SPECIAL FEATURES

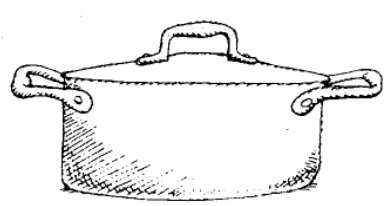
AFFORESTATION OF ARID WASTELANDS THROUGH ENERGY PLANTATIONS: A CASE STUDY FROM INDIA

This paper presents the results of a case study of an energy plantation on arid wastelands carried out by the Gujarat Energy Development Agency (GEDA) in Lathedi village in Kachchh District of Gujarat State in India. The case study reveals that the model of energy plantations on wastelands in the Kachchh region is technically and economically viable and can be replicated in other parts of India and elsewhere.

Introduction

The arid region of India, covering some 310 000 km², comprises about 12 percent of the country's total geographical area. By virtue of its geographic situation, the region is beset with numerous problems that need special attention. Most of the land in this region falls into the category of wastelands.

Afforestation of these wastelands is one of the alternative methods of rehabilitation. Energy plantations are a form of afforestation which could help in stabilizing soil conditions as well as in meeting the increasing demands of the growing human and livestock population for fuel and fodder, respectively. About 93 percent of the village population in India cook with fuelwood, which is collected from the forests. Keeping in view the growing gap between the demand and supply of fuelwood and the need to rehabilitate vast tracts of arid wastelands, the Gujarat Energy Development Agency (GEDA), a semi-government organization established for the promotion of non-conventional energy sources, initiated energy plantations in the Kachchh region of Gujarat. The Kachchh region is the western-most part of India and has an area of 46 120 km². Nearly 74 percent of the total area of the region falls into the category of waste or cultivable wastelands. Kachchh is more or less perennially drought-prone.



Energy plantations by GEDA

Energy plantations have been established by GEDA under the auspices of, and with financial support from, the Department of Non-conventional Energy Resources (DNES), Ministry of Energy, Government of India and the Government of Gujarat. DNES commissions interested governmental and non-governmental organizations to conduct field demonstrations at the national level with the objective of creating awareness about energy plantations at different levels. The plantations also help in environmental protection and in productive utilization of marginal lands. GEDA initiated energy plantations in 1986-87 in Moti Sindhodi village in Kachchh. Energy plantations were subsequently established elsewhere.

GEDA raised energy plantations on 1 366 ha of degraded land in Kachchh over seven years, from 1986-87 to 1992-93, at five different sites. More than 5.2 million seedlings were planted with a 75 percent overall survival rate. The high survival rate was due to good irrigation facilities provided by a number of borewells. These plantations have been a success, particularly in terms of the employment generated for the villagers residing nearby.

Lathedi village energy plantations

The energy plantations in Lathedi village were established by GEDA in 1988-89 with a target of rehabilitating 1 299 ha of village community land. De *jure*, the Revenue Department of the Government of Gujarat owns the land, but *de facto*, the villagers use it as common land. The Revenue Department leased the area to GEDA for 15 years at a token rent of one Indian rupee per year. GEDA used the problem-solving action-oriented approach for rehabilitating the wastelands of Lathedi village with the main focus on soil and water conservation and biomass production. The emphasis is more on environmental than on monetary benefits. Before the plantations were established, the area was badly eroded and devoid of organic carbon and the water available was unsuitable for irrigation.

GEDA received a grant of Rs 5million (US$385 802) from DNES in 1988 for energy plantations in Lathedi. By the end of 1992-93, owing to lack of funds, only 460 ha of plantation had been undertaken by GEDA. A total number of 1.4 million seedlings of 41 different species, viz. *Acacia* sp., *Azardichta indica, Casuarina equisetifolia, Leucaena leucocephala, Pongamia pinnata, Prosopis cineraria*, were planted during the period 1989-90 to 1992-93, with an overall survival rate of 84 percent. In 1988-89, only pre-plantation activities were undertaken. A total of Rs 4.915 million was spent on the plantation of 400 ha of wastelands during 1988-89 to 1992-93 – an expenditure that also includes recurring (maintenance) costs incurred during this period. A further 60 ha of energy plantations were undertaken up with support from the Gujarat Government under its Integrated Rural Employment Programme (IRDP).

Afforestation cost. The energy plantations in Lathedi employed two different spacings, 1.5 x 1.5 m and 2.5 x 2.5 m, depending on the species planted. In the former, 4 444 plants and, in the latter, 2 500 plants were raised per hectare; therefore, the cost of each plantation varied according to the spacing and the number of plants per

ESTIMATES OF OVERALL COST OF ENERGY PLANTATIONS ON ARID WASTELANDS OVER A FOUR-YEAR PERIOD, 1989-90 TO 1992-93 (IN RS/HA)

Type of expenditure	Cost of raising plantation	
	4 444 plants/ha	2 500 plants/ha
Raising seedlings (1989-90)	2 000	1 000
Land preparation (1989-90)	4 000	3 000
Planting (1989-90)	4 600	2 370
Maintenance (1989-90 to 1992-93)	8 400	5 700
Overall expenditure	19 000	12 070
Inflated overall expenditure (at 1995-96 prices)	32 050	20 235
Average plantation cost/plant (at 1995-96 prices)	7.20	8.10

Source: GEDA Office at Bhuj, Kachchh District, Gujarat, India.

hectare. The various types of expenditure (establishment and recurring) incurred during the first four years of plantation are presented in the Table below. The expenditure figures are calculated separately for planting 4 444 plants and 2 500 plants per hectare, and are based on the overall estimates made by GEDA officials.

A number of nurseries for raising saplings of different species were established in the plantation area itself. The various operations for this included site clearing, fencing, providing irrigation facilities, preparation of nursery beds, etc. Land preparation included such activities as survey and demarcation; trench fencing; ploughing; levelling; development of irrigation facilities (24 borewells); formation of irrigation channels; and application of manure; as well as the purchase of implements, manure and other supplies. The plantation operations included alignment and digging of pits; transport of saplings to the sites and planting; watering; application of insecticides; soil working; and protection and maintenance of the nurseries. The various maintenance operations performed in subsequent years included raising of saplings for casualty replacement; watering during the months of February to June and October; and soil working, manuring and protection.

Benefits from energy plantations. A group discussion with the beneficiaries of the energy plantations and the GEDA officials revealed that benefits had already started accruing from the plantations in the form of both tangible and intangible benefits.

Tangible benefits. The plantations had not started yielding many tangible benefits since they were only four years old at the time of data collection for this case study. However, certain benefits such as grass and fodder were available to the villagers from the plantation sites. Owing to good protection measures, grass had started growing in the area, which had before been devoid of any vegetation. In 1993-94, 700 000 kg of grass was sold to the villagers at Rs 2 to 2.75/kg. Previously, the villagers used to buy grass for their livestock from the nearby markets. Green fodder from many tree species and fuelwood from pruning operations were also available to the villagers.

The villagers, as well as the GEDA officials, expect that in future they will get many more benefits, in the form of timber, fuelwood , fodder and fruits. They are also sure that they will be self-sufficient in their day-to-day needs for different forest products. The trees have registered very good growth in adverse conditions.

Intangible benefits. The people of the nearby villages perceive many intangible benefits from the plantation area. For example, the area, once devoid of any vegetation, has become green and presents a soothing view in an arid region. According to them, there are more intangible than tangible benefits from the plantation: an immensely ameliorated microclimate in terms of temperature and humidity; lowered wind velocity, which has a direct positive effect on humidity; soil and water conservation measures have increased the availability of soil moisture for tree growth and have also increased the productivity of the soil; whereas previously there was no wildlife, now many wild animals and bird species inhabit the plantation area; and, finally, the area's formerly desolate look has now improved and people from nearby areas are being drawn to the plantation site for picnics.

Protection measures. Soil and water conservation measures (building earthen check dams, contour trenching, cross bunding and ploughing along the contour) have been undertaken in the entire plantation area. For protection against grazing and fire, people from the nearby villages have cooperated with GEDA officials. Villagers collect grass from the plantation area to avoid grazing by animals, thereby encouraging stall-feeding. Casuarina equisetifolia, Sesbania sp. and other species are raised along the fences to protect seedlings against the hot, desiccating and salt-laden winds. GEDA has also launched educational and extension activities aimed at making the local people aware of the importance of plantations.

Conclusion

The model of energy plantations on wastelands in the Kachchh region can be replicated in other parts of India, and worldwide, where wastelands are available in abundance. A large area of wastelands has been converted from desolate to green. The energy plantations have been found to be feasible from both the economics and the environmental viewpoint. The environmental benefits from the energy plantations in terms of microclimate amelioration and improved ecological conditions are expected to outweigh the

monetary benefits in term[illegible] availability of fuelwood, fodder, timber and other tree produces. Such plantations can be financed by various governmental agencies as well as by the financial institutions with the involvement of non-governmental organizations and people at the grassroots level.

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IEA BIOENERGY

IEA Bioenergy has already been featured in previous issues of Forest Energy Forum (John Tustin's guest editorial in FEF 6, information on two of IEA Bioenergy's tasks in FEF 7, etc.). Building on this, we have decided to dedicate a special section to IEA Bioenergy's activities, making it a regular feature of future issues of Forest Energy Forum.

The 2001-2003 Research Programme

Work in IEA Bioenergy is carried out through a series of Tasks, each having a defined work programme. Each participating country pays a modest financial contribution towards administrative requirements, shares the costs of managing the Tasks and provides in-kind contributions to fund participation of national personnel in the Tasks.

Each task is led by one of the participating countries (Operating Agent [OA]) with technical effort coordinated by a Task Leader (TL). The work is directed by an Executive Committee.

For the period 2001-2003, the work is structured into 12 Tasks. Most Tasks have a common duration of three years. The ongoing Tasks that have been agreed to date, with the relevant contact details, are as follows:

Task 28: Solid biomass fuels standardization and classification
OA: European Commission
TL: Andy Limbrick
e-mail: a.limbrick@dial.pipex.com

Task 29: Socio-economic aspects of bioenergy systems
OA: Croatia
TL: Julije Domac
e-mail: jdomac@eihp.hr

Task 30: Short-rotation crops for bioenergy systems
OA: Sweden
TL: Theo Verwijst
e-mail: theo.verwijst@lto.slu.se

Task 31: Conventional forestry systems for sustainable production of bioenergy
OA: Canada
TL: Jim Richardson
e-mail: jrichardson@on.aibn.com

Task 32: Biomass combustion and co-firing
OA: The Netherlands
TL: Sjaak van Loo
e-mail: s.vanloo@mep.tno.nl

Task 33: Thermal gasification of biomass
OA: United States
TL: Suresh P. Babu
e-mail: suresh.babu@gastechnology.org

Task 34: Pyrolysis of biomass
OA: European Commission
TL: Tony Bridgwater
e-mail: a.v.bridgwater@aston.ac.uk

Task 35: Techno-economic assessments for bioenergy applications
OA: Finland
TL: Yrjö Solantausta
e-mail: yrjo.solantausta@vtt.fi

Task 36: Energy from integrated solid waste management systems
OA: United Kingdom
TL: Niranjan Patel
e-mail: niranjan.patel@aeat.co.uk

Task 37: Energy from biogas and landfill gas
OA: Switzerland
TL: Arthur Wellinger
e-mail: arthur.wellinger@novaenergie.ch

Task 38: Greenhouse gas balances of biomass and bioenergy systems
OA: Austria
TL: Bernard Schlamadinger
e-mail: bernard.schlamadinger@joanneum.ac.at

Task 39 Liquid biofuels
OA: United States
TL: Don Stevens
e-mail: don.stevens@pnl.gov

IEA Bioenergy Annual Report 2000

The 2000 Annual Report of the IEA Bioenergy Executive Committee has just been published. A presentation of the bioenergy activities within Task 18 "Conventional forestry systems for bioenergy" is a special feature of this year's report.

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Meetings

The 46th Meeting of the Executive Committee of IEA Bioenergy was held in Zagreb, Croatia, from 7 to 9 November 2000. Mr M.A. Trossero, Senior Forestry Officer (Wood Energy), represented FAO at the meeting. Among the subjects discussed was the status of the activities implemented within the framework of the FAO-IEA Bioenergy Memorandum of Understanding (MoU). It was concluded that, despite its short tenure, the collaboration between FAO and IEA Bioenergy is giving the benefits expected in terms of: higher visibility, improved exchange of information and better accessibility to new areas of expertise. Mr Trossero also mentioned that most of the activities initiated are in their initial phase and there is still great potential for improvement and new cooperation.

The election of the Chairman and Vice-Chairman of the IEA Bioenergy Executive Committee took place and Dr J. Spitzer (Austria) and Dr K. Maniatis (European Commission), current Chairman and Vice-Chairman, respectively, were confirmed in their positions for 2001.

The second meeting of the Comité européen de normalisation (CEN) on "Solid Biofuels", Working Group 1 "Terminology, Definitions and Descriptions", was held in Berlin, Germany, on 13-14 February 2001. Mr M.A. Trossero, Senior Forestry Officer (Wood Energy), represented FAO at the meeting as an observer. The meeting was organized by CEN with the support of IEA Paris and IEA Bioenergy Task 28: "Solid biomass fuels standardization and classification".
[*Please see under Events of Interest for more information on this meeting.*]