)

Table 15. Requirement of fencing materials (3 strands)

Sl.No	Perimeter (meter)	Barbed wire (Kg)	2 meter spacing		2.5 meter spacing	
			Post No.	Unail/Kg	Post No.	Unails/Kg
1	100	47	50	2	40	1
2	200	94	100	3	80	3
3	300	141	150	5	120	4
4	400	188	200	6	160	5
5	500	235	250	8	200	6
6	600	283	300	9	240	8
7	700	330	350	11	280	9
8	800	377	400	12	320	10
9	900	424	450	14	360	11
10	1000	471	500	15	400	12

Table 16. Requirement of barbed wires for 4 strands

Sl.No	Perimeter (meter)	Barbed wire (Kg)	2 meter spacing		2.5 meter spacing	
			Post No.	Unail/Kg	Post No.	Unails/Kg
1	100	63	50	2	40	2
2	200	126	100	4	80	4
3	300	188	150	6	120	5

Sl.No	Perimeter (meter)	Barbed wire (Kg)	2 meter spacing		2.5 meter spacing	
			Post No.	Unail/Kg	Post No.	Unails/Kg
4	400	251	200	8	160	7
5	500	314	250	10	200	8
6	600	377	300	12	240	10
7	700	440	350	14	280	12
8	800	502	400	16	320	13
9	900	565	450	18	360	15
10	1000	628	500	20	400	16

Table 17. Requirement of barbed wire fencing for 5-Strands

Sl.No	Perimeter (meter)	Barbed wire (Kg)	2 meter spacing		2.5 meter spacing	
			Post No.	Unail/Kg	Post No.	Unails/Kg
1	100	79	50	3	40	2
2	200	157	100	5	80	4
3	300	235	150	8	120	6
4	400	314	200	10	160	8
5	500	392	250	13	200	10
6	600	471	300	15	240	12
7	700	549	350	18	280	14
8	800	628	400	20	320	16
9	900	706	450	23	360	18
10	1000	785	500	25	400	20

Table 18. Requirement of fencing materials (6 strands)

Sl.No	Perimeter (meter)	Barbed wire (Kg)	2 meter spacing		2.5 meter spacing	
			Post No.	Unail/Kg	Post No.	Unails/Kg
1	100	94	50	3	40	3
2	200	188	100	6	80	5
3	300	283	150	9	120	8
4	400	377	200	12	160	10
5	500	471	250	15	200	12
6	600	565	300	18	240	15
7	700	659	350	21	280	17
8	800	754	400	24	320	20
9	900	848	450	27	360	22
10	1000	942	500	30	400	24

7.6. Standards

Table 19. Standards

1	Barbed wire (12 gauge) per kg	6 meters
2	U Nail (8 gauge) 5 cm per kg	100 nos (standard)
3	U Nail 3.75 cm per kg	125 nos
4	Fencing post truck load	200 nos
5	Barbed wire truck load(DCM)	4.5 tons
6	Sand truck load	8 cubic meter
7	Leafmould truck load	8 cubic meter
8	Manual transportation of truckload of leaf mould within 1 km	Nu.6,650

CHAPTER 8: ROOT BALLING

Generally large size saplings are rarely raised in the forest nurseries. During ad-hoc landscaping activities, usually plants are root balled from the forest for instant greening. It is recommended to carry out rootballing activities before the sprouting of new leaves.

For pole size trees it is advisable to root ball the plants and keep it in the same pit for a season to get harden. Intensive care must be taken to keep the root ball soil in tack during handling. All this process will ensure achieving higher success rate. The root balling and live cuttings rates for plantations are tablualted (Table 20).

Table 20. Root balling and live cuttings rates for plantations

Sl.No.	Items of work minimize	Nos	Unit	Unit-Cost
1	**Trees root balling and collection.** All unit cost includes extraction, packing, manual carriage to road head, loading and unloading			
1.1	Trees size (1.1m to 2.4m height x 1 to 2.4 inch girth at breast height)	1	No	Nu. 500
1.2	Trees size (2.5 to 2.9m height x 2 to 2.5 inch girth at breast height)	1	No	Nu. 1,000
1.3	Trees size (3 to 4m height x 2.6 to 4 inch girth at breast height)	1	No	Nu. 1,500
1.4	Cost of hassen cloth per square meter	1	M^2	Nu. 40
1.5	Cost of soothly rope	1	Kg	Nu. 90
1.6	Cost of jute rope per per kilogram	1	Kg	Nu. 140
1.7	Machanical transportation of root balled trees. One truckload carry-15 trees (sizes of 1.5 to 4 m height and 1 to 4 inches diameter)	1	T/L	Depending on local transportation rate as per the distance
2	**Planting root balled trees**			

Sl.No.	Items of work minimize	Nos	Unit	Unit-Cost
2.1	Pit digging (Pit size 80 x 80 x 80cm)			
a)	Hard soil	1	Pit	Nu. 84
b)	Soft soil	1	Pit	Nu. 42
2.2	Planting of root ball trees include manual carriage of root ball from road head to plantation sites; Application of manure, back filling of soil and making of 'Thallies' (2m diameter) for watering.	1	Pit	Nu. 63
2.3	Providing materials like bamboo and sticks for the prop breast height.	1	No	Nu. 20
2.4	Making prop with bamboo and sticks at 2 to 3 meters long.	1	No	Nu. 10
2.5	Manure such as top fertile soil and leaf mould as per the existing market rate.	1	T/L	
2.6	All sizes (manual carrying beyond 300ft uphill and 600ft downhill of motorable road for plantation)	1	No	Nu. 225
3	**Bush root balling collection**			
3.1	Bush sizes (0.5 to 0.9 m height)	1	No	Nu. 125
3.2	Bush sizes (1 to 1.4 m height). All men days includes extraction, packing and manual carriage to road head, loading and unloading.	1	No	Nu. 250
3.3	Transportation = 60 nos bushes = one truckload as per existing transportation rate.			
4	**Bush root balling plantation**			
4.1	Pit digging (40 x 40 x 40 cm)			
a)	Hard soil	1	Pit	Nu. 42
b)	Soft soil	1	Pit	Nu. 21
4.2	Bush plantation includes manual carriage of root ball from road head to plantation	1	No	Nu. 50

Sl.No.	Items of work minimize	Nos	Unit	Unit-Cost
	site; application of manure, back filling of soil and making of thallies (1m diameter) for watering. Manual carriage and planting of all sizes bush within 300ft uphill and 600ft downhill of motorable road.			
5	**Willow cutting**			
5.1	Cutting, collection, carriage, pit digging and planting of Salix cutting of 8ft length and 5 Inches and above girth.	1	Feet	Nu. 33
5.2	Machanical transportation of Salix cutting. One truck load=350 Salix cuttings. Transportation cost will depend on prevailing rate.	1	T/L	

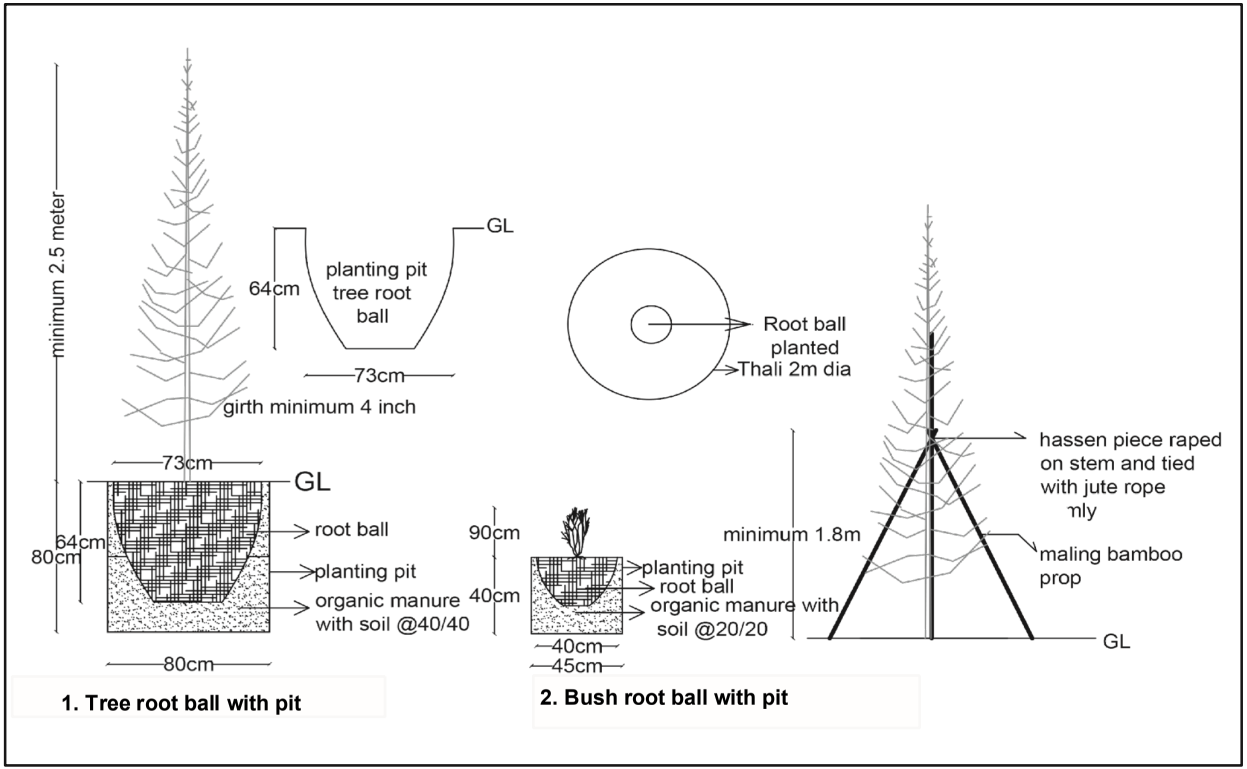

Figure 2. Guideline for root balling plantation of trees and bushes

CHAPTER 9: CHECK DAM

9.1. Dimensions for stone check dam

Table 21. Dimensions for stone check dam

a. Gully depth = 1m HE = 0.5m					
Gully width (m)	1.00	2.00	3.00	4.00	5.00
Keying on the right (m)	0.30	0.30	0.30	0.30	0.30
Keying on the left (m)	0.30	0.30	0.30	0.30	0.30
Ground foundation (m)	0.60	0.60	0.60	0.60	0.60
Height of the Gully (m)	1.00	1.00	1.00	1.00	1.00
Total length of the check dam (m)	1.60	2.60	3.60	4.60	5.60
Total height of the check dam (m)	1.60	1.60	1.60	1.60	1.60
Thickness of the check dam (m)	0.60	0.60	0.60	0.60	0.60
Dimension of the check dam without spill way (m3)	1.54	2.50	3.46	4.42	5.38
Dimension of the spill way (m3)	0.30	0.60	0.90	1.20	1.50
Dimension of check dam with spill way (m3)	1.24	1.90	2.56	3.22	3.88
b. Gully depth = 2m HE = 1m					
Gully width (m)	1.00	2.00	3.00	4.00	5.00
Keying on the right (m)	0.30	0.30	0.30	0.30	0.30
Keying on the left (m)	0.30	0.30	0.30	0.30	0.30
Ground foundation (m)	0.60	0.60	0.60	0.60	0.60
Height of the Gully (m)	2.00	2.00	2.00	2.00	2.00
Total length of the check dam (m)	1.60	2.60	3.60	4.60	5.60
Total height of the check dam (m)	2.60	2.60	2.60	2.60	2.60
Thickness of the check dam (m)	0.60	0.60	0.60	0.60	0.60
Dimension of the check dam without spill way (m3)	2.50	4.06	5.62	7.18	8.74
Dimension of the spill	0.60	1.20	1.80	2.40	3.00

way (m3)					
Dimension of check dam with spill way (m3)	1.90	2.86	3.82	4.78	5.74

Source: National Soil Service Centre, Simtokha

Note: We are assuming that the maximum gully width that we can tackle is 5m for stone check dam. HE = Effective Height of the Check dam

9.2. Dimensions for log check dam

Table 22. Dimensions for log check dam

a. Gully depth = 1m HE = 0.5m.			
Gully width (m)	1.00	2.00	3.00
Keying on the right (m)	0.30	0.30	0.30
Keying on the left (m)	0.30	0.30	0.30
Ground foundation (m)	0.20	0.20	0.20
Height of the Gully (m)	1.00	1.00	1.00
Total height of the check dam (m)	1.20	1.20	1.20
Diameter of the log (m)	0.10	0.10	0.10
Effective height (m)	0.50	0.50	0.50
No. of long logs required till spill way (no.)	7.00	7.00	7.00
Length of the long log required (m)	1.60	2.60	3.60
Spill way area (m2)	0.10	0.25	0.50
No. of short logs required	10.00	10.00	10.00
Short log length (cm)	65.00	100.00	130.00
b. Gully depth = 2m HE = 1m			
Gully width (m)	1.00	2.00	3.00
Keying on the right (m)	0.30	0.30	0.30
Keying on the left (m)	0.30	0.30	0.30
Ground foundation (m)	0.20	0.20	0.20
Height of the Gully (m)	2.00	2.00	2.00
Total height of the check dam (m)	2.20	2.20	2.20
Diameter of the log (m)	0.10	0.10	0.10
Effective height (m)	1.00	1.00	1.00
No. of long logs required till spill way(no.)	12.00	12.00	12.00
Length of the long log required (m)	1.60	2.60	3.60

Spill way area (m2)	0.30	0.60	1.00
No. of short logs required	20.00	20.00	20.00
Short log length (m)	0.65	100.00	130.00

Source: National Soil Service Centre, Simtokha

Note: We are assuming that the maximum gully width that we can tackle is 3m for log check dam.

9.3. Dimensions for live check dam

c) Trench of 20-25cm depth and 30-35cm width across the gully
d) Two holes (deep and big enough to insert 2-4 vertical cuttings)

Source: National Soil Service Centre, Simtokha.

Annexures

Annex 1. Metric weight and measures

METRIC WEIGHT AND MEASURES	
UNITS LENGTH	
10 millimeters (mm)	1 centimeter
10 centimeters (cm)	1 decimeter
10 centimeters (cm)	1 decimeter
10 decimeters (dm)	1 meter
100 centimeters	1 meter
10 meters (m)	1 decameter
10 decameters	1 hectometer
10 hectometers	1 kilometer
1000 meters	1 kilometer (km)
CAPACITY	
10 milliliters (ml)	1 centiliter
10 centiliters (cl)	1 deciliter
10 deciliters (dl)	1 liter
100 centiliters	1 liter
1000 milliliters	1 liter
VOLUME	
1000 cubic centimeters	1 cubic decimeter
1000 cubic decimeters	1 cubic meter
10,00,000 cm3	1 cubic meter (m3)
AREA	
100 decimal	1 acre
2.471 acre	1 hectare
10,000 square meters	1 hectare
100 hectares	1 square kilometer
WEIGHT	
10 milligram (mg)	1 centigram
10 centigram (cg)	1 decigram
10 decigram (dg)	1 gram
10 grams (g)	1 decagram
10 decagrams (dg)	1 hectogram
10 hectograms (hg)	1 kilogram
1000 grams	1 kilogram
100 kilograms	1 quintal
CONVERSION FACTOR FROM METRIC TO BRITISH SYSTEM	
1 meter	3,2808 feet (3.2 ft)

	1.0936 yards
0.9144 meters	1 yards
0.3048 meters	1 foot
25.04 millimeters (2.54 cm)	1 inch
1 kilometer	0.6214 miles
1.6093 kilometers	1 mile
METRIC (area)	**BRITISH (area)**
6.4516 sq. centimeters	1 sq. inch
0.0929 sq. meters	1 sq. foot
0.8361 sq. meters	1 sq. yard
1sq centimeter	0.1560 sq. inch
1 sq. meter	1.1959 sq. yard
2.5899 sq. kilometers	0.3861 sq. mile
0.4047 hectare	1 acre
1 hectare	2.4711 acre
1 acre	43,560 sq. feet
LINEAR MEASURESMENTS	
2.54 cm	1 Inch (in)
30.48 cm	1 foot (ft)
0.91 m	1 yard (yd)
1.61 km	Mile
12 inch	1 foot (ft)
3 (ft)	1 yard (yd)
1760 yards	1 mile
VOLUME	
1 cubic meter (m3)	35.31 cubic feet (cft)

Annex 2. Approval and implementation of the plantation norms and standards 2020

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Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests & Park Services

No. DoFPS/SFED/Pltn/2-15/2019-2020/ 495 **Dated; August 3, 2020.**

Note-Sheet

Sub: Seeking approval for implementation of Revised Norms and Standards for Nursery and plantation-2020.

The Norms and Standards for Nursery and Plantation were first developed in 1992 to guide the implementers in smooth execution of Nursery and Plantation activities across the country. It serves as the basis for standard technical requirements in the implementation of plantation and nursery activities. Since the activities involved for creation and maintenance of nursery and plantation varies according to site situations. The design and estimations are prepared based on the standard specification for various activities prescribed in the norms and standards for nursery and plantation which is strictly complied by the implementing agencies.

However, with the change in the overall economic situation, there have been many changes including the policy objectives for plantation, approach and mode of field implementation and labor cost etc. Hence, the policy documents and technical guidelines required periodical updates and revision to cope with the changing field situations for efficiency. The rates and standards prescribed in the norms and standards needs timely revisions which otherwise become obsolete.

Therefore, the revision of Norms and Standard for Nursery and Plantation 2016 has been carried out by a task force member comprising of representatives from the SFED and the Green Bhutan Corporation limited (GBCL). The draft revision has been tabled for discussion during one day consultation workshop with the plantation focal of all the Territorial Divisions and Parks followed by feedback and comments from the field Chiefs through email and incorporating them prior to endorsement from the Technical Advisory Committee (TAC) meeting of the DoFPS.

The revised version has taken adequate care of all the shortfalls to compensate the current implementation inconveniences such as the technical clarity in estimation process and alternatives to equate labor wage rates by transforming from the previous men days system to unit cost system. The following are the changes incorporated in the revision:

1. The revised Norms and Standards for Nursery and Plantation, 2020 is based on the **unit cost** (conversion rates based on practical field experience) for all the work items which was based on the **men-days** system in the old version.

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2. The different activities like seed collection, establishment of forest nursery, plantation creation and maintenance, fire line creation, fencing, land management, root-balling have been dealt with in separate chapters for technical clarity.
3. For the ease of field implementing agencies, specific period of seed collection, sowing time, seed viability and treatment has also been incorporated.
4. Under nursery management practices, supplementary information such as; selection of mother trees for seed collection, seed storing and treatments, organic pest control and bio-pesticide applications are some additional information added.
5. Under the "Forest Plantation" different types and categories of plantation based on the objectives has been defined for easy understanding.
6. Transportation of materials both for mechanical and manual carrying for different types of materials such as; number of fencing-posts, barbed-wire, sand, top soil and leaf mould per truck load are quantifies and prescribed.
7. For the timely field implementation of the activities, the revised Norms and Standards for Nursery and Plantation 2020 is linked with the Seasonal Calendar prescribed in the Plantation and Nursery M&E Guidelines-2019.

Submitted for Approval

Chief Forestry Officer
SFED

Recommend by:

Director
Department of Forests and Park Services

Approved:

Approved since it is cleared by TAC + on the assumption that it does not contravene any extant legislation + policies. [signature] 4/8/2020.

Secretary
Ministry of Agriculture and Forests

དཔལ་ལྡན་འབྲུག་གཞུང་། སོ་ནམ་དང་རགས་ཚོར་ལྷན་ཁག། རགས་ཚོར་དང་
སྐྱོང་ཀ་ཞབས་ཏོག་ལས་ཁུངས།

Royal Government of Bhutan
Ministry of Agriculture and Forests
Department of Forests & Park Services

No. DoFPS/SFED/Pltn/2-3/2020-2021/ **Dated; Sept 7, 2020.**

To
The Chief Forest Officers
Divisions/ Parks & Wildlife Sanctuaries

Sub: Implementation of Revised Norms and Standards for Nursery and plantation-2020.

Dear Sirs/Madam

This is to inform you that, the Norms and Standards for Nursery and Plantation 2016 has been revised and the MoAF has accorded approval for implementation vide Note-sheet No.DoFPS/SFED/Pltn/2-15/2019-2020/ 45; dated; August 3, 2020.

Therefore, all are hereby informed to follow the revised version of the ***Norms and Standards for Nursery and Plantation-2020*** with immediate effect for preparation of any estimates related to plantation and nursery activities. For austerity measures only the soft copy (PDF version) shall be made available in the MoAF website for use in the field and no print copies shall be supplied.

With the revision of the norms and standards, the overall cost per unit area has been increased and therefore, the implementing agencies (Divisions/Parks & GBCL) must ensure to improve the overall quality of the plantation work with enhanced supervision, monitoring and compliance to the technical specifications.

(Lobzang Dorji)
DIRECTOR

Copy:
1. The Hon'ble Secretary, MoAF-Thimphu for favor of his kind information.
2. Chief Executive Office, Green Bhutan Corporation limited, Thimphu for kind information.
3. The CFO, SFED-Thimphu for information and follow-up action.

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