AFoCO-NIFoS Joint Research Project Document

Research code	*AFoCO/021/2021*

Research Profile		
Research Title	Performance of Cluster Method in Rehabilitating Degraded Lands in Cambodia	
Research Duration	Estimated start date: 1 July 2021 Estimated end date: 30 June 2023	
Implementing Institution	Institute of Forest and Wildlife Research and Development (IRD)	
Country	Cambodia	
Research Site	Siem Reap Province, Cambodia	
Main Objective	To test the cluster planting in terms of cost effectiveness in rehabilitating a degraded and arid site. The objectives of this study are: 1. Evaluate the cost effectiveness of cluster planting combined with Miyawaki method in rehabilitating degraded lands; 2. Determine the survival of test species (*D. cochinchinensis*) planted together with other species in a cluster using the Miyawaki method; and 3. To determine the effectiveness of coconut husk as a water retaining agent on the survival of seedlings.	
Thematic Areas	Customized Restoration and Reforestation Models	
Budget and source of finance	Total: US$ 34,500 - AFoCO : US$ 34,500 - National : - - Others : -	
Proponent Profile		
Name/ Position	Sokh Heng, Ph.D. Position: Director	Signature Date

Organization (Head Office/Division)	Institute of Forest and Wildlife Research and Development (IRD)		
Address	Khan Sen Sokh, Phnom Penh, Cambodia		
Contact	Tel: 012 639 961	Fax:	Email: sokhhengpiny@yahoo.com

Summary

The study will test a modified technique of restoring the degraded lands using *Dalbergia cochinchinensis*. The improved restoration technique involved a combined cluster and Miyawaki method, and the use of coconut husk as a water-retaining agent. Looking for an alternative restoration method is becoming exigent. Many restoration efforts have failed and are expensive. The study will test three restoration techniques: (1) cluster planting technique combined with Miyawaki method; (2) standard planting with coconut husk as water retaining agent; and (3) natural planting as control. This study will specifically determine the following: (1) Cost-effectiveness of cluster method in restoring degraded forestlands; (2) Benefits of mixed planting and Miyawaki on the growth and survival of test species (*D. cochinchinensis*); and (3) Beneficial effect of coconut husk as a water-retaining agent on the survival of seedlings.

Miyawaki Method involves the simultaneous planting over a given area a mixture of numerous and diverse species representing the different seral stages (early seral stage represented by pioneer species), middle, and late seral stage (represented by climax species). The planted seedlings will encourage competition and will ultimately favor the plants that are suitable for the area. The cluster planting method involves the planting of a land area in clusters. The cluster plots will be planted with species following the Miyawaki approach. The aim is to reduce the cost of planting over a given landscape and at the same time creating a microclimate of the planted species. Coconut husk will be placed in a net bag and buried at the root zone of the planted seedlings as a water-retaining agent. Coconut husk is highly hygroscopic and can absorb and keep moisture and gradually release moisture to the root zone of the seedlings. The performance of the techniques will be based on the growth (height and diameter) and survival of *Dalbergia cochinchinensis*.

Section A. Research Project Context and Need Analysis

1. Background and Research Context

Restoring degraded lands, particularly in Siem Reap is very challenging since the soils are exposed to physical elements after logging and slash and burn farming. The soils get dry very fast as they could hardly hold moisture. The low survival of planted seedlings can be mitigated using a water-retaining agent. The low survival of plants in dry and sandy areas was caused by quick drying of the topsoil resulting in a water-stressed condition. The addition of material can act like a "sponge" that will store moisture and gradually release it to the plants. Many literatures pointed out that coconut husk provided good materials for retaining moisture. Coco husk offers some advantages since this material is cheap and biodegradable. Miyawaki method was reported to have a high degree of success in rehabilitating degraded areas where the suitable species are not previously known. The Miyawaki method has been successfully tested in the AFoCO project although the conventional Miyawaki method could hardly be replicated since its cost of establishment is very high (i.e., due to the high number of seedlings needed). The Miyawaki method can be modified to reduce cost using cluster planting design. Cluster planting can be adopted to cover a wide area under a limited budget.

2. Problem Statement

Siem Reap is one of the important provinces in Cambodia that is of significance owing to its historical value and because it is where the Stueng Sreng watershed, one of the largest watersheds in Cambodia is located. The unabated cutting and land encroachment has reduced many forests in Siem Reap in a degraded condition. Recognizing the role of the forests in the functioning of the watershed and the ecosystem, the government and the Civil Society Organizations (CSO) have started rehabilitating the degraded areas. The rehabilitation of the degraded lands has very limited success as the plantations often suffer high mortality. The underlying reasons include the following:

1. Limited knowledge on the appropriate species to plant due to lack of site suitability study of the major species;
2. The high cost of planting and maintenance; and
3. High mortality during the dry season due to poor water retaining capability of the soil.

Finding a practical means of overcoming this challenge is a continuing effort. Continuous Testing in the field is needed to address this problem.

3. Specific Research Objectives

The study aims to find the effective alternate planting method in rehabilitating degraded lands. The study will test cluster planting method in combination with Miyawaki approach and the use of coconut husk as water retaining agent. Specifically, the study will evaluate the following:

- Cost effectiveness of cluster method in restoring degraded forestlands;

- Benefits of mixed planting and Miyawaki on the growth and survival of test species (*D. cochinchinensis*); and
- Beneficial effect of coconut husk as a water retaining agent on the survival of seedlings

Section B: Materials and Methodologies

1. Literature Review

Restoring the degraded lands is often constrained by the limitation of budget. The suitability of the site to a particular species is often not known due to the lack of species-site matching studies and the limited research data on the site requirements of each species. Also, many sites are too degraded and difficult to restore. Some options that increase the survival of plantations are rather expensive which could hardly be replicated. Recently, the Miyawaki method drew interest among conservationists and restoration managers. The method involves planting over a certain area with diverse species at a very high density. Under this approach, the canopy closes immediately and suppressed the weeds that will compete with the planted seedlings. Also, the close planting can create a microclimate that will favor the recruitment and colonization of plants suitable to the area. Because the density of planting is very high, the method becomes very expensive. The cluster approach to planting has reported success in other countries, particularly with oak. The approach can cover wider areas at a relatively lower cost over a landscape. The method can be combined with the Miyawaki method, by planting in the cluster plots, at high density, diverse species. On the other hand, the coconut husk can be used as a water-retaining agent to increase the survival of planted seedlings.

The Cluster Planting Method. Large afforestation programs often have limited funds and are forced to plant trees at a wide spacing to achieve target areas (Saha *et al*. 2017). Cluster planting on favorable sites can be used to minimize seedling mortality and offer the best strategy for afforestation (SchoÈnenberger 2001) by reducing competition with grasses or attracting birds and other animals that might disperse seeds (Corbin and Holl 2012).

The Miyawaki Method. The mixing of species has been considered to be more advisable in restoring degraded lands as diverse plantations are considered to be more sustainable. The mixing of species can result in increasing carbon sequestration and stand productivity and encourages diverse species that provide forage to a wide range of species in the food chain and improve the nutrition cycle (Liu *et al.* 2018). Some species act as nurse trees to other tree species by providing shades to shade-tolerant plants. A successful mixed-species plantation may combine fast-growing with slow-growing species, short-lived with long-lived species, light-demanding with shade-tolerant species, shallow with deep rooting species, nitrogen-fixing with non-nitrogen-fixing species, or slim-crowned and height oriented with wide-crowned and more laterally expanding species (Liu *et al.* 2018). The Miyawaki method aims to bring to a given area plant representing different seral stages (i.e., late seral or climax species, the intermediate and the early seral or pioneer species). The method also plants seedlings at very high density to close the canopy. The long process of establishing late seral plantation can be shortened by the Miyawaki method (Vessella *et al*., No Date; Sharma No Date; Wang *et al.* 2002). The method is

recommended to restore degraded areas where traditional afforestation programs failed (Sharma No Date).

Coco Husk as Water Retaining Material. The use of water-retaining agents has been adopted in many reforestations works. The use of coconut husk is considered to provide a potential of addressing the low survival due to water stress. Coir piths are highly hygroscopic property and could hold water 8 times its weight making them good material for water retaining agent (Ravindranath and Radhakrishnan,2016).

2. Information on project target area and criteria for site selection

The study will be implemented in Khun Ream Research station. Khun Ream is located in Siem Reap province. The site is characterized by sandy soil. The experiment will be located in a degraded forest.

3. Research Design and Methodology

3.1 Goals and Objectives

The overall goal of this study is to find a cost-effective method of restoring a degraded site. This is achieved by comparing the different restoration techniques. The study is to achieve the following objectives:

1. Determine the cost-effectiveness of cluster method in restoring degraded forestlands;
2. Determine the effectiveness of cluster and Miyawaki method on the growth and survival of test species (*D. cochinchinensis*)
3. Determine the beneficial effect of coconut husk as a water retaining agent on the survival of *D. cochinchinensis.*

3.2 Methodology and Activities

The methodologies of the study are presented in the following sections. The methodologies are disaggregated according to the three objectives.

3.2.1 Objective 1: Determining the cost effectiveness of cluster method in restoring degraded forestlands

3.2.1.1 Establishment of Experimental Plots

1. An experimental site will be located covering approximately 2.25 hectares. The 2.25 hectares will be allocated for the three treatments (at 0.25 Ha each) and 3 blocks.
2. A signboard will be installed labeling each block as follows: Block 1, Block 2, and Block 3.
3. Each block will be subdivided into 3 experiment plots (0.25 Ha each):

- **Treatment 1 (Cluster Planting Design).** For Treatment 1, four (4) clusters measuring 10 m x 10 m will be established where the seedlings will be planted using the Miyawaki method (See Figure 1). A mix of seedlings (6 to 12 species comprising of the climax, pioneer, and fruit-bearing species) will be planted at 2m x 2 m or around 25 seedlings for the 10 x 10 m plot (please see Table 1 for the potential species). *Dalbergia cochinchinensis* (the test species) should be one of the species that will be planted in Treatment 1. The climax species will be planted at the inner part of the cluster plot while the fruit-bearing and the pioneer species will be planted surrounding the climax species (please see Figure 2).
- In treatment 1, a 2m x 2m subplot will be established at the periphery of the Miyawaki plot (i.e., at the recruitment zone) that will serve as a recruitment monitoring plot. The new seedling that grows naturally (recruited) will be counted and measured. The species of the seedling will also be identified.
- In the subplot of Treatment 1, grasses will be harvested on a 1 square meter plot. The grasses will be weighed to determine the biomass. The same will be done in Treatment 2 and 3.

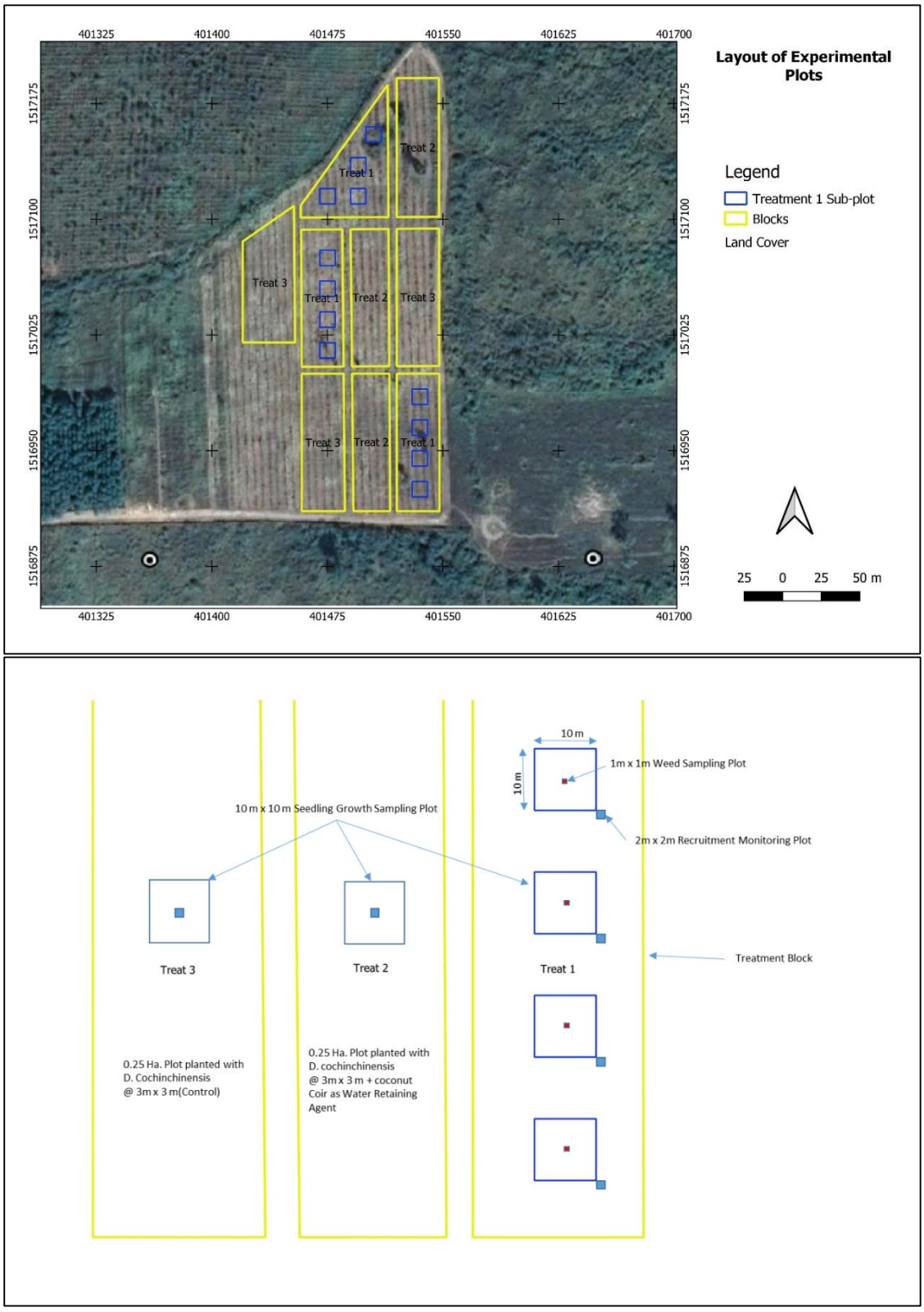

Figure 1. Layout of the Experimental Plot

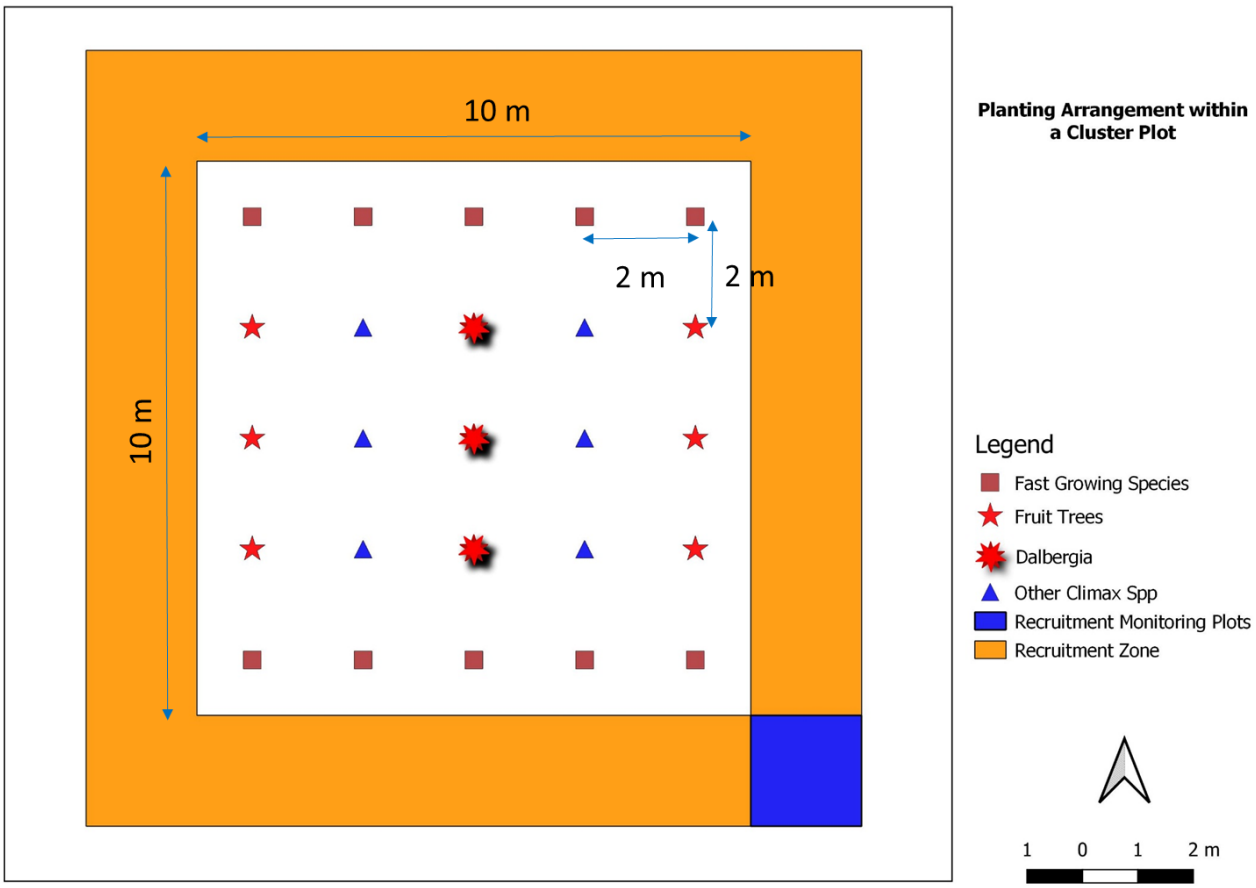

Figure 1. Planting Arrangements of *D. cochinchinensis* and other Climax Species

The proposed species to be used as the climax, fruit trees, and pioneer species are listed in Table 1. Except for Dalbergia, the other species may be changed depending on the availability of the planting materials.

Table 1. List of Species to be planted[1]

Candidate Pioneer Species (to be planted at the periphery of the cluster plot)	**Candidate Fruit Bearing Species (to be planted at the mid portion)**	**Candidate Climax/Late Seral Species (to be planted at the inner part of the cluster plot)**
▪ *Albizzia lebbeck* ▪ *Cassia siamea* ▪ *Aquilaria crassna (Chann*	▪ *Chrysophyllum caimito* ▪ *Syzygium cumini (Pring)* ▪ *Annona squamosal (Tep)*	▪ ***Dalbergia cochinchinensis (Kranhoung)[2]*** ▪ *Anisoptera costata*

[1] *The species may be replaced depending on the availability of seeds during the seed production phase*
[2] *A required species to be planted since this will be the test species or species to be compared with other treatments*

Candidate Pioneer Species (to be planted at the periphery of the cluster plot)	Candidate Fruit Bearing Species (to be planted at the mid portion)	Candidate Climax/Late Seral Species (to be planted at the inner part of the cluster plot)
crassna) ▪ *Azadirachta indica (Pdau)* ▪ *Diospyros sp. (Troyeung)* ▪ *Lagerstroemia speciose (Antanel)* ▪ *Mitrella mesnyi (Rumdoul)*	▪ *Annona muricata (Tep Barang)* ▪ *Wild guava (Psidium guajava)* ▪ *Averrhoa carambola*	▪ *Dalbergia oliveri (Neang Nuon)* ▪ *Syzygium spp* ▪ *Dipterocarpus alatus (Chheuteal)* ▪ *Dipterocarpus intricatus (Trach)* ▪ *Dipterocarpus obtusifolius (Tbeng)* ▪ *Hopea odorata (Kokir)* ▪ *Pterocarpus macrocarpus (Thnong)* ▪ *Shorea roxburghii (Popel)* ▪ *Shorea siamensis (Phchek Reang)* ▪ *Sindora cochinchinensis (Kokor)*

Table 2. ***Breakdown of Seedling Requirement***

Species	Seedlings per Treatment Plot			Total
	Treat 1	Treat 2	Treat 3	
D. cochinchinensis	3 sdlngs per plot x 4 plots/block x 3 blocks = 36 seedlings	278 seedlings per plot x 3 blocks = 834 sdlngs	278 seedlings per plot x 3 blocks = 834 seedlings	1,704 seedlings
Fruit Trees (Treatment 1)	6 seedlings per plot x 4 plots/block x 3 blocks = 72 seedlings	-	-	72 seedlings
Fast Growing Species (Pioneer Species) (Treatment 1)	10 seedlings per plot x 4 plots/block x 3 blocks = 120 seedlings	-	-	120 seedlings
Other Climax	6 seedlings per plot x 4	-	-	72

Species	Seedlings per Treatment Plot			Total
	Treat 1	Treat 2	Treat 3	
Species (Treatment 1)	plots/block x 3 blocks = 72 seedlings			seedlings
Total	300 seedlings	834 seedlings	834 seedlings	1,968 seedlings

A 1 m x 1 m plot will be established at the center of the cluster or Miyawaki plots to monitor the growth of the weeds.

- **Treatment 2 (Planted with Coconut Husk)**. For treatment 2. The plot will be planted with *Dalbergia cochinchinensis* (the test species) which will be planted at 3m x 3m. A net bag containing 250 ccs of coconut husk will be buried beside the seedlings to serve as a water-retaining agent. Before embedding the coconut husk beside the outplanted seedlings, the coconut husk will be moistened by dipping it into the bucket of water.

- **Treatment 3 (Control Plot)**: For treatment 3, the plot will be planted with *D. cochinchinensis* at 3m x 3m as in just like the conventional plantation. This will serve as a control plot.

The same procedure will be used for blocks 2 and 3.

- For treatments 2 and 3, a 1 x 1 m plot will be established at the center of the plots for the collection of grasses

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3.2.1.2 Maintenance and Monitoring of Research Plots

1. Only brushing and spot clearing will be used in land preparation. For treatment 1, the clearing will be done only in the 4 subplots, while clearing the entire 0.25 hectare will be done in Treatment 2 and 3.

2. The costs of establishing each plot including the cost of seedlings will be duly recorded. In treatment 1, a pole will be established at the center of the plot. Photographs will be taken for the four sub-plots for documentation. For treatments 2 and 3, another permanent pole will be established approximately 70 m from the Northeastern corner. This is where the photographs will be taken to the plots.

3. Throughout the conduct of the experiment, brushing will be done as needed when the grasses become twice the height of the planted seedlings. The brushing in Treatment 1 will be done only in the subplots. For treatments 2 and 3, brushing will be done in the entire plot.

4. After 3 months, the biomass will be collected and weighed again.

5. Measurements of the survival and growth of the planted seedlings will be done for the planted seedlings. In treatment 1, the measurements will be done for all seedlings planted in the plot. For treatments 2 and 3, four sampling subplots will be established just like in Treatment 1.

3.2.1.3 Analysis

1. The frequency of weeding cost of site preparation and planting and maintenance of the three treatment plots will be calculated and compared.
2. The costs of the three treatments will be divided by the surviving seedlings to determine the cost-efficiency.
3. The same method will be done for Treatment 2 and 3.
4. The cost efficiency will then be compared for each treatment

3.2.1.4 Collaboration with NIFOS

Under the first objective, the project will have sought the technical assistance of NIFOS in terms of performing the appropriate economic analysis of the study.

3.2.2 Objective 2: Determine the effectiveness of cluster and Miyawaki method on the growth and survival of test species (*D. cochinchinensis*)

3.2.2.1 Establishment of Experimental Design

The experimental design will follow the same experimental layout described in Objective 1.

3.2.2.2 Maintenance and Monitoring of Research Plots

1. The maintenance brushing will follow the method described under Objective 1.
2. Survival and growth data (height and diameter) of the climax, fruit trees, and pioneer species, will be collected from the established plots. The species that survived will be recorded.
3. Periodic sampling will also be conducted on the weeds from the subplots indicated in Figure 1 and Figure 4.

3.2.2.2 Analysis

For objective 2, the analysis will focus on the comparative survival and growth of planted trees, disaggregated whether they are fruit trees, pioneer species, or climax species. A comparison will be made on the survival and growth of each species and also for each Treatment. The comparison will be made using Analysis of Variance. The height will be compared among species and treatments.

Aside from the growth of the timber species, the growth of weeds and the frequency of weeding will also be recorded. This is to evaluate the capability of the Miyawaki method to suppress the weeds.

3.2.2.4 NIFOS Role

NIFOS will assist the project in providing a theoretical aspect of succession and in performing a statistical analysis on the result of the study.

3.2.3 Objective 3: Determine the beneficial effect of coconut husk as water retaining agent on the survival of seedlings

3.2.3.1 Establishment of Experimental Design

The experimental design will follow the same experimental layout described in Objective 1 and Objective 2.

3.2.3.2 Maintenance and Monitoring of Research Plots

1. The maintenance brushing will follow the method described under Objective 1 and Objective 2.
2. Survival and growth data (height and diameter) of the climax, fruit trees, and pioneer species, will be collected from the established plots. The species that survived will be recorded.

3.2.3.3 Analysis

The comparison will be made on the growth and survival of Dalbergia that are planted using the Miyawaki method, planted with coconut husk, and the control (i.e., conventional planting).

3.2.3.4 NIFOS Role

The project will seek advice from NIFOS in conducting the analysis and explanation on the mechanics of retaining the moisture by the coconut husk and the physiological basis of absorption of moisture by the plants.

Section C: Implications and contributions to current body of knowledge

1. Expected Outcomes and Outputs

At the end of the study, IRD will produce a technical report on the outcome of the study. The report will contain the following:

1. Statistical analysis comparing the growth of the plants in Treatments 1, 2, and 3.
2. Comparative cost-efficiency of the three treatment.
3. Policy recommendations on the potential of the Miyawaki method.

2. Practical Implications

The study will help the reforestation program of the government in finding a practical approach in restoring the deforested landscape. The proposed cluster planting design will also aim to make the Miyawaki method more affordable. The scheme is considered to be a very effective approach in restoring degraded forestlands but it can only be implemented in limited areas due to its cost. The cluster planting method aims to address this issue.

The drought that frequently affects northwestern Cambodia has stifled the restoration effort of the government. Evaluating the effectiveness of coconut husk as a water retainer can provide a solution to the low survival of outplanted seedlings.

3. Theoretical Implications

The study can contribute to explaining the benefits of mixed-species planting in restoration. The study will also help in verifying whether cluster planting is more advantageous than the conventional regular planting method which is current practice in many government restorations programs. Lastly, the study will test the advantages of the coconut husk as a retaining agent on the survival of the plants. The results can provide a basis for its adaptability in restoring larger areas.

Section D. Research Budget of Objectives/Outputs/Activities

Quarterly Work Plan and Schedule of Activities

Outputs / Key Activities	Performance Indicator	Responsible Person	2021			2022				2023	
			Apr	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
0.0 Inception	Inception Report Prepared and Submitted	IRD Staff	x								
1.0 Preparation and Site Layout and Establishment											
▪ Activity 1.1 Production/Purchase of Seedlings	1,968 seedlings produced	Research Assistant and Nursery Staff		x							
▪ Activity 1.2 Layout and Establishment of Experimental Plots	9 Experimental Blocks Established	Research Assistant and Laborers		x							
▪ Activity 1.3 Sampling of Weeds	Sampling conducted in 18 sampling plots	Research Assistant and Laborers		x							
▪ Activity 1.4 Maintenance Weeding of Experimental Plots	6 blocks and 8 sub plots brushed	Laborers			x		x		x	x	
▪ Activity 1.5 Monitoring and Measurements	18 sub-plots sampled	Research Assistant and Laborers			x	x	x	x	x	x	
Activity 2.0 Analysis of Data											
▪ Objective 1: 1. Evaluate the cost effectiveness of cluster planting combined with Miyawaki method in rehabilitating degraded lands	Report/Analysis	Lead Researcher									x
▪ Objective 2: Determine the survival of test species (D. cochinchinensis) planted together with other species in a cluster using the Miyawaki method	Report/Analysis	Lead Researcher									x
▪ Objective 3: 3. To determine the effectiveness of coconut husk as a water retaining agent on the survival of seedlings	Report/Analysis	Lead Researcher									x

Budget Plan (Detailed Cost)

Outputs / Key Activities	Allocation by Unit				Yr. 2021			Yr. 2022				Yr. 2023	
	Unit Cost (USD)	Qty	Unit	Total Cost	Apr	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
0.0 Inception				**100**	100	-	-	-	-	-	-	-	-
Supplies and Matls	100		$ (lump sum)	100	100	-	-	-	-	-	-	-	-
1.0 Preparation and Site Layout and Establishment				**23,984**	-	7,068	3,500	1,458	3,500	1,458	3,500	3,500	-
Activity 1.1 Production/Purchase of Seedlings				**2,876**	-	2,876	-	-	-	-	-	-	-
Supplies and Matls	150		$ (lump sum)	150	-	150	-	-	-	-	-	-	-
Cost of Seedlings	1	1,968	Seedlings	1,968	-	1,968	-	-	-	-	-	-	-
Travel, Project Staff	100	2	days	200	-	200	-	-	-	-	-	-	-
DSA, Project Staff	43	6	person-days	258	-	258	-	-	-	-	-	-	-
Technical Services	300	1	technical report	300	-	300	-	-	-	-	-	-	-
Activity 1.2 Layout and Establishment of Experimental Plots				**2,665**	-	2,665	-	-	-	-	-	-	-
Labor - Site Preparation - Treatment 1	250	0.12	Ha	30	-	30	-	-	-	-	-	-	-
Labor - Site Preparation - Treatment 2	250	0.75	Ha	188	-	188	-	-	-	-	-	-	-
Labor - Site Preparation - Treatment 3	250	0.75	Ha	188	-	188	-	-	-	-	-	-	-
Labor - Planting - Treatment 1	0	300	seedlings	30	-	30	-	-	-	-	-	-	-
Labor - Planting - Treatment 2	0	834	seedlings	125	-	125	-	-	-	-	-	-	-
Labor - Planting - Treatment 3	0	834	seedlings	209	-	209	-	-	-	-	-	-	-
Coco Husk	45	10	bags	450	-	450	-	-	-	-	-	-	-
Travel, Project Staff	100	5	Travel-days	500	-	500	-	-	-	-	-	-	-
DSA, Project Staff	43	15	person-days	645	-	645	-	-	-	-	-	-	-
Technical Services	300	1	Technical Report	300	-	300	-	-	-	-	-	-	-
Activity 1.3 Sampling of Weeds				**1,527**	-	1,527	-	-	-	-	-	-	-
Labor - Weed Collection	30	18	plots	540	-	540	-	-	-	-	-	-	-
Travel, Project Staff	100	3	Travel-days	300	-	300	-	-	-	-	-	-	-
DSA, Project Staff	43	9	person-days	387	-	387	-	-	-	-	-	-	-
Technical Services	300	1	Technical Report	300	-	300	-	-	-	-	-	-	-
Activity 1.4 Maintenance Weeding of Experimental Plots				**8,168**	-	-	2,042	-	2,042	-	2,042	2,042	-
Labor - Brushing - Treatment 1	250	0.48	Ha.	120	-	-	30	-	30	-	30	30	-

Outputs / Key Activities	Allocation by Unit				Yr. 2021			Yr. 2022				Yr. 2023	
	Unit Cost (USD)	Qty	Unit	Total Cost	Apr	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Labor - Brushing - Treatment 2	250	3.00	Ha.	750	-	-	188	-	188	-	188	188	-
Labor - Brushing - Treatment 3	250	3.00	Ha.	750	-	-	188	-	188	-	188	188	-
Travel, Project Staff (Fuel and Gas)	100	36	Travel-days	3,600	-	-	900	-	900	-	900	900	-
DSA, Project Staff	43	36	person-days	1,548	-	-	387	-	387	-	387	387	-
Technical Services	350	4	Technical Report	1,400	-	-	350	-	350	-	350	350	-
Activity 1.5 Monitoring and Measurements				**8,748**	-	-	1,458	1,458	1,458	1,458	1,458	1,458	-
Labor - Measurements and Data Collection - Treatment 1	50	24	plot-measurements	1,200	-	-	200	200	200	200	200	200	-
Labor - Measurements and Data Collection - Treatment 2	50	6	plot-measurements	300	-	-	50	50	50	50	50	50	-
Labor - Measurements and Data Collection - Treatment 3	50	6	plot-measurements	300	-	-	50	50	50	50	50	50	-
Travel, Project Staff	100	36	Travel-days	3,600	-	-	600	600	600	600	600	600	-
DSA, Project Staff	43	36	person-days	1,548	-	-	258	258	258	258	258	258	-
Technical Services	300	6	Technical Report	1,800	-	-	300	300	300	300	300	300	-
2.0 Analysis of Data				**1,320**	-	-	-	-	-	-	-	-	1,320
Objective 1				**448**	-	-	-	-	-	-	-	-	448
Supplies and Matls	148	1	analysis	148	-	-	-	-	-	-	-	-	148
Technical Services	300	1	Technical Report	300	-	-	-	-	-	-	-	-	300
Objective 2				**425**	-	-	-	-	-	-	-	-	425
Supplies and Matls	125	1	analysis	125	-	-	-	-	-	-	-	-	125
Technical Services	300	1	Technical Report	300	-	-	-	-	-	-	-	-	300
Objective 3				**447**	-	-	-	-	-	-	-	-	447
Supplies and Matls	147	1	analysis	147	-	-	-	-	-	-	-	-	147
Technical Services	300	1	Technical Report	300	-	-	-	-	-	-	-	-	300
3.0 Personnel				**5,400**	-	675	675	675	675	675	675	675	675
Admin Staff	100	24	person-days	2,400	-	300	300	300	300	300	300	300	300
Research Asst.	125	24	person-days	3,000	-	375	375	375	375	375	375	375	375
4.0 Program Support (12%)				**3,696**	12	929	501	256	501	256	501	501	239
TOTAL PROJECTBUDGET				**34,500**	**112**	**8,672**	**4,676**	**2,389**	**4,676**	**2,389**	**4,676**	**4,676**	**2,234**

Budget Allocation (By Source)

Outputs / Key Activities	Total	Allocation (%)			Ápr 2021	Jul-Dec 2021	Jan-Dec 2022	Jan-Jun 2023
		Direct Cost (%)	Personnel Cost (%)	Others (%)				
0.0 Inception	100	0.3%	-	-	100	-	-	-
1.0 Preparation and Site Layout and Establishment	23,984	69.5%	-	-	-	10,568	9,916	3,500
Activity 1.1 Production/Purchase of Seedlings	2,876	8.3%	-	-	-	2,876	-	-
Activity 1.2 Layout and Establishment of Experimental Plots	2,665	7.7%	-	-	-	2,665	-	-
Activity 1.3 Sampling of Weeds	1,527	4.4%	-	-	-	1,527	-	-
Activity 1.4 Maintenance Weeding of Experimental Plots	8,168	23.7%	-	-	-	2,042	4,084	2,042
Activity 1.5 Monitoring and Measurements	8,748	25.4%	-	-	-	1,458	5,832	1,458
2.0 Analysis of Data	1,320	3.8%	-	-	-	-	-	1,320
Objective 1	448	1.3%	-	-	-	-	-	448
Objective 2	425	1.2%	-	-	-	-	-	425
Objective 3	447	1.3%	-	-	-	-	-	447
3.0 Personnel	5,400	-	15.7%	-	-	1,350	2,700	1,350
4.0 Program Support (12% of Project Budget)	3,696	-	-	**10.7%**	12	1,430	1,514	740
TOTAL BUDGET	**34,500**	**73.6%**	**15.7%**	**10.7%**	**112**	**13,348**	**14,130**	**6,910**