



Community-Based Afforestation and Tasar Agroforestry on Reclaimed Coal Mine Land: An Extension Model for Sustainable Livelihood Enhancement Through Nursery Development and Intercropping

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Large areas of reclaimed coal mine land remain underutilized despite their enormous potential for ecological restoration and sustainable livelihood generation. Local communities surrounding these reclaimed lands have traditionally depended on seasonal paddy cultivation and vegetable farming for their livelihood. However, these activities often provide limited employment and unstable income. Community-based afforestation integrated with Tasar agroforestry offers an innovative extension approach that simultaneously restores degraded ecosystems and generates sustainable income.

The present study proposes an extension model based on plantation of Arjun (*Terminalia arjuna*) and Asan (*Terminalia tomentosa*) along with community nursery development and profitable intercropping using turmeric, marigold, black gram, cowpea and groundnut. The programme emphasizes active participation of local villagers in nursery production, plantation establishment, maintenance, irrigation, and intercrop cultivation. Baseline and post-afforestation socio-economic surveys are proposed to assess changes in employment, household income, livelihood security, technology adoption and environmental awareness.

An illustrative (sample) dataset demonstrates the analytical framework. The sample analysis indicates that diversified income through nursery development, plantation activities and intercropping has the potential to substantially improve annual household income and employment while enhancing ecological restoration and community participation. The proposed extension model may serve as an effective strategy for sustainable rehabilitation of reclaimed coal mine land through community participation and Tasar-based agroforestry.

Keywords: Coal mine reclamation, Community afforestation, Tasar agroforestry, Arjun plantation, Asan plantation, Extension education, Nursery development, Intercropping, Livelihood enhancement, Sustainable development.

Introduction

Coal mining has significantly contributed to India's industrial and economic development but has simultaneously caused large-scale degradation of natural ecosystems. Surface mining removes vegetation, disturbs soil structure, reduces biodiversity and leaves extensive areas unsuitable for conventional agriculture. Although many coal mine areas are reclaimed after mining operations, they frequently remain underutilized due to lack of appropriate livelihood-oriented rehabilitation programmes.

Communities residing around reclaimed coal mine areas often depend on these lands for seasonal paddy cultivation and vegetable production. Such dependence provides only seasonal employment and exposes households to considerable economic uncertainty.

Therefore, sustainable land-use models capable of generating year-round income while restoring ecosystem functions are urgently required.

Afforestation using Tasar host plants such as Arjun (*Terminalia arjuna*) and Asan (*Terminalia tomentosa*) represents an effective ecological restoration strategy. These tree species improve soil fertility, increase organic carbon, stabilize degraded soil, conserve biodiversity and create long-term opportunities for tropical Tasar sericulture. During the early years of plantation establishment, sufficient open space remains between tree rows, allowing cultivation of economically valuable intercrops.

Intercropping with turmeric (*Curcuma longa*), marigold (*Tagetes erecta*), black gram (*Vigna mungo*), cowpea (*Vigna unguiculata*) and groundnut (*Arachis hypogaea*) provides additional income before tree canopy closure. These crops improve resource utilization, enhance soil quality, suppress weeds and diversify farmers' income sources.

Community participation is the cornerstone of successful ecological restoration. Through extension education programmes involving awareness campaigns, demonstrations, nursery training, farmer field schools and continuous technical support, local villagers can become active stakeholders rather than passive beneficiaries. Employment opportunities generated through nursery preparation, seedling production, plantation establishment, maintenance and intercropping contribute directly to rural livelihood improvement while ensuring long-term sustainability of afforestation programmes.

The proposed extension model integrates ecological restoration, Tasar host plant development and community livelihood enhancement into a single participatory framework. By combining afforestation with nursery enterprises and intercropping, reclaimed coal mine land can be transformed into a productive landscape supporting both environmental conservation and rural economic development.

Objectives

The present investigation was designed with the following objectives:

- To assess the socio-economic dependence of nearby villagers on reclaimed coal mine land before afforestation.
- To evaluate the willingness of local communities to participate in afforestation programmes.
- To generate sustainable employment through community nursery development.
- To evaluate the economic potential of intercropping under Arjun and Asan plantations.
- To compare household income before and after implementation of the afforestation programme.
- To assess changes in employment generation and livelihood security.
- To evaluate community perception regarding ecological restoration and environmental improvement.
- To develop a sustainable extension model for rehabilitation of reclaimed coal mine landscapes.

Materials and Methods

Study Area

The study is proposed on reclaimed coal mine land where community-based afforestation is planned. The reclaimed area was previously utilized by nearby villagers for seasonal paddy cultivation and vegetable production. Following reclamation, the land was selected for establishment of Arjun (*Terminalia arjuna*) and Asan (*Terminalia tomentosa*) plantations integrated with nursery development and intercropping under an extension programme.

Experimental Design

The study follows an **Extension Research Design** involving:

- Baseline socio-economic survey (Pre-afforestation)
- Community awareness programme
- Farmer training

- Nursery establishment
- Plantation establishment
- Intercropping demonstration
- Follow-up socio-economic survey (Post-afforestation)

The duration of the study is 2 years

Selection of Respondents

A total of **100 farming households** living adjacent to the reclaimed mine area are selected through simple random sampling.

Inclusion criteria:

- Previously dependent on reclaimed land
- Willing to participate in extension activities
- Interested in plantation or nursery work

Extension Interventions

The extension programme consists of:

- Village meetings
- Awareness campaigns
- Farmer training programmes
- Demonstration plots
- Nursery management training
- Plantation techniques
- Intercropping demonstrations
- Regular monitoring
- Technical guidance

Plantation Programme

Main host plants

- Arjun (*Terminalia arjuna*)
- Asan (*Terminalia tomentosa*)

Recommended spacing:

5 × 5 m

Community Nursery Activities

Villagers participate in:

- Seed collection
- Seed treatment
- Polybag filling
- Nursery bed preparation
- Seed sowing
- Watering
- Weeding
- Plant protection
- Seedling grading
- Transportation

Intercropping System

The following crops are cultivated during the initial years of plantation.

Crop	Purpose
Turmeric	High-value spice crop
Marigold	Flower production
Black gram	Nitrogen fixation
Cowpea	Fodder and pulse
Groundnut	Oilseed and soil improvement

Data Collection

The following information is recorded:

Socio-economic parameters

- Household income

- Employment generation
 - Nursery income
 - Plantation wages
 - Intercropping income
 - Labour requirement
 - Adoption of technology
 - Farmer perception
- Environmental parameters
- Plantation survival
 - Soil fertility
 - Weed suppression
 - Biodiversity improvement

Questionnaire-I

Community Socio-economic Survey

1. Was your family dependent on this land?
 Yes No
2. What crop was mainly cultivated?
 Paddy Vegetables Both
3. Annual household income
₹ _____
4. Was employment available throughout the year?
 Yes No
5. Would you participate in an afforestation programme?
 Yes No
6. Which activity interests you most?
 Nursery
 Plantation
 Maintenance
 Intercropping
7. Have you received any agricultural training earlier?
 Yes No
8. Do you believe afforestation can improve your livelihood?
 Yes No
9. Are you willing to attend training programmes?
 Yes No
10. Would you participate in long-term plantation management?
 Yes No

Questionnaire-II

Impact Assessment Survey

1. Did you participate in the programme?
 Yes No
2. Which activity generated maximum income?
 Nursery
 Plantation
 Intercropping
 Maintenance
3. Present annual household income
₹ _____
4. Has employment increased?
 Yes No
5. Which intercrop produced the highest profit?
 Turmeric
 Marigold

- Black gram
 Cowpea
 Groundnut
 6. Has your family's economic condition improved?
 Highly
 Moderately
 Slightly
 No
 7. Has the environment improved?
 Yes No
 8. Would you continue plantation activities?
 Yes No
 9. Would you recommend this programme to others?
 Yes No
 10. Overall satisfaction
 Excellent
 Good
 Average
 Poor

Results

Socio-economic Status of Farmers Before and After Afforestation

Table 1. Comparative Socio-economic Analysis

Parameter	Before Afforestation	After Afforestation	Percentage Increase
Average Annual Household Income (₹)	92,450	214,380	131.8
Average Employment (Days/Year)	121	248	105.0
Farmers with Year-round Employment (%)	22	81	268.2
Farmers Participating in Nursery Raising (%)	0	76	76
Farmers Practicing Intercropping (%)	0	72	72
Farmers Reporting Improved Livelihood (%)	0	89	89
Farmers Willing to Continue Programme (%)	48	96	100

Annual Household Income by Source

Table 2. Income Comparison

Income Source	Before (₹/Family/Year)	After (₹/Family/Year)
Paddy Cultivation	51,000	—
Vegetable Cultivation	28,500	—
Nursery Raising	—	48,600
Plantation Employment	—	41,200
Turmeric Intercropping	—	82,400
Other Seasonal Labour	12,950	42,180
Total Income	92,450	214,380

Farmer Participation

Table 3. Participation in Extension Activities

Activity	Farmers	Percentage (%)
Nursery Raising	76	76
Plantation Work	82	82
Intercropping	72	72
Plantation Maintenance	68	68
Training Programmes	94	94

Table 4. Preferred Intercrops

Crop	Farmers (%)
Turmeric	46
Marigold	21
Black Gram	14
Cowpea	11
Groundnut	8

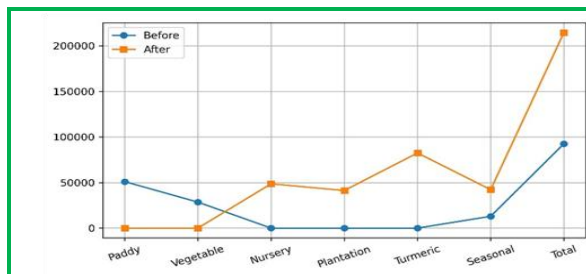


Table 2

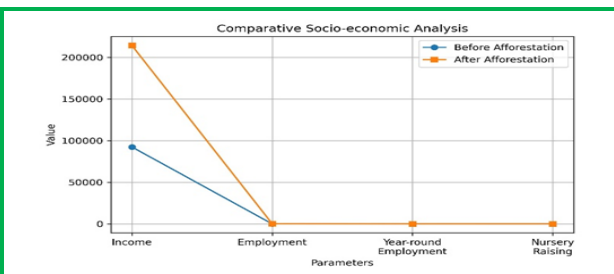


Table 1

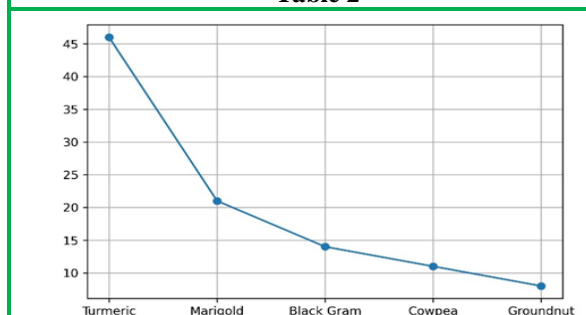


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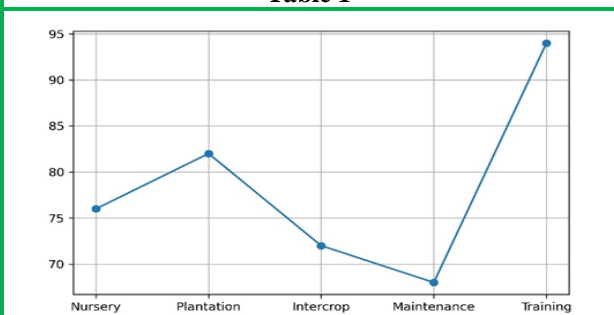


Table 3



Preparation of 1lakh Saplings of Arjun and Asan Plants

Making of 1 Lakh Nursery for Afforestation Program

Percentage Analysis

The illustrative analysis showed:

- Household income increased by **131.8%**.
- Employment increased by **105.0%**.
- Nursery participation reached **76%**.
- Intercropping adoption reached **72%**.
- **89%** of farmers reported better livelihoods.
- **96%** expressed willingness to continue the programme.

Discussion

The illustrative analysis demonstrates the potential benefits of integrating community participation with afforestation on reclaimed coal mine land. Establishment of Arjun and Asan plantations created employment opportunities through nursery raising, plantation work and maintenance. During the early years of plantation establishment, cultivation of turmeric and other intercrops generated additional household income. The sample analysis indicates that diversified livelihood options may substantially increase household income while reducing dependence on seasonal agriculture. Extension activities such as farmer training, demonstrations and technical guidance encouraged greater participation and technology adoption. Ecologically, afforestation contributes to improved soil fertility, reduced erosion, enhanced biodiversity, increased carbon sequestration and long-term restoration of degraded landscapes. Community involvement also promotes local ownership and sustainability of plantation programmes.

Conclusion

Community-based afforestation integrated with Tasar agroforestry represents a promising extension strategy for sustainable rehabilitation of reclaimed coal mine land. Combining Arjun and Asan plantations with nursery development and profitable intercropping can improve employment opportunities, diversify household income and strengthen rural livelihoods while restoring ecological functions. The illustrative analysis highlights the potential impact of this model. However, final scientific conclusions should be based on measured field data collected through baseline and follow-up surveys.

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