



Biodiesel-based Opportunities to Rehabilitate Degraded Lands and Income Generation

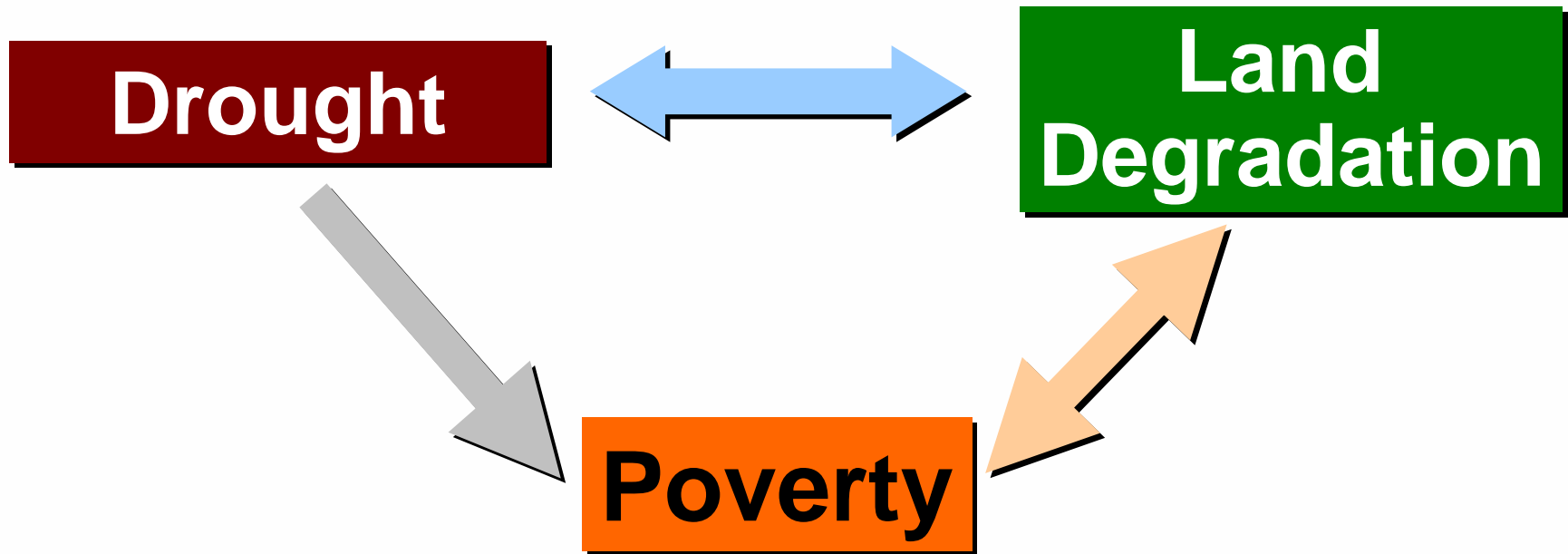


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The Nexus



Water is the Key-Issue

An Entry Point

Integrated Watershed Management

Emerging Issues

- ❖ Food security
- ❖ Water Security
- ❖ Energy security



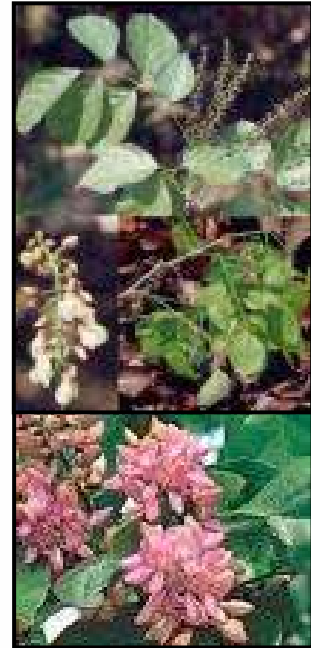
Rehabilitation of Degraded Common Lands

- ❖ Vast areas in India are in need of rehabilitation
- ❖ Few good examples of rehabilitation exist
- ❖ Biofuels are good candidate for rehabilitation

Pongamia Pinnata – An Experience



- Leguminous--N₂-fixing tree widely grown in India
- Grown on river banks, sea coast, and interior dry places upto 1000 m elevation in India
- Starts yielding from 4-7 years and seed yield varies from 10-250 kg tree⁻¹
- Medicinal value and wood is used for agricultural implements
- Oil cake is used as organic fertilizer, leaves are also used for mulching and composting, seed oil is a commercial product and used as biodiesel



- Drought tolerant shrub, oil is used as biodiesel and has medicinal value
- Largest *Jatropha* cultivation in India was in Nashik
- Average yield in Nashik was low (<1 kg tree ≈ 1 - 1.5 t ha^{-1}) as against 9 - 12 t ha^{-1} reported yield
- Grown on productive land
- High labor costs



Development Model

- *Pongamia pinnata* as technology
- Doubling, tripling income is goal
- Women groups as delivery mechanism
- Carbon income as seed money
- Application in poor, arid areas thru watershed, agro-forestry interventions
- Focus on Adilabad district, Andhra Pradesh



Principle

- ❖ *Pongamia* oil used in power generators
- ❖ Carbon income through VERs

Example

- ❖ Chalpadi: 7.5 kVA generator produces 10-12 kWh daily from 5-6 liters of *pongamia* oil
- ❖ Power system run by village women
- ❖ Successful experiment being replicated by state government in 100 villages
- ❖ 900 tCO₂eq sold to Germany
- ❖ Carbon income=1 year income per family



GTZ-ICRISAT-SBT: PPP Initiative

- ❖ Collectors Model
- ❖ Growers Model
- ❖ Empowering the poor people
- ❖ Harnessing value chain benefits for the stakeholders



- ❖ Germplasm collection and evaluation
- ❖ Suitable agronomic practices
- ❖ Demonstrations and data collection
- ❖ Mass Multiplication methods
- ❖ Technological issues



NOVOD-ICRISAT Initiative: Model to Benefit Landless People



- ❖ Collective action for minimizing land degradation
- ❖ CPRs are rehabilitated thru biodiesel plantations with SWM
- ❖ SHGs are formed and would benefit not only from the wages but will have usufruct rights
- ❖ Within six months usufruct rights awarded to SHGs



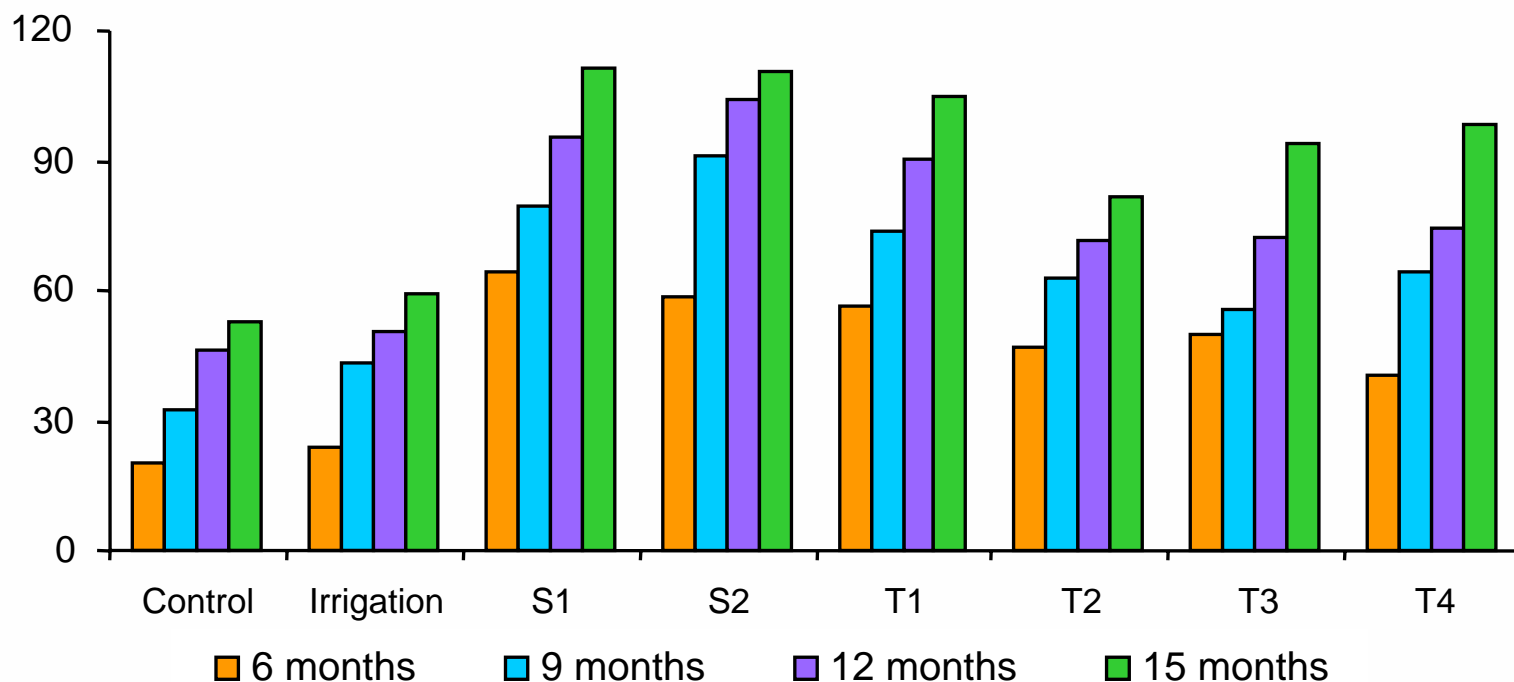
Evaluation of seed samples of *Jatropha* and *Pongamia* for oil content, seed weight and per cent germination

Sl. No.	Sample No.	Source	100 seed weight (g)	% Oil content	Germination %
<i>Jatropha Curcus</i>					
1	IJC-1	Rajgarh	63.8	28.0	10
2	IJC-2	AP	68.2	38.4	90
3	IJC-4	Tamilnadu (Erode local)	44.0	28.6	85
4	IJC-6	Rajasthan	69.5	34.8	78
5	IJC-8	JNKV	72.6	34.7	-
6	IJC-10	MONDC	69.2	31.8	-
7	IJC-11	CHRK-GBR	69.4	34.4	17
8	IJC-12	TFRI	66.5	33.5	-
9	IJC-15	-do-	60.67	33.6	42
<i>Pongamia Pinnata</i>					
1	IPC 1	Bombay	233.2	30.4	90
2	IPC -2	Goa	132.7	21.3	90
3	IPC -4	Banglore	177.0	40.9	90
4	IPC -5	Adilabad	102.4	39.5	90
5	IPC -6	Adilabad (Behranguda)	105.2	32.9	90
6	IPC -9	-do-	101.2	36.6	85
7	IPC -10	-do-	102.0	33.1	85

Effect of mycorrhizal inoculation on growth of *Jatropha* seedlings in nursery

Treatment	Plant height (cm)	Stem girth (cm)	Number of leaves
Inoculated	47	6.5	16
Non-inoculated (control)	35	5.9	12

Plant height (cm) of *Jatropha curcas* from different treatments such as irrigation, spacing, manurial trials, at ICRISAT, Patancheru



Control (no irrigation), S1= 2 X 2 m, S2=3 X 2 m, T1=50 g urea (U) + 38 g SSP, T2= 50 g U + 76 g SSP, T3= 100 g U +38 g SSP, T4= 100 g U + 76 g SSP

Chemical composition of oilcakes analyzed at ICRISAT, Patancheru, India

Nutrients	<i>Jatropha</i> ¹	<i>Pongamia</i> ²
Nitrogen (%)	4.91	4.28
Phosphorous (%)	0.90	0.40
Potassium (%)	1.75	0.74
Calcium (%)	0.31	0.25
Magnesium (%)	0.68	0.17
Zinc (ppm)	55	59
Iron (ppm)	772	1000
Copper (ppm)	22	22
Manganese (ppm)	85	74
Boron (ppm)	20	19
Sulphur (ppm)	2433	1894

Source of oilcake: 1. Coimbatore, Tamil Nadu 2. Powerguda, Andhra Pardesh

On-station Work at ICRISAT, Patancheru

Pests on *Jatropha*

Caterpillars damage



On-station Work at ICRISAT, Patancheru (Contd.) Pests on *Jatropha*



Leaf miner damage



1/12/09

On-station Work at ICRISAT, Patancheru

Pests on *Jatropha*

(Contd..)



Stem borer damage



On-station Work at ICRISAT, Patancheru
Intercropping in *Jatropha* (Contd..)



Pigeonpea intercrop



Oil Seed Cake for Increasing Crop Yields

Grain yield response of soybean to the application of *Pongamia* press cake and inorganic fertilizers



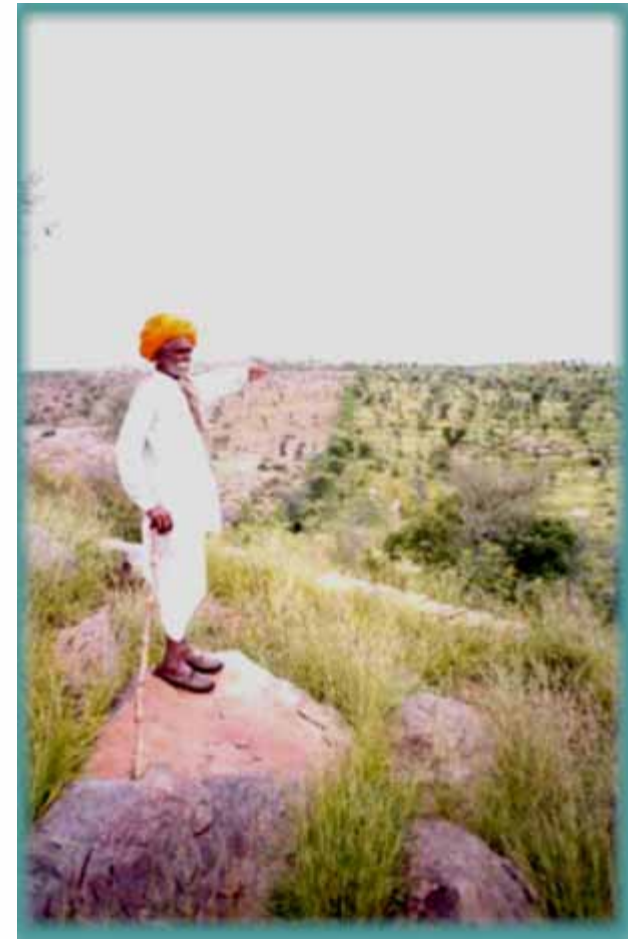
Treatment	N applied (kg ha ⁻¹)	Yield (kg ha ⁻¹)	% increase over farmers' practice	Net benefit over farmers' practice (Rs. ha ⁻¹)
Farmers' practice (DAP – 100 kg)	16	900	-	-
<i>Pongamia</i> press cake (300 kg)	12	1340	49	4230
Fertilizer (Urea – 50 kg)	23	1450	61	6800
½ <i>Pongamia</i> cake (150 kg) + ½ Urea (25 kg)	17	1650	83	7950

Current Scenario

- ❖ Increased demand for biodiesel locally and internationally
- ❖ Increased awareness about biodiesel amongst policymakers and planners
- ❖ Enhanced support from planners
- ❖ Industries are gearing up to handle market demand
- ❖ Processing technologies are available
- ❖ Farmers are looking for alternate crops

Strategy for Operationalizing Biodiesel Initiative

- ❖ Harness the existing material through collective action
- ❖ Develop Wastelands using biodiesel plantations along with soil and water conservation
- ❖ Low quality lands with supplemental irrigation could be brought under biodiesel plantation



Strategy for Operationalizing Biodiesel Initiative *(Contd..)*

- ❖ Undertake vigorous research on various aspects of biodiesel plantations
- ❖ Establish good demonstration-cum-research plots in different agro-ecoregions
- ❖ Good productive lands to be spared for crop production to achieve food security



Where are We for Base Material Production

- ❖ Assessment of existing available material for processing
- ❖ We have no experience or data for growing biodiesel plantations in blocks
- ❖ Lack of identified high-yielding accessions/varieties
- ❖ Suitable agronomic practices for economic production are not available
- ❖ Mass multiplication techniques from high-yielding mother plants are needed

Where are We for Base Material Production *(Contd..)*



- ❖ Suitable agro-ecoregions in India for growing large scale plantations to be identified
- ❖ Pests and diseases on these crops when grown as block plantations
- ❖ Crop yields with irrigation and water requirement are not known
- ❖ Crops for intercropping to be identified







Decentralized Biodiesel Making



Suitable for	: Entrepreneurs, Transport companies and Farmer cooperatives	
Suitable location	: Town and district places	
Feasible capacity	: 1 kl per shift/3 kl per day	
Plant capacity	: Raw material	Cultivation area
1 kl/shift	4 tons of seeds	480 ha
For 3 kl/day	12 tons of seeds	1440 ha



Cost of Biodiesel Project – 1 kl Capacity



Plant and Machinery	US\$
1. Crude oil extraction – 40 t seeds/day	23,333
2. Trans desterification – 10 t biodiesel	55,556
3. Utilities and storage etc	21,111
Basic cost	100,000
Taxes, transport, erection & commissioning	33,333
Total cost of plant	133,333
Civil Construction	
4. Cost of civil construction	44,444
5. Working capital	44,444
Total project cost	222,221

Source: Dhopeswarkar et al. 2006.

Biodiesel Operational Cost

	US\$/L	US\$/L	US\$/L
	300 kl/yr	600 kl/yr	900 kl/yr
Seeds – 4 kg @ \$ 0.11 per kg	0.44	0.44	0.44
Consumables	0.04	0.04	0.04
Fixed cost - at 100%	0.22	0.11	0.07
Operating cost	0.09	0.09	0.09
Total cost	0.79	0.68	0.64
By products sales (-)	0.22	0.22	0.22
Oil cake 3 kg @ \$0.056 = \$0.17			
Glycerine 0.1 kg @ \$0.55 = \$0.052			
Net cost/L	0.57	0.46	0.42
Capacity utilization	100%	100%	100%

Bio-diesel Car



Conclusions

- ❖ Decentralized model for producing and processing raw material
- ❖ Intensive research to optimize productivity on sustainable basis
- ❖ Rehabilitation of wastelands through biodiesel plantations along with soil and water conservation measures
- ❖ Harness existing potential through organized collective action and increased awareness



Thank You