An economic value chain model for energy and livelihood security in rural India: A framework for appraisal

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Schema of Presentation

- Objective
- Literature Review
- Economic Value Chain Model
- Survey Details – Madhya Pradesh[1]
- Case Study – Khargaon, MP
- Value Analysis and Recommendations

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Objective

- To produce the optimal possible mix of energy carriers and supply them to domestic and industrial users in large villages/village clusters (with a population of above 5000) and towns;
- in a way that …
  - it makes use of the available resources efficiently and effectively
  - it improves livelihoods of the people and ensures livelihood security
  - the energy generated is largely environment friendly

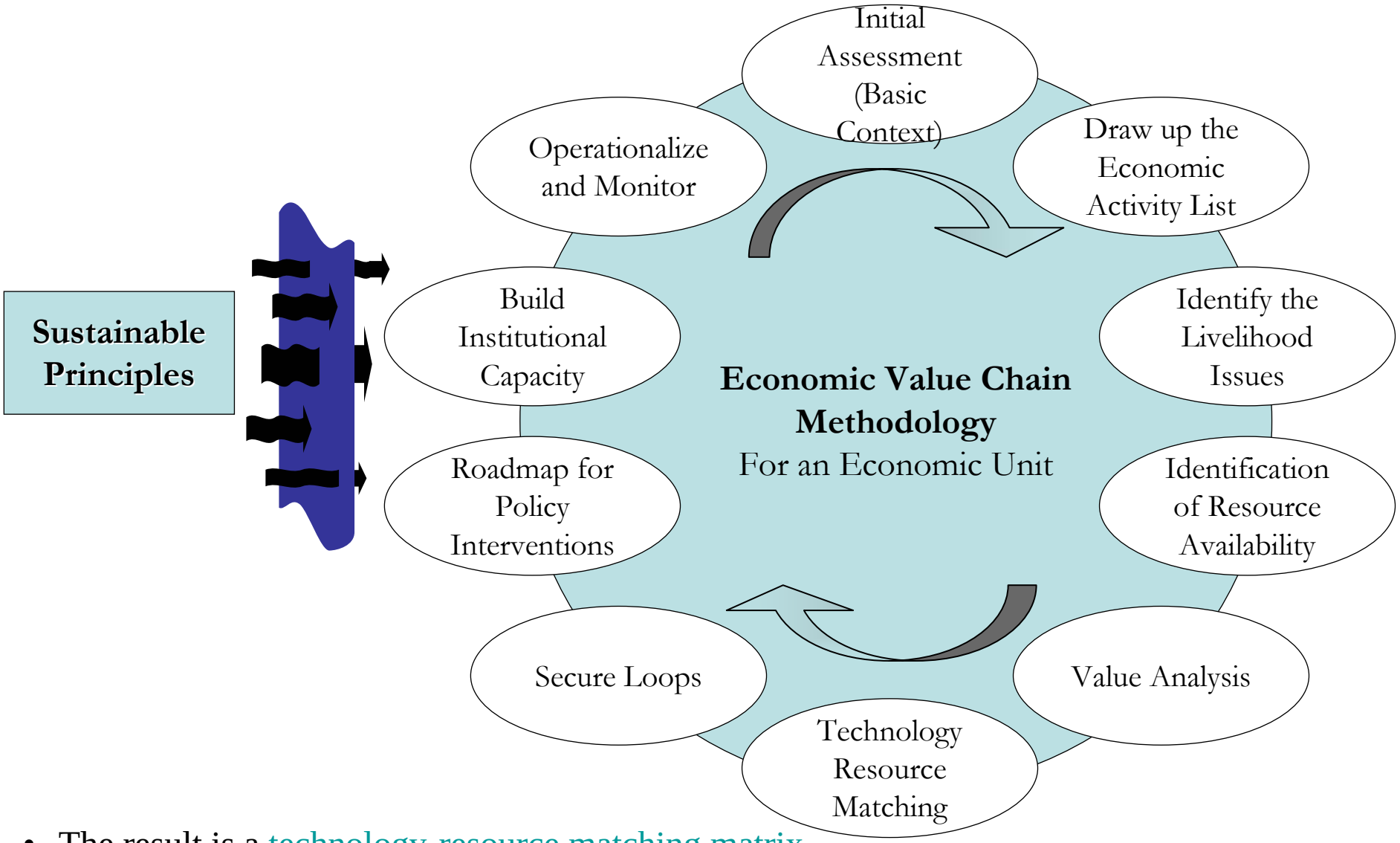
- The large villages/ towns will be referred to as the Economic Unit

- Focus on value intensification and value enhancement

Literature Survey

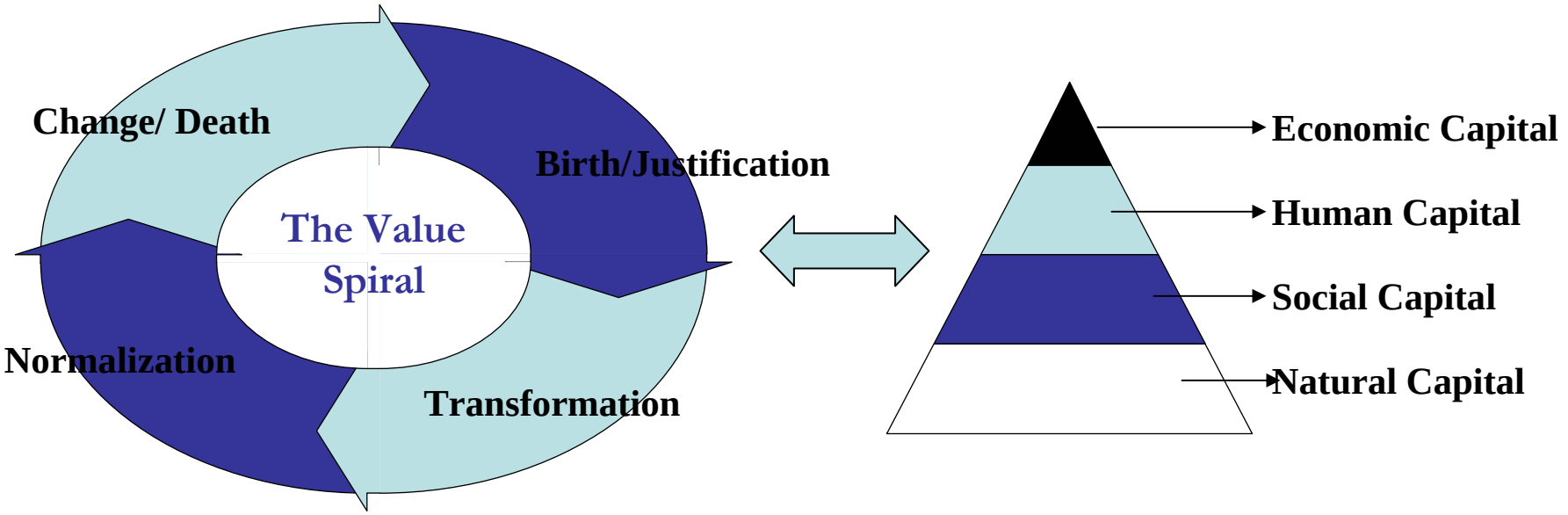
- The value chain approach (Porter, 1985)
- This concept is modified to consider a village as an economic unit
  - identify key activities that form the value chain
  - has the potential of creating a sustainable advantage
  - Objective: to maximize activities in terms of energy and livelihood sustainability for the people of that economic unit
- Review evidence
  - Value Analysis involves not only calculating the cost vs. economic benefits, but also the social benefits, and environmental benefits both short term and long term
  - Rural energy systems must advance rural economic growth that is
    - economically efficient, need-oriented and equitable, self-reliant and empowering, and environmentally sound (AKN Reddy, 1999)
    - Achieved by optimal use of the available technology, economic, human, social and natural capital.
    - Social capital refers to the collective value of all social networks and the inclinations that arise from these networks to do things for each other (Robert Putnam, Bowling Alone, 2000)

Methodology



- The result is a technology-resource matching matrix

Value Analysis - The Value Spiral of Social Phenomenon



Net Potential Value (NPV) = f(Technology Output, Economic Capital, Human Capital Social Capital, Natural Capital)

NPV = k (T*H*S*E*N)

Technology Output (T) = f(Resource usage, efficiency, reliability, accessibility, affordability)
Human Capital (H) = f(Human Capabilities, Education/ Training, Applications, Innovation and R&D)
Social Capital (S) =f(Relational capabilities, standardization and universalization, employment, livelihood pattern)
Economic Capital (E) = f(GDP, FDI, GNP,…)
Natural Capital (N) = f(natural resource indicators related to usage and consumption…)

All the factors have a multiplier effect on the net value

Source: K^3 Theory of Value and Networks (unpublished – Kumudhini Ravindra, Gopika Kannan. and Jibananand Khuntia)

Technology Options

Energy carrier	BioGas	Electricity		
Technology Options	Biomass reactors	Biogas – through use of engines	Co-generation	Solar PV, Wind farms, Tidal farms, small hydel
Inputs	Biomass (animal waste and leaf litter)	Animal waste and Leaf litter	Industrial effluents, etc	Solar radiation, wind, ocean waves, hydro power

Energy carrier	Biodiesel, Ethanol	Methane (CNG)	Hydrogen Fuelcell	Synthetic Oil
Technology Options	Biodiesel plants, Algae farms at generation sites	Extraction from Biogas produced from reactors	Fuel cell Technology	Fischer-Tropsch Synthesis
Inputs	Jatropha etc, algae	Biomass, animal waste etc	Hydrogen from Hydrogenase bacteria	Coal / Coke

Technology is chosen to maximize the dimensions of to Energy Security at rural level (Consumer)

Case Study

An illustration of the economic value chain model

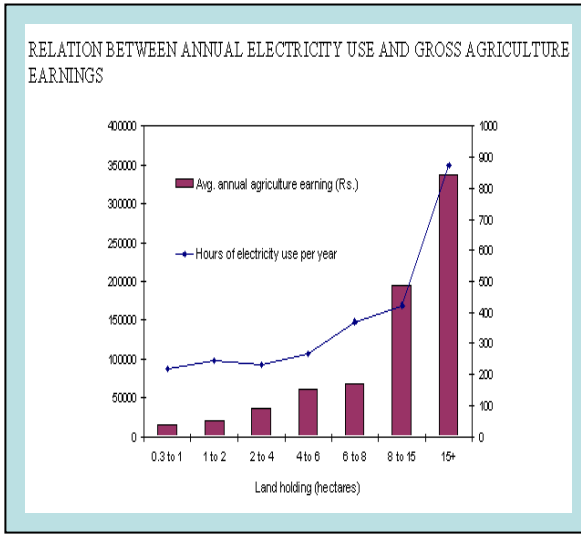
Khargaon, MP, India

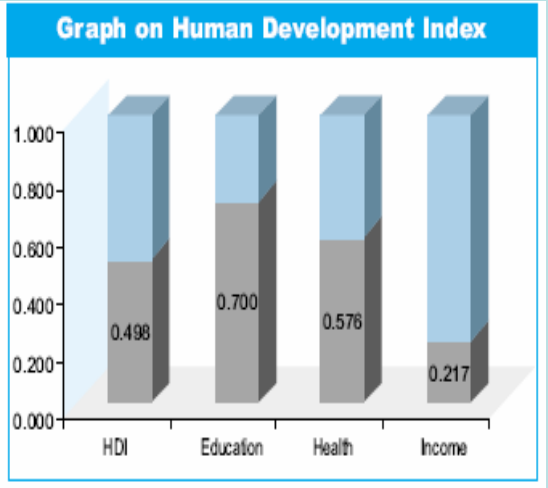
Khargaon (Western Nimar) region is on the southern banks of river Narmada.

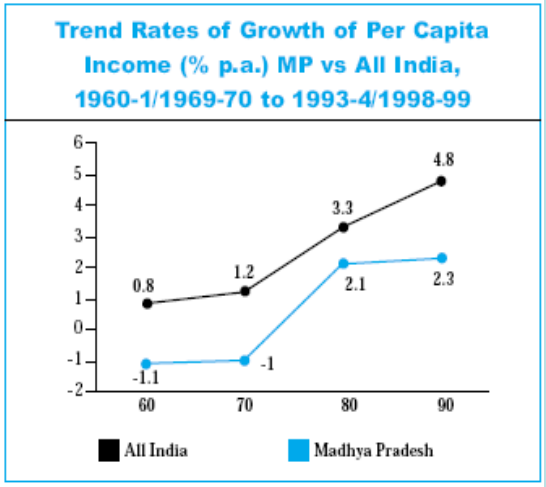
- The results are based on a sample of 554 farmers, from 204 villages in 17 districts of MP, surveyed in the year 2003
- The land division – Marginal – 0.1 to 1.0 hectare(ha); Small – 1.01 to 2.0 ha; Semi medium – 2.01 to 4.0 ha; Medium – 4.01 to 10.0 ha; and Large – 10.01 and above ha.
- Pump irrigated land: 12.8% of the land sown
- Rain fed land: 44.89% of the land sown
- Total land sown in MP: 59.03 %

Basic Context

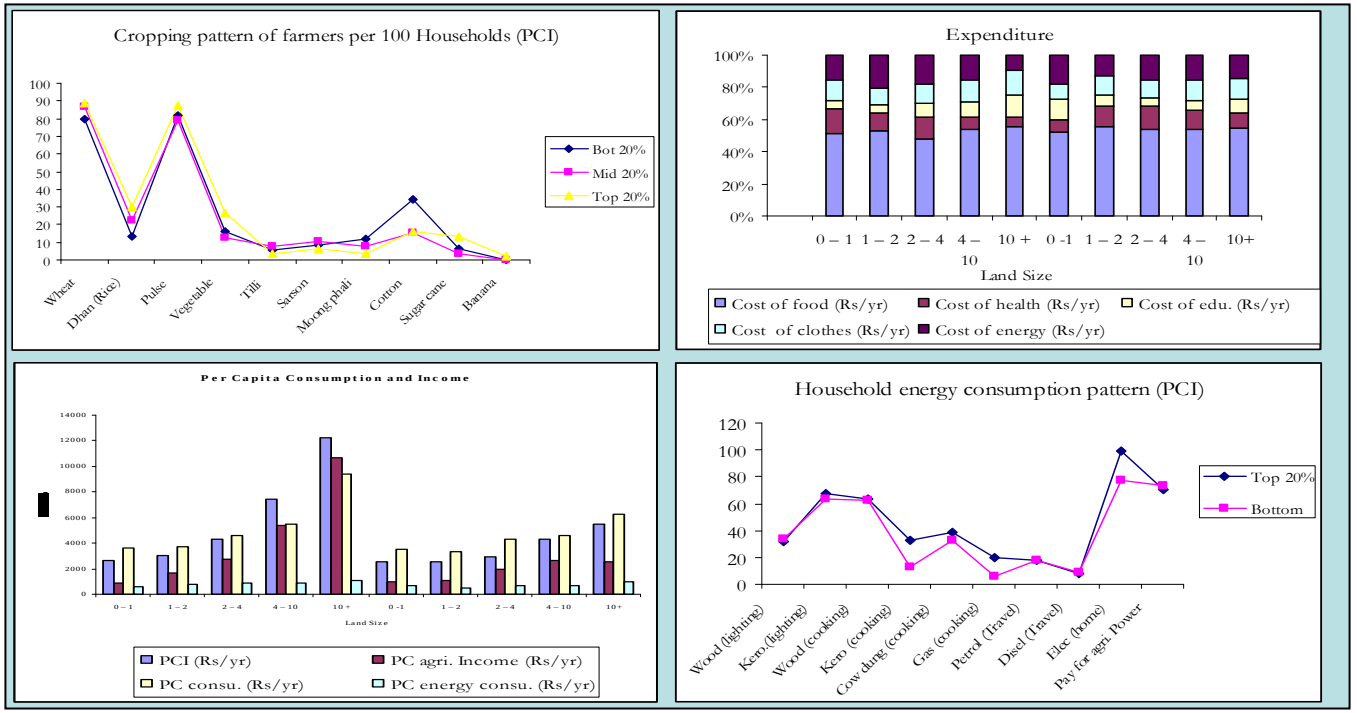
- Crop Zone – Cotton, Jowar
- Soil type – Medium Black (medium)
- Agriclimatic zone – Nimar Plain
- Rivers – Narmada, main river flowing about 100 km, Kunda & Veda
- Irrigation projects – Dejla-Devada, Garhi-Galtar & Ambaknala
- Agricultural Products – Cereals (wheat, jowar, makka), dhan, pulses, vegetables, moongphali, cotton, soyabean and sugarcane
- Economic Activities – Agriculture, Animal rearing, Handicrafts, manual labour, cottage industries, …







Survey Results



- Three categories for livelihood support - landless and marginal farmers, tribals & women
- Agricultural products to focus on – Soyabean, **Mustard, Cotton**, Wheat, Paddy, Pulses, Jowar, Fruits and Vegetables, Spices, cultivated medicinal and aromatic plants, **NTFPs (tendu, mahua, amla, harra),** gathered medicinal and aromatic plants, bamboo and grasses, **timber** (CP Teak and others)
- Livelihood alternatives – agricultural skills and livestock rearing skills, vocational training, **operation and maintenance of energy systems**, **agri-processing**, and natural resource based handicrafts (wood, bamboo, metal)

Value Analysis and Alternatives for Khargaon, MP

Technology	Biogas	Grid Electricity	Electricity by Biogas	Electricity by RES	Biodiesel	Ethanol	Methane (CNG)	Hydrogen Fuelcell	Synthetic oil
Accessibility Index									
Affordability Index									
Reliability Index									
Availability Index									
Efficiency									
Acceptability by consumer									

Index Score — High — Medium — Low

- **Economically feasible alternatives**
  - For short term – Promote Biogas and electricity by biogas, RES (Renewable energy sources) like PV Cells and small hydel
  - For long term – invest in bio-diesel crops on existing waste or non-irrigated land
- This is substantiated by other research literature as well
- **Benefits (Sample)**
  - Social – increasing employment among the marginal and landless farmers, tribals and women
  - Environmental – increasing credits in Carbon Trading at a national level
  - Economic - entrepreneurship or cooperative structures for use of agricultural waste

Operationalization

- Technology Mix (Energy Package)
  - 5000 m3/d of biogas plants also providing 50 ton/d of rich manure for the farmers
  - Several small hydel plants of the capacity of 100kW to 1MW plants set up at identified sites
  - 1.2 MW equivalent of producer gas based – electricity generation /irrigation systems
  - Initial 2500 ha of land in the target area (wasteland and non-irrigated land) to be used for growing tree cover and biodiesel crops like pongamia, jatropha…
  - Providing Solar PV cells through a range of pricing options (like input-output exchange, prepaid, “Rs.5/day”, etc) to enable payments by all categories of consumers
  - Enabling value enhancement activities like rural industries and commercial activities (agri-processing, handicrafts, and so on…) in the region
  - Evolve a natural resource database, its use, optimization and decision making support
- Train the local villagers for operation and maintenance of the system
- Institutional set up to be created with the participation of the locals to ensure maximum support for the activities

To Secure loops… and to ensure long term sustainability

- Ensure the byproducts produced in one technological system is fed into other systems to make the entire process more efficient… (eg. Biogas sludge to be used as fertilizer)
- Ensure village level participatory resource appraisal and plans for local resource use involving
  - Land use
  - water harvesting and recharge
  - domestic electricity distribution
  - domestic and irrigation water distribution
  - water recharge through watershed approach
- Address possible barriers that would crop up at every stage
  - Grass-root level barriers
  - Financial mechanisms
  - Policy impact and policy level barriers

Conclusions

- This model provides a methodology to identify the optimal mix of energy carriers that maximize both energy and livelihood security
- The model in its final form would be able to quantify the Value Potential for any activity
- The energy options identified are all highly environment friendly and with long term sustainability
- The model does not just prescribe technology options but also suggests value enhancement activities to ensure livelihood security
- It also addresses operational issues that one would invariably face like the education and empowerment of the people, maintenance and upkeep of the proposed structures and systems, stakeholder commitment and making energy alternatives attractive and economically viable in the market
- Policy makers can draw on this model to develop and enhance the existing policy options (for example NREGA)

Thank You

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