



Food and Agriculture
Organization of the
United Nations

Dry Season Plantation (DSP) Trial

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Dry season plantation trial, FAO

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Background

- Bangladesh lost 197kha of tree cover from 2001 to 2020 (GFW, 2021)
- Critical in Cox's bazar due to sudden influx of >1 million refugees
 - Soil degradation is prevalent
 - Soil seed bank is severely depleted
 - Exposed soil surface is amenable to erosions
 - Landslides are becoming quite common



Rationale

More actors in forest degradation, less in restoration

Quick restoration is inevitable

Plantation season covers 4-Monsoon months (June-Sep)

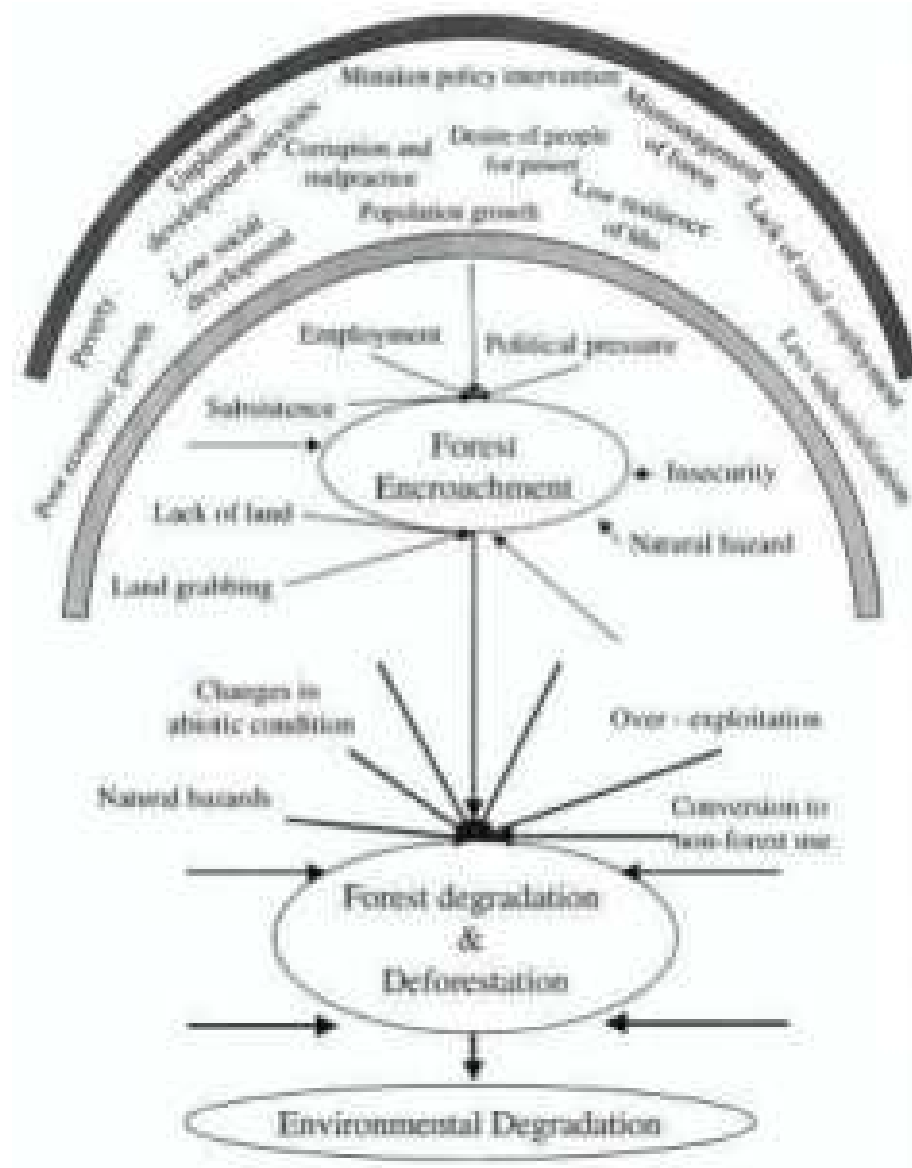
Makes restoration efforts slow

Planting in dry season (Oct-May) can expedite restoration

DSP aims extending plantation beyond Monsoon

Initially DSP maybe costly but cost will go down

Mainstreaming requires DSP to be cost-effective and frictionless



Zibeben, 2014

Initial thoughts

Why don't we plant in dry season?

- Soil moisture
- Hilly sites
- Irrigation water sources
- Irrigation requirements
- Labor cost for extra irrigation
- Deciduous spp are prevalent
- Low survival rate, etc.

Drawbacks of regular plantation

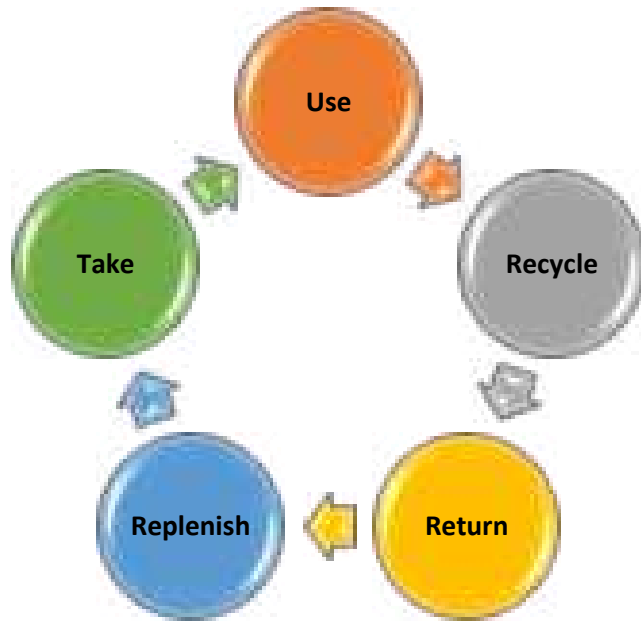
- Soils are disturbed in rain
- High soil erosion
- In hilly sites, landslide risk enhanced
- Higher competition with weeds
- Extra cost for weeding
- Plantation management is costly
- Site preparation is slower



What can be done for DSP?

- ☐ Selection of species
- ☐ Moisture conservation
 - ✓ Moisture retention materials (biochar, cocopeat, etc.)
 - ✓ Reduce evaporation from soil (*mulch*)
- ☐ Irrigation
 - ✓ Traditional irrigation
 - ✓ Infrequent irrigation for cost saving
 - ✓ Slow irrigation devices (eg. cocoon)
 - ✓ Piped and spot irrigation
 - ✓ Fog catching for irrigation
 - ✓ Water vapor harvesting for irrigation

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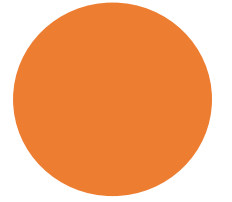


Circular thinking

- Wastes to moisture conservation materials – **waste to resource**
- Cycle nutrients back to the forest – **sustainable ecosystem**
- Net inflow of nutrients, replenish past leaching - **compensation**
- Amend soil to conserve moisture - **conservation reduces inputs**
- Mix species to optimize resource utilization – **diversity matters**
- Equal share of inputs among the plants – **new planting technique**
- Solving multiple problems – **use of water hyacinth as moisture retention materials to solve water hyacinth issue.**
- Biochar for moisture retention – **soil amendment**
- Local entrepreneurship for innovation– **plantation in livelihood support**

Approach – trial DSP

- Site like deteriorated sites at Camp
- Trial moisture conservation and retention
- Assess irrigation requirement
- Evaluate under slopes akin to hill forest of Bangladesh
- Try mixed plantation to evaluate the species performance
- Hexagonal arrangement for proper space and resource use
- Interventions for slope stabilization
- Legume undergrowth for nutrient enhancement



Materials used for DSP at Shilkhali and Camp 19

Essentials	Minor items	Ornamental items	Safety items	Others
Seedlings	Legume seeds	Grass tiles	Nylon net	Watering pipe
Sticks	Jute net	Cane seedlings	Dry bamboo	Pump
Cow dung	Jute rope	Bamboo seedlings	GI wire	Small trolley
Compost	Rice straw	Paints and thinner	Safety helmets	Bamboo basket
Cocoon	Saw dust	Paint brush	Safety gloves	Stationary
Biochar			First aid box	
Cocopeat				
Water hyacinth				



Site condition: Shilkhali (outside camp)

- Highly degraded site
- Sparse and shrubby ground vegetation
- Severe human interferences
- Mixed land use
- Close to water body
- Has similarity to camp sites
- Different slope condition
- Prone to erosion

Trials: at Shilkhali

29 plots, 5 treatments, 6 species

Treatment 1 (Only irrigation): 6 plots, 2 at each of top, middle and bottom slopes

Slow irrigation with cocoons

Treatment 2 (Cocoon): 5 plots, 2 at each of top and middle with 1 at bottom slope

Soil amendment and Moisture conservation

Treatment 3 (Cocopeat): 6 plots, 2 at each of top, middle and bottom slopes

Treatment 4 (Biochar): --do--

Treatment 5 (Water hyacinth compost): --do--

Species	Slope	Biochar	Cocoon	Cocopeat	Water hyacinth compost	Irrigation only	Slope total
Chikrassi	Bottom	33	16	15	16	28	108
	Middle	32	32	50	32	33	179
	Top	16	33	47	31	45	172
Bohera	Bottom	34	17	19	17	36	123
	Middle	36	37	51	36	35	195
	Top	19	38	55	36	58	206
Arjun	Bottom	32	16	17	17	31	113
	Middle	31	35	47	32	32	177
	Top	16	30	47	30	50	173
Kalojam	Bottom	37	19	18	18	41	133
	Middle	37	37	53	36	36	199
	Top	18	37	56	37	51	199
Neem	Bottom	33	16	16	15	35	115
	Middle	32	31	58	32	32	185
	Top	16	31	49	32	50	178
Telsur	Bottom	31	16	15	17	28	107
	Middle	32	29	42	32	32	167
	Top	15	31	43	34	51	174
Treatment Total		500	501	698	500	704	2903

Trial DSP: Camp 19

Modifying **Miyawaki plantation technique** for hilly land and for dry season

0.26 ha of land, 17 species

Site condition

- Highly degraded site
- Completely barren and exposed soil
- Severe human interferences
- No water source nearby
- Different slope condition
- Prone to erosion



Camp dry season adapted Miyawaki site



Trial: Camp 19

Inputs in randomly arranged pit

400 gm of soil amendment/pit

Biochar: 50 gm

- Dry water hyacinths: 20 gm
- Water hyacinth compost: 30 gm
- Cocopeat: 100 gm
- Rice husk: 50 gm
- Saw dust: 50 gm
- Cow dung: 50 gm
- Compost: 50 gm

No chemical fertilizers were used



Species: Shilkhali

Species

Six indigenous species

- Arjun (*Terminalia arjuna*)
- Bohera (*Terminalia bellirica*)
- Chikrassi (*Chukrasia tabularis*)
- Kalojam (*Syzygium spp.*)
- Neem (*Azadirachta indica*) and
- Telsur (*Hopea odorata*)



Species: Camp 19

Species

Fifteen indigenous species

- Arjun (*Terminalia arjuna*)
- Bohera (*Terminalia bellirica*)
- Chickrassi (*Chukrasia Tabularis*)
- Neem (*Azadirachta indica*)
- Telsur (*Hopea odorata*)
- Kalojam (*Syzygium cumini*)
- Amloki (*Phyllanthus emblica*)
- Putijam (*Syzygium fruticosum*)
- Chapalish (*Artocarpus chama*)
- Shal (*Shorea robusta*)
- Garjan (*Dipterocarpus turbinatus*)
- Dhakijam (*Syzygium grande*)
- Sil Batna (*Castanopsis indica*)
- Bokul (*Mimusops elengi*) and
- Pitraj (*Aphanamixis polystachya*)
- Parul jam
- Surja







Locally sourced earthen cocoons









Soil amendment and Moisture conservation materials















Trial outcomes: DSP at Shilkhali

Survival (S%) of seedlings against the number (N) of seedlings planted.

	Biochar		Cocoon		Cocopeat		Water hyacinth compost		Irrigation only		Total	
	N	S (%)	N	S (%)	N	S (%)	N	S (%)	N	S (%)	N	S (%)
Chikrassi	81	100	81	100	112	100	79	100	106	100	459	100
Bohera	89	100	92	100	125	100	89	100	129	100	524	100
Arjun	79	100	81	100	111	100	79	100	113	100	463	100
Kalojam	92	100	93	100	127	100	91	100	128	100	531	100
Neem	81	100	78	100	123	100	79	100	117	100	478	100
Telsur	78	100	76	100	100	100	83	100	111	100	448	100
Treat. total	500	100	501	100	698	100	500	100	704	100	2903	100

The irrigation regimes for different treatments and the possibility of improvement.

Treatments	Cocoon	Biochar	Cocopeat	Water hyacinth compost	Irrigation only
Irrigation regimes					
Trial interval (days)	8	4	4	4	0
Probable improvement (days)	28	7-10	7-10	7-10	1

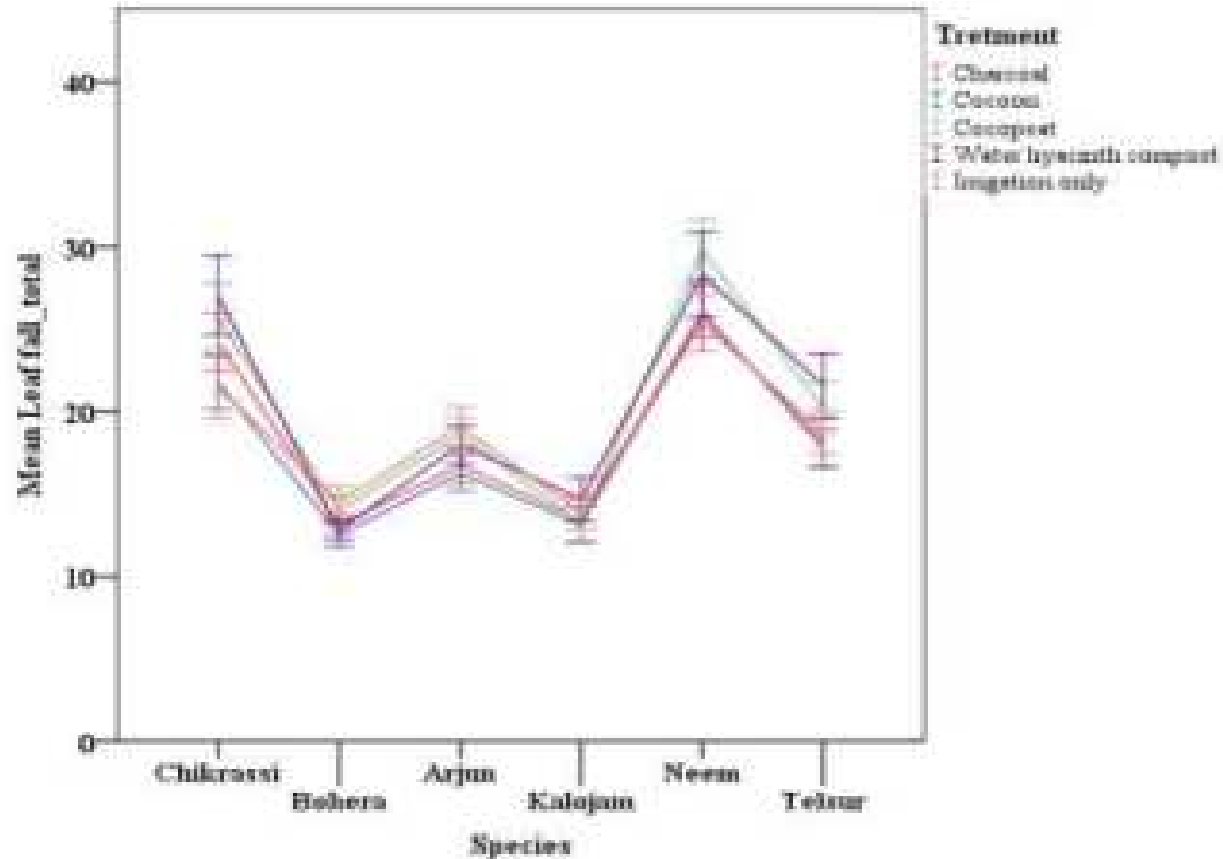
Outcomes:
Shilkhali #1
(3 months)



Outcomes: Shilkhali #2 (3 months)

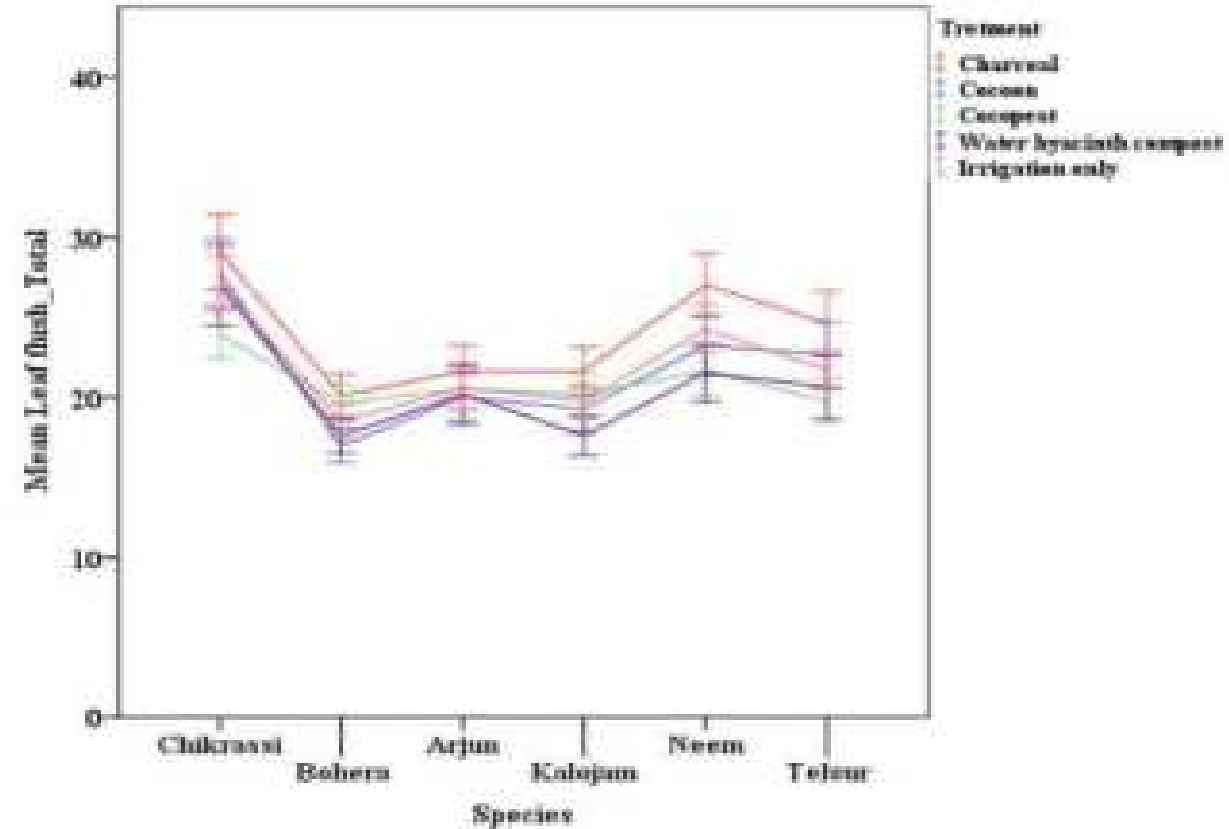


Leaf fall



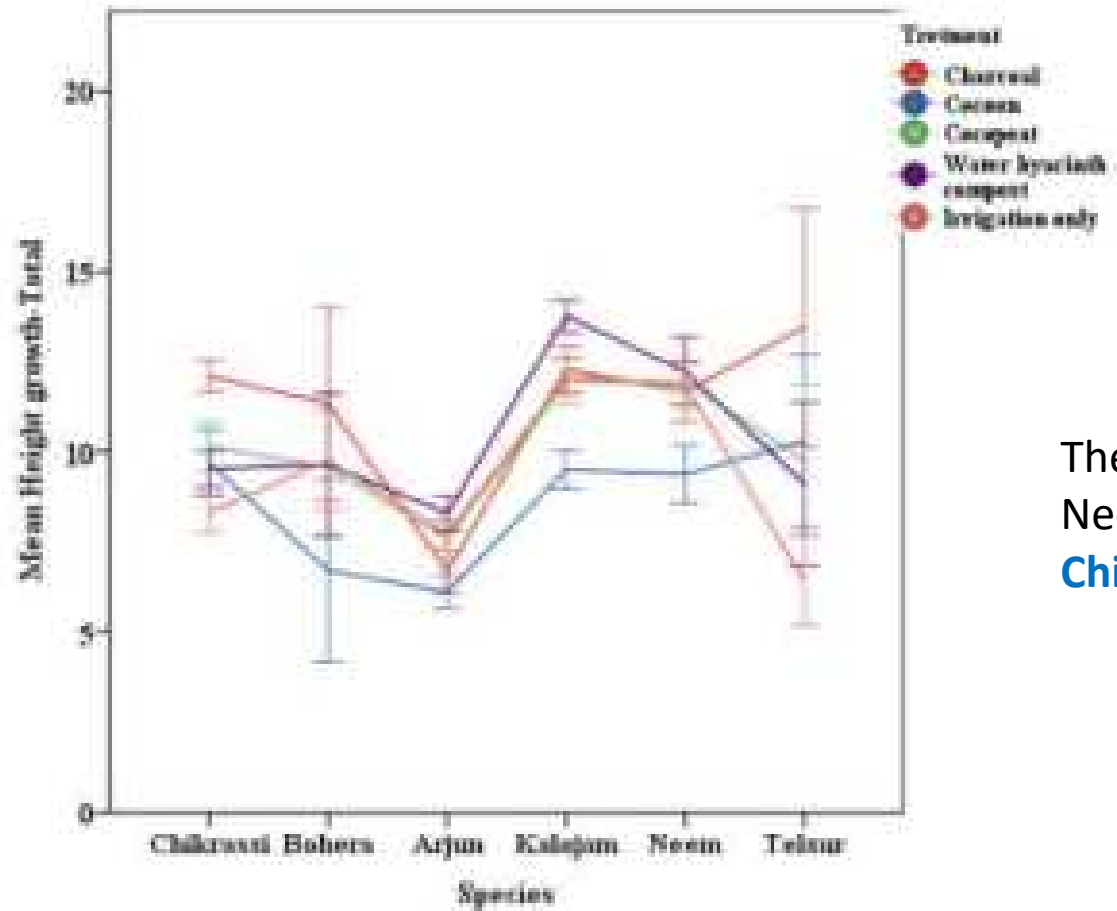
Species with better initial performance in terms of leaf fall were **Kalojam>Bohera> Arjun> Telsur >Chickcrassi >Neem**

Leaf flush



The sequence in terms of leaf flushing behaviours was **Chickcrassi > Neem > Telsur> Kalojam and Arjun>Bohera**

Initial height increment



The sequence from the highest to lowest was
Neem and **Kalojam > Bohera, Telsur and
Chickrassi > Arjun**

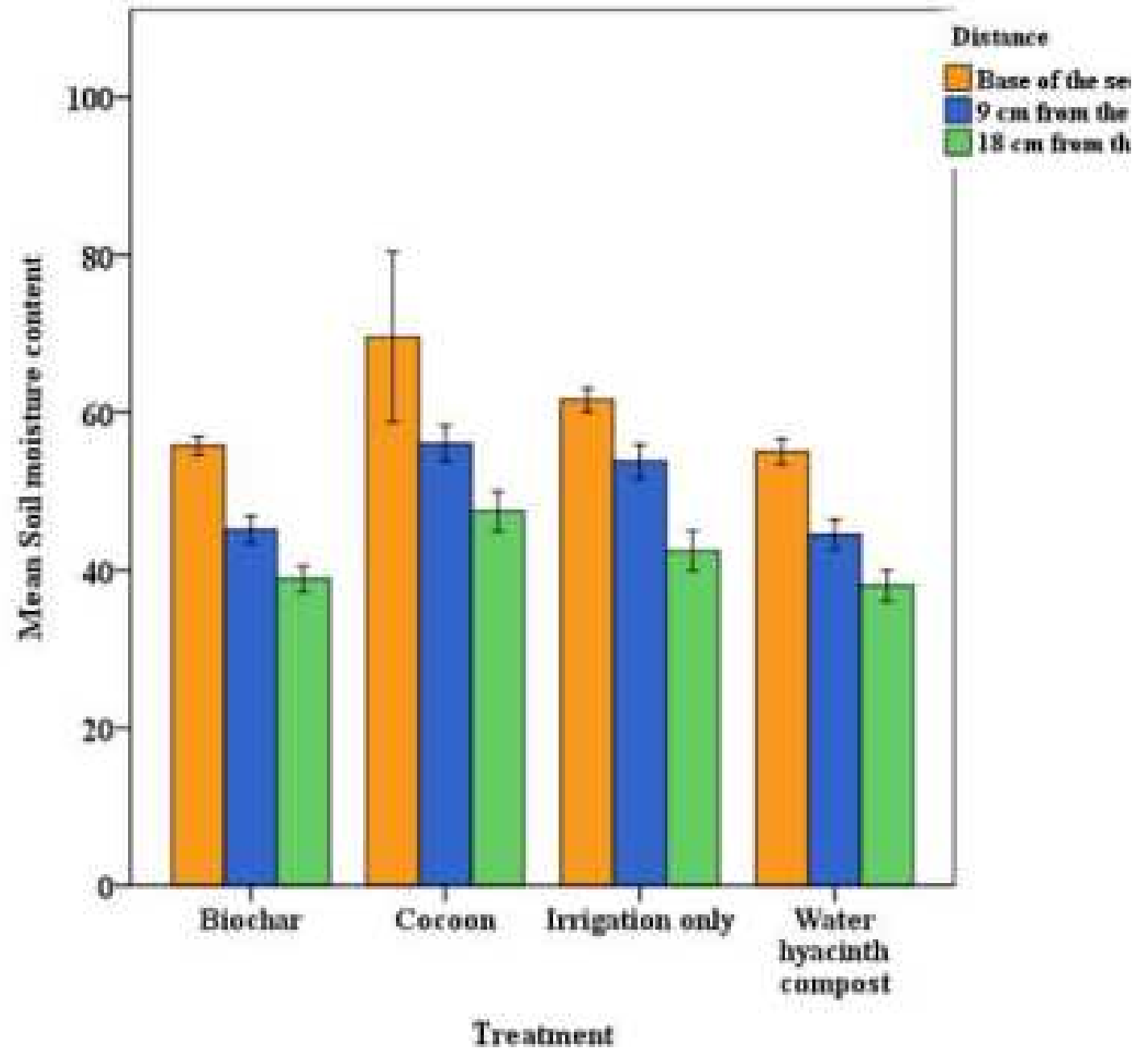
Comparison among
treatments (first 3
months)

	Cocoon	Biochar	Cocopeat	WHC	Irrigation only
Leaf fall (P1)	a	ab	c	c	b
Leaf fall (P2)	b	b	ab	a	a
Leaf fall (P3)	b	b	b	b	a
Leaf fall (Total)	a	a	b	b	a
Leaf flush (P1)	b	c	a	a	b
Leaf flush (P2)	a	c	b	b	a
Leaf flush (P3)	a	a	a	ab	b
Leaf flush (Total)	ab	c	ab	a	b
Height growth (Int-1)	bc	c	ab	b	a
Height growth (Int-2)	a	b	b	b	b
Total height growth	a	d	bc	c	b
Height growth rate	a	d	bc	c	b
Collar dia growth (Int-1)	a	a	a	a	a
Collar dia growth (Int-2)	b	a	b	b	ab
Total Collar dia growth	a	a	a	a	a
Collar dia growth rate	a	a	a	a	a
Undergrowth	a	a	a	a	a

Comparison among
species (first 3
months)

	Bohera	Kalojam	Arjun	Telsur	Chikrassi	Neem
Initial leaf number	a	b	b	c	e	d
Leaf fall (P1)	a	b	c	d	e	f
Leaf fall (P2)	b	a	e	e	d	c
Leaf fall (P3)	b	a	b	a	a	c
Leaf fall (Total)	a	a	b	c	d	e
Leaf flush (P1)	a	a	b	c	e	d
Leaf flush (P2)	a	a	b	b	d	c
Leaf flush (P3)	c	c	b	b	a	a
Leaf flush (Total)	a	b	b	c	e	d
Height growth (Int-1)	a	b	ab	c	b	b
Height growth (Int-2)	b	c	a	a	b	c
Total height growth	b	c	a	b	b	c
Height growth rate	b	c	a	b	b	c
Collar dia growth (Int-1)	a	a	a	a	a	a
Collar dia growth (Int-2)	c	e	d	a	d	b
Total Collar dia growth	a	a	a	a	a	a
Collar dia growth rate	a	a	a	a	a	a
Undergrowth	a	a	a	a	a	a

Variations in soil moisture content (%) among treatments with distance from the base of the seedling



Trial outcome:
CAMP 19
(3 months)





After 1 year

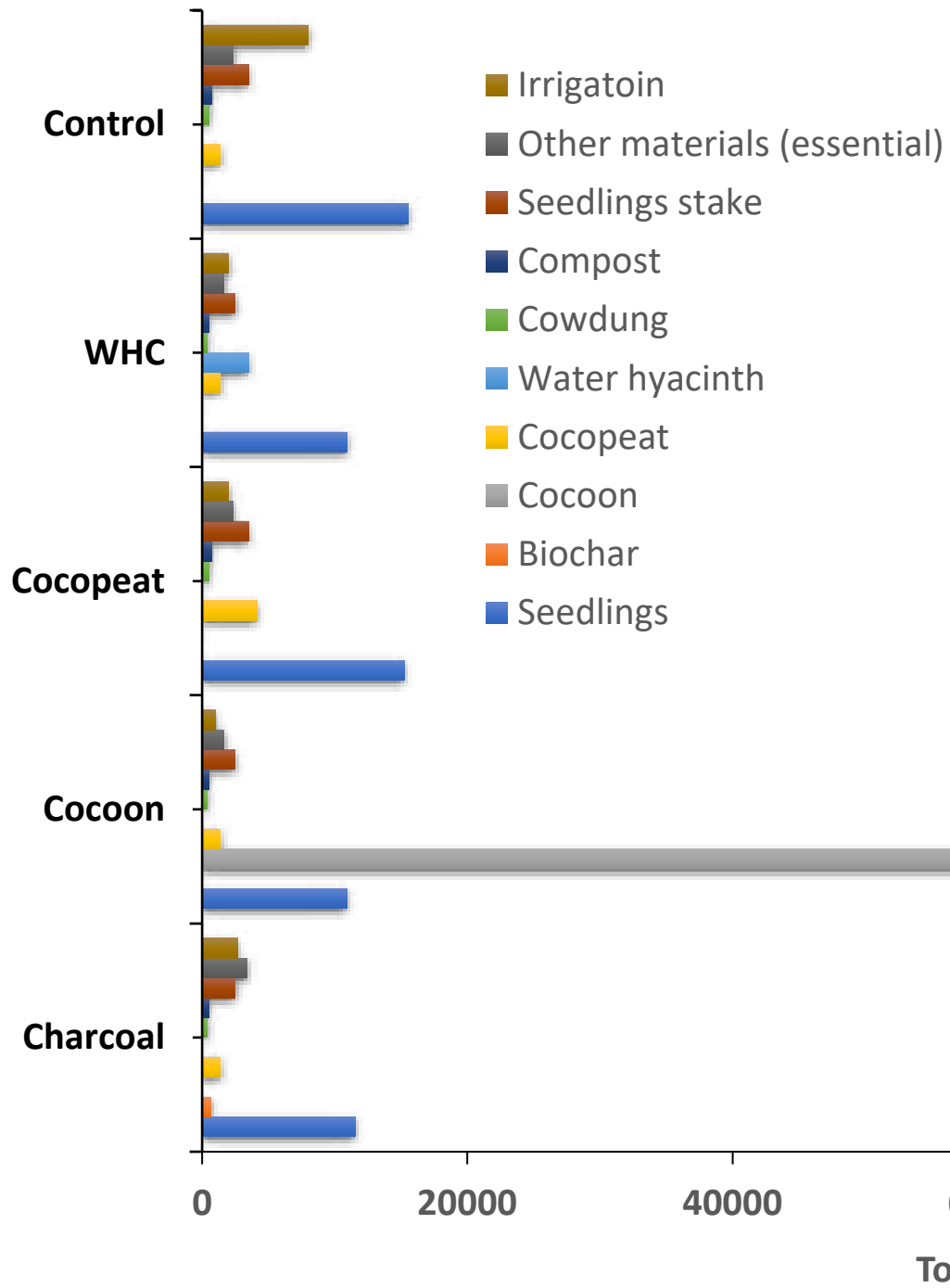




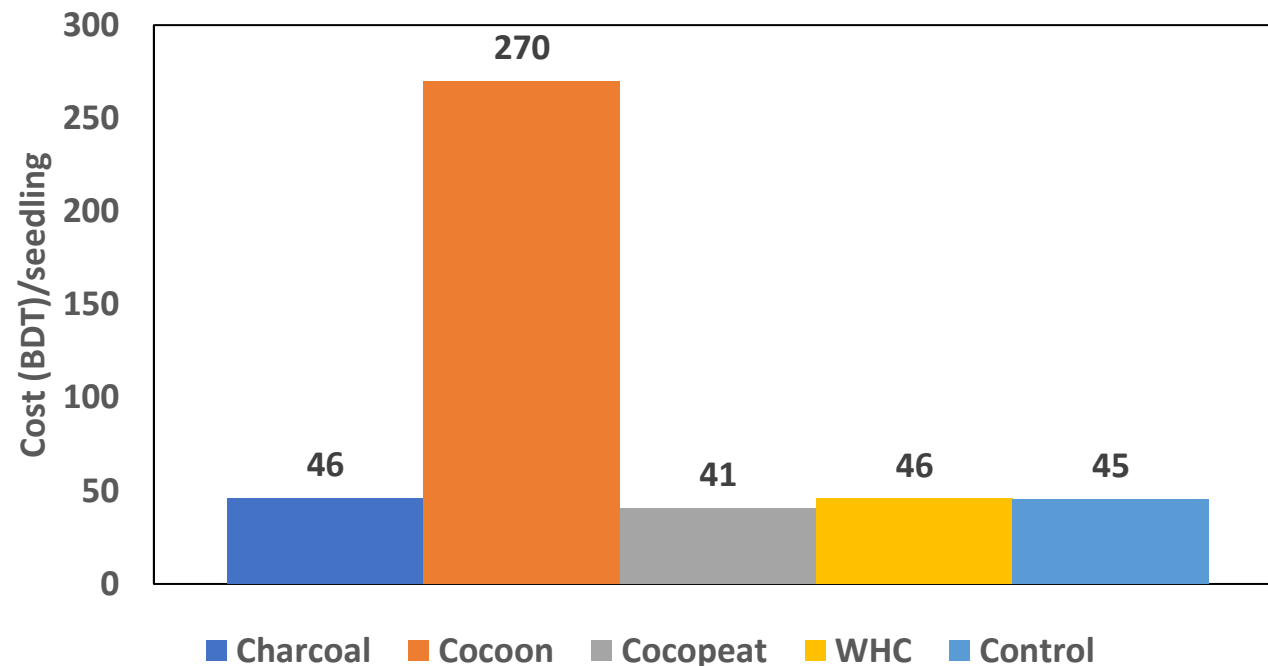


So...

What about the cost??

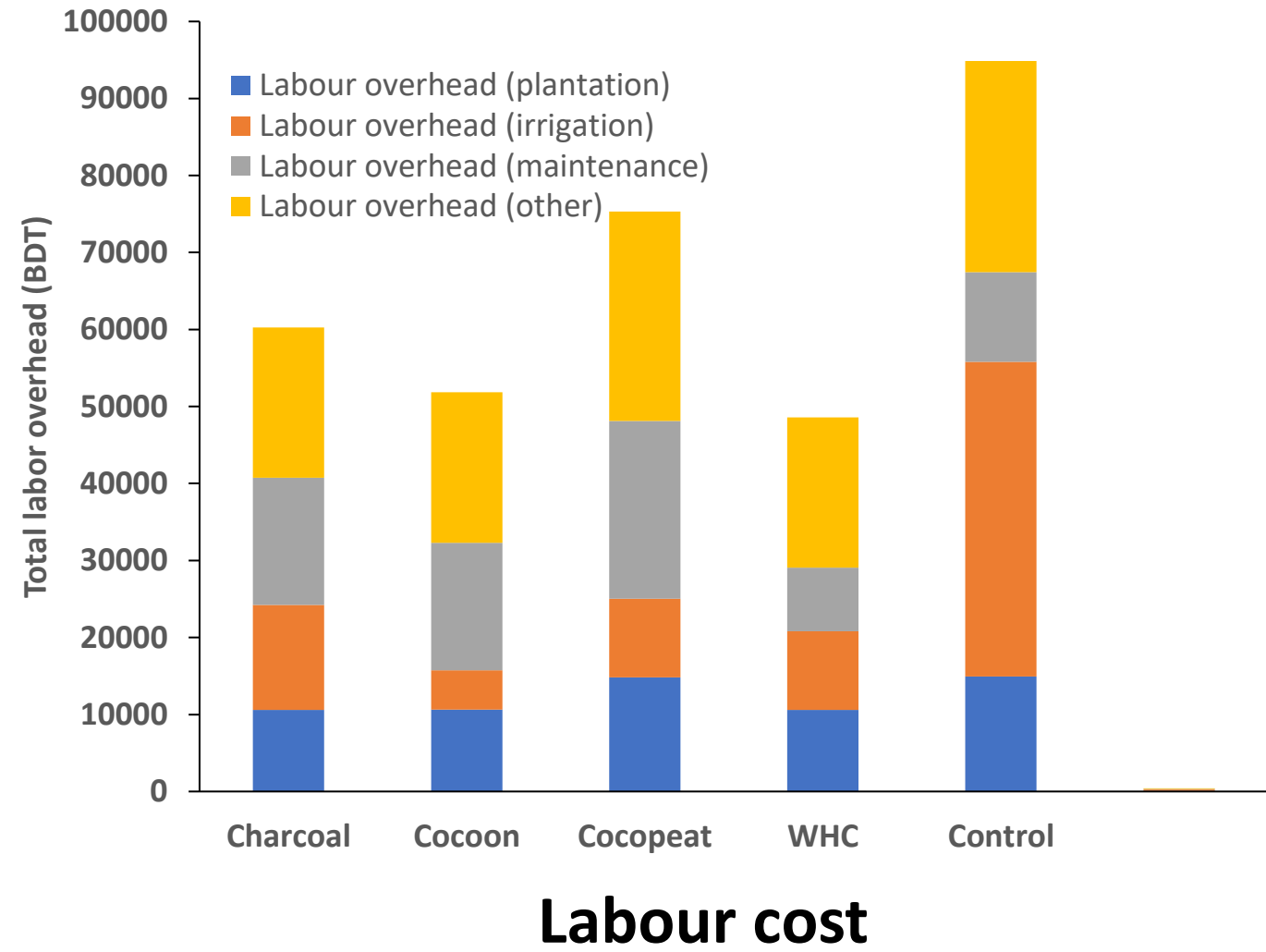
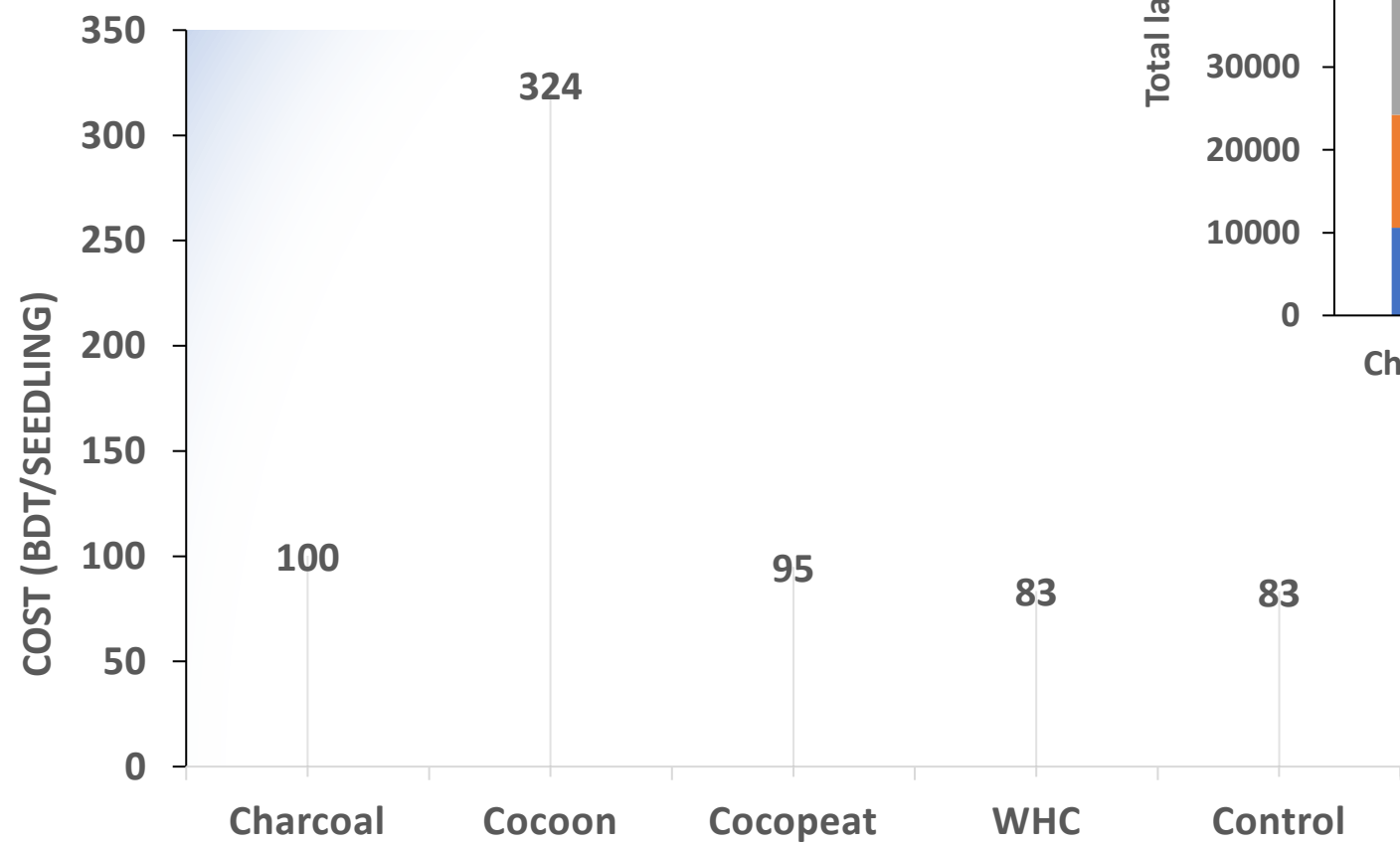


Material cost



Cost breakdown

Essential material plus labour cost



Major conclusions

- DSP is possible, mixed performance in trials
- Cocoons are costly, performed great and can be reused to reduce cost
- Good care ensures great survival rate irrespective of slopes and species
- Other moisture conservation materials can be experimented with
- ***Disturbance to soil is done before rain sets in – reduced erosion***
- ***Preemptive measures can be taken against landslide***
- ***Plants are established before first rain – good growth after first rain***
- ***Weeds poses minimal threat in dry season – reduction of cost***

Further works

- Maintaining and monitoring the plantations for long term performance
- Trials with combinations of trials and
- Try new materials and devices
- Trial under more indigenous species
- Establish permanent large scale trial plots for long time studies
- Extension of Miyawaki model
- Apply moisture conservation materials in all ongoing plantation activities

Thank you ? ? ?