A SYSTEMS APPROACH TO INTEGRATED RURAL ENERGY PLANNING AT MICRO-LEVEL FOR A TRIBAL VILLAGE IN CHHOTANAGPUR

by

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पूज्य माता पिताजी के
चरण कमलों में
सादर समर्पित

DEDICATED TO
MY PARENTS

CERTIFICATE

This is to Certify that the thesis entitled **"A SYSTEMS APPROACH TO INTEGRATED RURAL ENERGY PLANNING AT MICRO-LEVEL FOR A TRIBAL VILLAGE IN CHHOTANAGPUR"**, being submitted by Mr. Rajneesh Arora for the award of the degree of DOCTOR OF PHILOSOPHY in **CENTRE FOR RURAL DEVELOPMENT AND APPROPRIATE TECHNOLOGY**, Indian Institute of Technology, Delhi, is a record of bonafide research work carried out by him. He has worked under our guidance and supervision in conformity with the rules and regulations of this Institute. The research report and results presented in this thesis have not been submitted elsewhere for any other degree or diploma.

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ABSTRACT

The main objective of this study is to evolve a methodology for making an optimal choice of energy technologies subject to the various constraints in a village level economy of a tribal region.

The tribal area of Bihar i.e. Chhotanagpur was selected for the present study. Village CHAPATOLI in Bishunpur Block of Gumla District was taken for an intensive study.

A detailed energy survey was conducted to identify the energy consumption and production network in the village.

To test the performance and acceptability of various traditional and new energy technologies different trials, demonstrations and investigations were conducted.

The energy system in the village is very complex. There are important interconnections among the different subsystems. Considering the complexity of the system and the extent to which reliable information is available in the village context with reference to the pattern of supply and consumption of energy, a simple Mixed Integer Linear Programming model is adopted to analyse the cost implications of the various options.

Different choices considered in respect of the supply side, demand side, technology options, decision variables,

labour, firewood, electricity are studied by sensitivity analysis through the construction of a number of scenarios. The model is also used to assess the implications of government subsidy for various new technologies in terms of corresponding variations in the optimal allocation pattern for energy. The results of these studies are presented and discussed for checking out the relative robustness and resilience of the base case scenario.

cost parameters, objective function and constraints in the model are explained. Basic assumptions made in formulating the programming model for the study as well as its limitations are also pointed out.

An assessment of long term energy requirement is a pre-requisite for effective planning in the energy sector. Energy demand is dependent on the demand of different sectors of the economy. In order to link the energy model with the rest of the village economy, the input output analysis technique is used. A structural matrix of input coefficients for the 5 major sectors of village economy (viz., Agriculture, Village Industries, Animal Husbandary, Forestry and Services) is generated using survey data for the year 1989 as an approximation for the base year 1990. This technique is invoked to compute the inter-sectorially consistent gross output requirements of different sectors for the base-year and target years of 1995 and 2000 A.D. This forms the basis for the assessment of demand parameters in each sector of the economy for the reference years of interest.

The optimal allocation of energy supply for the base year 1990 and target years 1995 and 2000 A.D. are presented as a base-case scenario together with its variants. The impacts of changes in availability of resources like manual

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