A woman in a red long-sleeved shirt and a patterned skirt is harvesting wheat in a field. She is holding a bundle of wheat stalks. In the background, another person is visible working in the field. The field is filled with golden wheat stalks, and there are some green plants in the distance.

**A Feasibility Study on the Application of  
GREEN TECHNOLOGY FOR SUSTAINABLE  
AGRICULTURE DEVELOPMENT: Assessing the  
policy impact in selected APCAEM-member countries**

**Gunjan Gautam  
Kathmandu, Nepal**



# Background

- Green Technology (GT) - environmental healing technology that reduces environmental damages, which contributes to both poverty reduction and sustainable agricultural development.
- The study accommodates MDGs 3 goals, eradicate extreme poverty and hunger (G1); promote gender equality and empower women (G3); and ensure environmental sustainability (G7).
- The study heavily focuses on environmental concerns and increasing demand for green production for raising income and achieving sustainable agricultural development.



# Objectives

- Identifying appropriate technology suitable for income generation through sustainable agriculture;
- Examining the impact and implications of national policies on GT;
- Diagnosing policy-level impact of GT on rural income generation under the sustainable agricultural development framework;
- Reviewing the challenges and available policy options for the adoption of GT

A woman wearing a red long-sleeved shirt and a patterned sarong is harvesting rice in a field. She is holding a bundle of harvested rice stalks. In the background, another person is visible working in the field. The field is filled with golden rice stalks, and there are terraced fields in the distance.

## Green Technology and Their Interlinkages

- Technology for environment-friendly agriculture
- Agriculture technology and poverty reduction
- Green Technology and rural environmental concern
- Income generation especially of farmers
- Linking gender dimension



# Green Technology and Their Interlinkages

- **Technology for Environment-Friendly Agriculture**

- As good agricultural land is already farmed, the natural resource availability for further farming expansion is exhausted.
- Worldwide urbanization, higher costs of energy, population growth that damage environment have necessitated the development of technology-driven energy and cost efficiency mechanism.
- Need is to achieve sustainable agriculture that obtain higher yield and increase income without affecting the environment.



## Green Technology and Their Interlinkages (Cont....)

- **Agriculture Technology and Poverty Reduction**

- Major cross country analysis (Thirtle et al., 2001) shows, on average, every 1% increase in agricultural yield reduce number of people living on less than U.S.\$1 a day by 0.83%.
- It is a challenge to sustain and expand agriculture sector's unique poverty-reducing power in terms of increased production and decreased average cost.
- Sustainable agriculture integrates three main goals – environmental health; economic profitability; and social and economic equity.
- Among the available technologies such as organic agriculture, biotechnology etc., the challenge is to decide suitable, affordable, and competitive technology.



## Green Technology and Their Interlinkages (cont...)

- **Green Technology and Rural Environmental Concern**
  - Against massive environmental degradation, the challenge is to ensure people's right to food security by guaranteeing that present and future generations have equal access to the capital, human and natural resources.
  - Adequate allocation of resources is necessary to channel science & technology into rural areas for encouraging farmers to replace the use of chemical pesticides and fertilizers through organic farming.
  - As ecologically sound farm management practices rely on low levels of inputs, indigenous knowledge, and appropriate technologies, skill on agro-ecology for sustainable yield should be imparted.



## Green Technology and Their Interlinkages (cont...)

- **Income Generation Especially of Farmers**

- Improvements in agricultural technology can have significant impact on long-term growth (world agriculture has met food needs of a six fold increase in world population over past 200 years).
- The GT is technology that supports yield-increase per hectare, releases labor for employment in non-farm sector, and helps in increasing farmers' income. With such considerations independent inputs, processes and services, projects, etc can represent technological interventions.
  - ICRIASAT shows that the addition of boron and sulphur in soil has resulted in 28 to 70% increase in yields in Indian states.
  - Mobile-lady in B'desh who provides door-to-door service for testing of water pH to find out status of shrimp pond also helps crop cultivators in soil pH testing .
  - Watershed development as a model for integrated genetic and natural resource management has improved rural livelihoods in drought-prone areas.





## Green Technology and Their Interlinkages (cont...)

- **Linking Gender Dimension**

- Much of women's labor is unpaid in the APCAEM region where informal sector activities are ignored in national economic statistics.
- The policy support to improve the efficiency of women's involvement in such diversified areas is inadequate.
- A proper understanding of gender dimensions with regards to the need for involving women as a leader and professional in the transfer of new technologies and practices should be recognized.



# Methodology

- Based on both primary and secondary sources of information
- Feasibility study attempts to identify the gaps, if there are any, in the application of Green Technology and attempts to justify their feasibility based on the results from experiments and experiences with concerned technology.
- Recommendations are largely based on qualitative methods and on an operational definition of sustainability using priority indicators.
- The review of selected regulatory measures in the selected countries is made to find out their strength and weaknesses to facilitate GT initiative.



## Methodology (Cont...)

- Selection of Technology

- Technology has been selected on the basis of criteria suggested by Robert C. Wicklein i.e.

- System independence
    - Image of modernity
    - Individual vs collective technology
    - Cost of technology
    - Risk factor
    - Evolutionary capacity of technology
    - Single purpose vs multiple purpose technology



## Methodology (Cont...)

- **Situation analysis**

- Situation analysis of selected technology have been carried out on the basis of

- Current performance
- Policy
- Cost benefit analysis
- Performance indicators



## Status of GT in APCAEM member countries (India, Malaysia, Nepal)

- Demand for high value crop is increasing but high transaction cost and conditionality have undermined gains from trade.
- Absence of appropriate technology has reduced scope of gains from trade.
- Misuse of modern farming input has created environmental problem.
- So challenge is to achieve agricultural growth through GT



## Status of GT in APCAEM member countries (India, Malaysia, Nepal) (Cont.....)

- Attempt is being made to promote GT in APCAEM member countries
- Malaysia has recognized and is promoting renewable energy as fifth fuel.
- Nepal has biotechnology policy which focuses food security and poverty alleviation
- India has invested large amount of money for R&D of GT

A woman wearing a red long-sleeved shirt and a patterned sarong is harvesting rice in a field. She is holding a bundle of harvested rice stalks. In the background, another person is visible working in the field. The text is overlaid on the top half of the image.

# Status of GT in APCAEM member countries – Feasible Green Technologies

## A. Solar Photovoltaic

- Provides clean decentralized electricity production option. The new generation of solar energy can be one of the most affordable and efficient energy sources in the future.
- Daily Solar Incidence
  - India → 4-7 kWh per square meter
  - Malaysia → high by world standards.
  - Nepal → has become reliable source of energy in rural areas



## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### B. Wind Energy

- India estimates total wind generation capacity of 45,000 MW
- In Nepal river corridors have been observed to have high wind potential
- In Malaysia the availability of wind resource varies with location.





## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### C. Biofuel

- Both Malaysia and India have already started to produce biofuel feedstock.
- Nepal has announced through budget speech of 2008/09 to produce such feedstock

### D. Biogas

- India's biogas potential is estimated to be 12 million biogas plants
- Nepal carries the potential of 1.9 million biogas plants.
- In Malaysia Palm Oil Mill Effluent can generate 177 MW

A woman wearing a red long-sleeved shirt and a patterned sarong is harvesting rice in a field. She is holding a bundle of harvested rice. In the background, another person is visible working in the field.

## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### E. Micro and Small Hydropower

- Hydropower plants ranging from maximum capacity of 500 kW in Nepal to 25 MW in India
- Small hydropower potential approximating 15,000 MW exists in India.
- Hydropower potential of Nepal is believed to be 42000 MW.
- In Malaysia hydropower potential of 25000 MW was identified till the end of 2001

A woman wearing a red long-sleeved shirt and a patterned sarong is harvesting rice in a field. She is holding a bundle of harvested rice stalks. In the background, another person is visible working in the field.

## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### F. Biomass

- India estimates biomass availability of 600 million tons from agriculture and forest residues
- Malaysia's biomass based energy generation capacity was reported 488 MW in 2000
- Improved Cooking Stoves in Nepal is very successful and it uses biomass.



## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### G. Solar Thermal, Improved Water Mill, Geothermal Energy

- The Tenth Plan in India pledged to install 1005000 sq. m solar water heating systems and 162000 solar cookers of which 995000 sq. m and 70978 were installed respectively.
- Improved Water Mills in Nepal have made milling efficient (up to 3kW can be generated) and reliable. 25,000 traditional mills are still in operation in Nepal.
- Seventy-nine geothermal manifestation areas have been identified in Malaysia.



## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### H. Bio Transgenics

- Most transgenic technologies are in research and development and comprehensive results have not been ascertained.
- India is producing BT Cotton
- Malaysia has empanelled biotechnology as one of the drivers of new agriculture in the Tenth Malaysian Plan.

A woman wearing a red long-sleeved shirt and a patterned skirt is harvesting wheat in a field. She is holding a bundle of wheat stalks. In the background, another person is visible working in the field.

# Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

## I. Organic Farming

- National Planning Commission of India in 2000 recognized organic farming as a thrust area.
- In Nepal preliminary drafts of organic certification policies and procedures have been developed.

A woman wearing a red long-sleeved shirt and a colorful patterned headscarf is working in a rice field. She is looking down at a bundle of harvested rice stalks. In the background, another person is visible working in the field. The field is filled with tall, golden-brown rice stalks.

## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### J. Integrated Pest Management (IPM)

- Food and Agriculture Organization led Inter Country Programs (IPC) for IPM Farmer Field Schools (FFS) in Asia, national IPM programme in Indonesia (1989- 2000), and national projects of smaller scales in Bangladesh, Cambodia, China, and Nepal.
- In Malaysia IPM with FFS approach never got operational.
- In India most of IPM activities are funded from the government budget.
- In Nepal despite initial incertitude between 1997 and 2001 some 8,600 farmers participated in IPM through FFS.



## Status of GT in APCAEM member countries – Feasible Green Technologies (Cont...)

### H. Information and Communication Technology (ICT)

- ICT has important role to promote GT
- The Government of Nepal's Information and Technology Act 2004 supports ICT intervention for agricultural development and environmental management
- Ninth Malaysian Plan commits to use of ICT for providing access to market and trading information.



A woman wearing a red long-sleeved shirt and a patterned skirt is harvesting wheat in a field. She is wearing a colorful headscarf and is smiling as she works. In the background, another person is visible working in the field. The field is filled with golden wheat stalks, and there are some green plants in the distance.

# Case Studies – Nepal

## Biogas

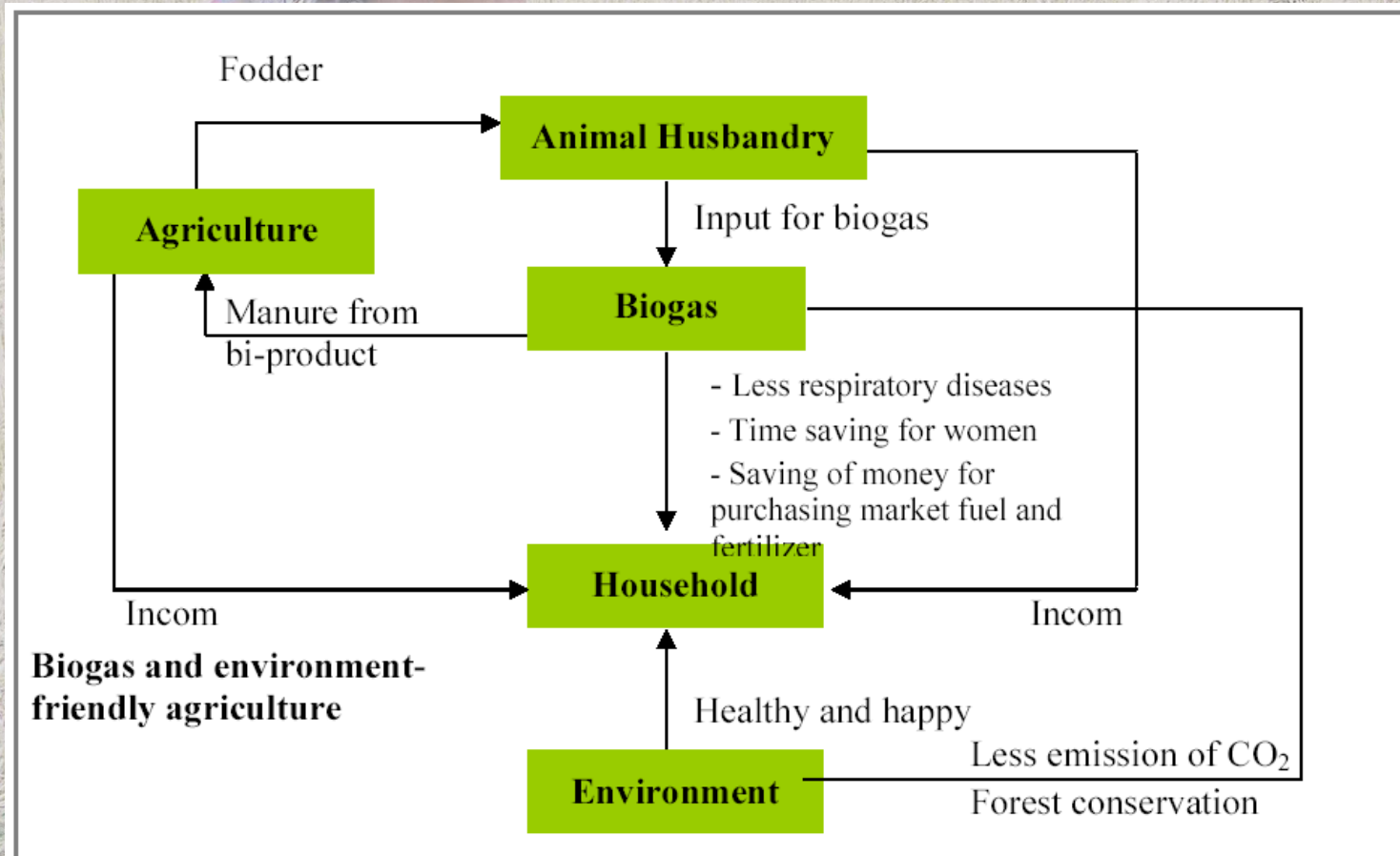


# Nepal- Biogas

- Biogas is product of anaerobic digestion of organic matter by methanogenic bacteria.
- Biogas can serve to meet energy requirements for cooking, lighting, refrigeration, electricity generation, and internal combustion engines.
- Biogas Support Programme (Phase I-IV) has been instrumental in promotion of biogas in Nepal.
- Successful biogas sector of Nepal is the result of a consolidated effort of public and private stakeholders; and donor agencies.

# Nepal- Biogas

## Sustainability and Biogas





# Biogas- Nepal

## Biogas and Poverty Reduction

- Biogas creates impact on poverty through reduced health and sanitation problem, time saving and increase in income level.
- 90% Nepali household with biogas plant had proper toilets as compared to 60% of non-biogas household.

# Biogas- Nepal

## Poverty Reduction Impact of Biogas

Poverty Reduction Indicator (PRI)	PRI in Household Sector	PRI in Industrial Sector	PRI in Commercial Sector	PRI in Social Sector
Security (Income, Employment, Credit)	√	√	√	√
Knowledge and Information			√	√
Health	√			
Drudgery Reduction	√			
Empowerment/Inclusion				
Gender Equity	√			
Environmental Sustainability				√

Source: Amatya, et. al., 2006

# Biogas-Nepal

## Biogas and Rural Environment

Net greenhouse gas saving per digester in Nepal (tCO<sub>2</sub>/biogas plant/year)

Size of plant	Terai	Mid-hills	Average (Terai and Hills)
4 m <sup>3</sup>	3.17	5.75	4.46
6 m <sup>3</sup>	7.27	8.00	7.63
8 m <sup>3</sup>	9.33	9.94	9.63
10 m <sup>3</sup>	7.44	7.87	7.65
<b>Average of all sizes</b>			<b>7.35</b>

Source: (Pandey 2005)



# Biogas-Nepal

- Biogas and Income Generation to Farmers
  - Biogas increases income through
    - Increased agricultural productivity
    - As a substitute for fuel wood and commercial fuel
    - Reduced health cost

# Biogas-Nepal

## Biogas and Gender Issue

**Average time allotted to different biogas related activities before and after installation of biogas plant**

<b>Activity</b>	<b>Saving in Time (Hour/Day)</b>
Cattle Care	(-) 0.01
Collection of Water	(-) 0.35
Collection of dung	(-) 0.07
Mixing of water and dung	(-) 0.15
Cooking	(+) 1.11
Cleaning cooking utensils	(+) 0.39
Lighting fuel collection	(+) 0.09
Collection of firewood	(+) 1.38
<b>Total saving of time</b>	<b>2.38 hours/day/family</b>

*Source: Devpart, 1998*





# Biogas-Nepal

## Summary of Cost and Benefit

<b>Cost</b>	<b>Benefit</b>
Installation cost	Time saving for women
Maintenance cost	Reduced expenditure for kerosene and other fuel
Transaction cost for searching	Conserved forest
	Manure for farming
	Less use of fertilizer
	Reduced respiratory diseases
	Income from CO <sub>2</sub> fund



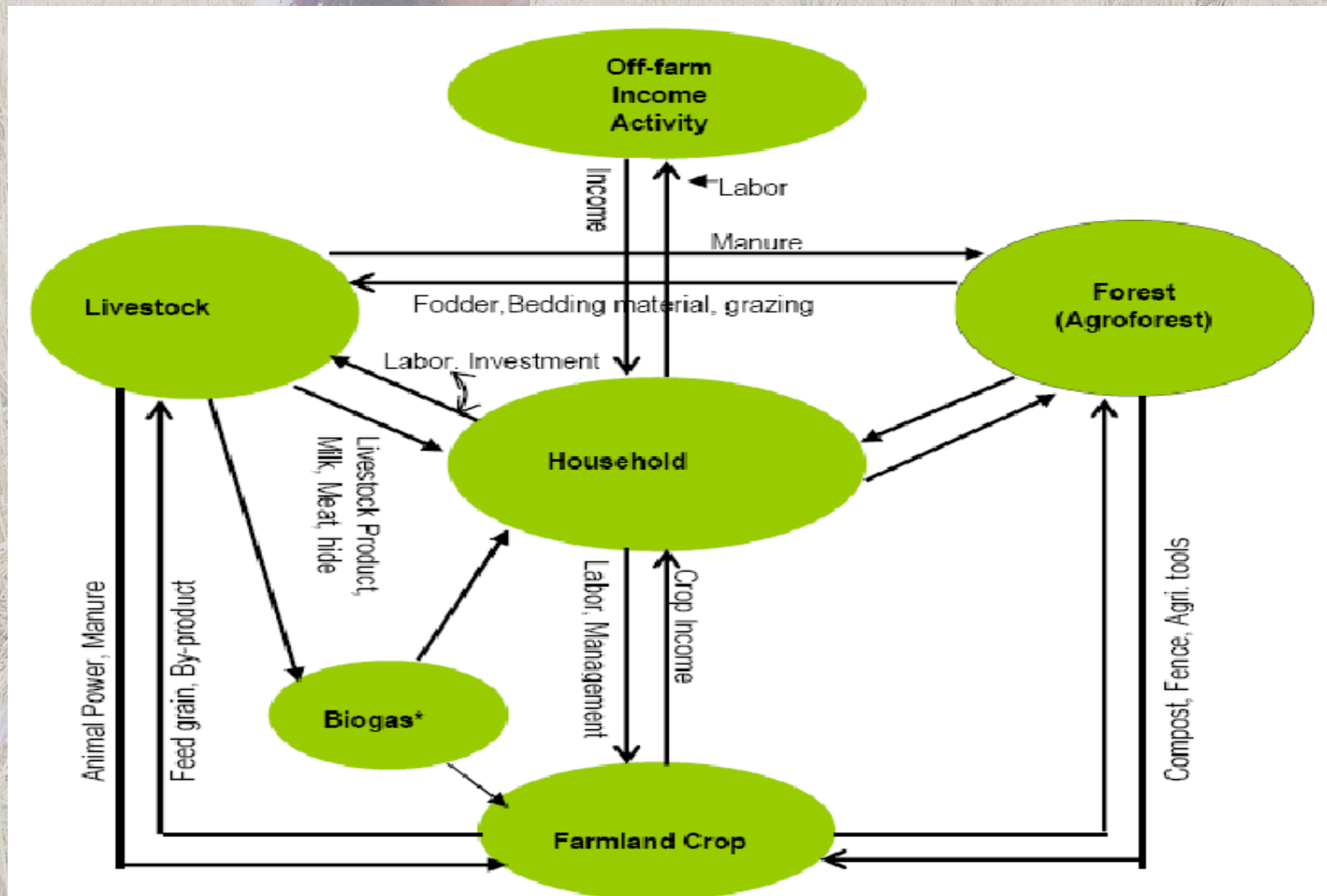
## Agroforestry-Nepal

- Growing trees on farm is common practice in Nepal.
- Agrosilvoanimal (Farm forestry and Slope agriculture land technology) and Agrosilviculture (shifting cultivation and Taungya) are the best-practiced systems of agro forestry in Nepal
- Agroforestry is integral part of Nepalese agriculture.

# Agroforestry-Nepal

## Agroforestry and Sustainability

Inter linkages of agro forest, agriculture, households, and livestock





# Agroforestry-Nepal

- Agro-forestry and environment-friendly agriculture
  - Agro-forestry helps to improve the soil fertility
  - Agro-forestry → livestock → biogas → environment friendly agriculture.
- Agro forestry, Income generation to farmers and poverty reduction
  - Increased food production through improved soil quality;
  - Diversifies sources - selling tree by-product such as fruits, wood and other forest product extracted from agro-forest;
  - Diversifies sources - selling livestock product such as milk, meat etc.

# Agroforestry-Nepal

Agro forestry, Income generation to farmers and poverty reduction

Net benefit from forestry alone, agriculture alone and agroforestry

Net benefits ('00000 NRs/ha)

Year	Forestry alone	Agriculture alone	Agroforestry
1	-0.37	0.1	-0.25
5	0.02	0.095	0.09
10	0.02	0.095	0.12
20	5	0.085	7.085



# Agroforestry-Nepal

- Agroforestry and Rural Environment
  - Agro-foestry has very high potential for carbon sequestration.
  - Agro forest can control the erosion problem.
  - Agroforestry increases biodiversity that may be useful, besides other benefit, to reduce pest attack in the crops.
  - Tall trees may act as wind blocks to shelter harvestable crops, reduce wind erosion and delay the attack of desertifying sands.



# Agroforestry-Nepal

- Agro forestry and Gender Issues

- Nepalese rural woman have very high workloads due to responsibility in both farm and household.
- Women spent more than three-fourth of household time collecting forest products.
- Adoption of agrofoestry will reduce time required for all these activities and increase welfare of women.

# Agroforestry-Nepal

## Summary of Cost & Benefit

<b>Cost</b>	<b>Benefit</b>
Initial investment	Income of farmer
Opportunity cost of land	Improved social wellbeing
Marketing cost for forest product	Improved environmental quality
	Reduced threat from pest, insect and animal on other crop
	Women empowerment



# INDIA: Biofuel- Jatropha



- India's energy demand is expected to grow at an annual rate of 4.8 per cent over the next couple of decades.
- The continuous fluctuations in oil price and the non-renewable character of fossil fuel is a problem.
- Biofuel could be the possible solution as it
  - Reduces the problem of global warming.
  - Creates new markets and products for farmers.
  - Is renewable in nature; reduces fear of energy crisis.
  - Gives a local alternative to monopolized fossil fuel market.

A woman wearing a red long-sleeved shirt and a patterned sari is harvesting Jatropha plants in a field. She is holding a bundle of harvested plants. In the background, another person is visible working in the field. The field is filled with tall, golden-brown Jatropha plants. The title "INDIA: Biofuel- Jatropha" is overlaid in blue text at the top of the image.

## INDIA: Biofuel- Jatropha

- Some problems of biofuel are
  - High quantity of feedstock is required for producing less fuel
  - Biofuel feedstock may reduce production of food grain
  - Poor people may suffer- being excluded from the benefits and subjected to higher food prices
- Experts have suggested use of marginal land for feed stock production
- Jatropha can be grown in marginal land

A woman wearing a red long-sleeved shirt and a patterned sari is harvesting Jatropha plants in a field. She is holding a bundle of harvested plants. In the background, another person is visible working in the field. The field is filled with tall, golden-brown Jatropha plants. The title "INDIA: Biofuel- Jatropha" is overlaid in blue text at the top of the image.

## INDIA: Biofuel- Jatropha

- Jatropha
  - Can grow even in saline, marginal and infertile soil.
  - Requires little maintenance that in turn reduces cost of production.
  - Productivity is also high.
  - Repels other animals and insects.

A woman wearing a red long-sleeved shirt and a patterned saris is harvesting Jatropha plants in a field. She is holding a bundle of harvested plants. In the background, another person is visible working in the field. The field is filled with tall, golden-brown Jatropha plants. The title 'INDIA: Biofuel- Jatropha' is overlaid in blue text at the top of the image.

## INDIA: Biofuel- Jatropha

- Jatropha and environment-friendly agriculture
  - Reduces use of fertilizer and pesticide
  - Reduces emission of green house gasses
  - Maintains the soil fertility
  - Reduces soil erosion



# INDIA: Biofuel- Jatropha

- Jatropha and poverty reduction

- In India, out of 142.81 millions hectares of net sown area, only 55.05 millions hectares area is irrigated
- 19 millions hectares area is barren and uncultivable
- 13 million hectares area is cultivable wasteland
- Land availability for Jatropha production is high in India.
- If 13 million hectare area of wasteland is used for Jatropha production and one man is employed per hectare then 13 million new jobs will be created.
- Biofuel sectors requires approximately fifty percent less investment than petroleum sector to create one additional employment.



# INDIA: Biofuel- Jatropha

- Jatropha and Rural Environment

- Doesn't require pesticide, insecticide, fertilizer and irrigation.
- No adverse impact on soil, land and water.
- No negative impact on forest and biodiversity.
- Improves the soil quality of saline and wasteland and stops desertification.



# INDIA: Biofuel- Jatropha

- **Jatropha and Income Generation to Farmers**

- A farmer can produce up to 3.25 ton/hectare Jatropha seeds per year;
- With current market price a farmer can make INr 18750
- This amount is less than income from sugar cane
- But it is profitable because
  - Production cost is negligible
  - Can be produced in marginal land whose opportunity cost is almost zero

- **Jatropha and Gender Issue**

- Jatropha requires less intensive labor
- Women can carry out most of the agricultural work



# INDIA: Biofuel- Jatropha

- Government's Policy on Jatropha
  - "India needs to grow Jatropha to tackle dry land and generate bio-diesel."
    - Dr. A.P.J. Abdul Kalam
- India has announced National Bio-diesel Mission.
- Government has decided to use Jatropha seed as the feedstock for biodiesel
- Phase I-
  - Cultivate 400,000 hectares with Jatropha
  - Establish seed collection and oil extraction centres
- Sustaining expansion of the programme leading to the production of bio-diesel to meet 20 per cent of the country's diesel requirements by 2011-12.



# INDIA: Biofuel- Jatropha

## Summary of Cost & Benefit

Cost	Benefit
Direct production cost	Income of farmer
Opportunity cost of land	Improved social well being
Reduced income of petro-product seller	Improved environmental quality
	Reduced threat from pest, insect and animal on other crop
	Reduced risk from oil price and import shocks

# INDIA: Biofuel- Jatropha

## Evaluation of Technology for Adoption

Characteristics	Impression	Reason
System Independence	Yes	Less capital is required
Image of Modernity	Yes	Relatively new concept so people will not hesitate to adopt in the ground of social prestige
Individual Vs Collective	Collective	For economies of scale people will have to grow collectively
Cost of Technology	Very low	Only labour is the significant input
Risk Factor	Very low	Little will be at stake as it is grown in marginal land
Evolutionary capacity	Very high	Fuel shortage in India will expand the Jatropha production
Single vs Multi Purpose	Multipurpose	There are many use of Jatropha. Jatropha is not only a cash crop but also technology to save environment and fill the gap of energy supply

## MALAYSIA : Biomass

- Major concern in Malaysia is to reduce overdependence on exhaustible sources of energy.
- Major contributor of biomass is palm oil industry.
- Production of biomass is possible throughout the year because of high sunlight and high rainfall. Government supports use of biomass for energy generation.

# IMPACT OF GREEN TECHNOLOGY

A woman wearing a red long-sleeved shirt and a colorful patterned headscarf is harvesting wheat in a field. She is holding a bundle of wheat stalks. In the background, another person is visible, also working in the field. The field is filled with golden wheat stalks, and the overall scene is a rural agricultural setting.

- On promoting green practices
  - Green Technology Initiative (GTI) has been launched in London
  - 77% U.S. voters believe America has not done enough to facilitate green practices
  - China has been aggressively involved in the development of environmentally friendly farming practices



# IMPACT OF GREEN TECHNOLOGY (cont.)

- On Sustainable Agriculture, Rural Income, and Poverty Reduction
  - Non-sustainable land use practices contribute to low agricultural productivity and poverty
  - Agriculture technology offers opportunities for raising food grain production
  - Impact of climate change on agriculture needs to be given due consideration by facilitating green technology.



## IMPACT OF GREEN TECHNOLOGY (cont.)

- On Contributing to Income Generation through Ecological Agriculture and Rural Renewable Energy
  - Energy improves productivity, creates employment and increases income.
  - Choosing the appropriate alternative energy technology is very important.
  - Renewable energy technology has been the best substitute for improving the quality of life of rural households.
  - Crops planted using conservation tillage practices have helped retain carbon in the soil.
  - Shift from the traditional environmental policy towards ecological modernization through green technology is necessary.

# National Policies for GT: Impact, Implication and Challenges

- **Nepal**

- Neither separate nor umbrella policy has been promulgated.
- Latest periodic plan (TYIP) contains disaggregated objectives towards GT
- **Agriculture policy:** Conserve, promote and utilize agricultural biodiversities through the development and dissemination of environment friendly technologies.
- **NAP 2005:** Promote organic farming
- **Rural Energy Policy 2006:** Covers small and micro-hydro project, biogas, biofuel and biomass gasification, solar energy, wind energy, improved cook stove, rural electrification, etc.
- **Subsidy Policy for Renewable (Rural) Energy, 2006:** Allots subsidies for system that are delivered through pre qualified companies.
- Technology transfer is highly dependent on provision of subsidy.

A woman in a red shirt and patterned headscarf is harvesting wheat in a field. In the background, another person is visible working in the field.

# National Policies for GT: Impact, Implication and Challenges

- India

- New and Renewable Energy Plan
- Electricity Act
- Renewable Energy Act
- Through these provisions India aims to meet 20 percent of countries total requirement of energy from renewable sources by 2020 .
- Also interesting are policies on bio-fuel, bio-diesel (National Bio-diesel Mission) and bio transgenic (Plant Variety Protection Act).





# National Policies for GT: Impact, Implication and Challenges

- **Malaysia**

- New energy policy (5th Fuel Policy) - Five Fuel Diversification Policy.
- Aims to reduce the dependency on petroleum product through use of alternative sources of energy.
- Malaysian government expects to increase oil palm by 5.5 percent during the Ninth Plan
- Malaysia's National Biotechnology Policy reflects Malaysia's ambitions with biotechnologies.



# Challenges and Opportunities

- Complex task is to strike a balance between environmental and business concerns.
- APCAEM countries need to immediately prepare themselves for need-specific alternative technologies.
- It would be extremely difficult to sustain the current high per capita rate of energy consumption without using renewable sources.
- It will be difficult for the developing countries to make financial as well as political commitment.
- Renewable and environmentally-friendly energy resources are necessary for replacing fossil fuels.
- Illiteracy of the farmers



# Challenges and Opportunities (Cont)

- Land acquisition and infrastructure problems associated with bio fuel, solar and hydropower plant.
- Energy price agenda needs to be revised to encourage the implementation of Climate Change Convention under the current prices of oil.
- Development of innovative, appropriate and efficient information and communication systems
- Global consensus in accepting climate change as a constraint to development.



## Conclusion

- When used correctly agro-environment-friendly technology has promoted sustainable agricultural growth and reduced widening rural-urban income disparities.
- GT in the reviewed countries has mostly minimized environmental hazards and made farmers more productive through enhanced efficiency.
- Sustainable agriculture is resource conserving; environmentally non-degrading; technically appropriate; and economically and socially acceptable.



## Conclusion (Cont...)

- If the policies on food security and income generation fail to address poverty and malnutrition, application of green technology will remain incomplete.
- Understanding of Information technologies and their inter-linkages with agricultural sector is vital for evaluating the strength of pro-poor and environment-friendly agricultural technology.
- Interlinkages of technologies with society should be deliberated in advance to access their roles in achieving the expected outcomes.



## Recommendation

- The simultaneous improvement in agricultural productivity, employment creation, and promotion of renewable energy is the only answer.
- Design effective communication packages to create awareness.
- Community level application of GT such as wind and solar energy.
- Supportive public-private investment policy for the development of GT is recommended.



## Recommendation (Cont...)

- Regarding biofuel, Governments should balance between food crop and fuel crop using policy instruments.
- Government should provide technical assistance to create human resource for supporting technology transfer.
- Removal of subsidies on pesticides, decoupling staple food production from pesticides, strong coordination between national and international agencies and diversion of funds formerly spent on chemical use to human resource development are some suggested immediate interventions.
- Governments should initiate programmes which will take ICT to the poor people.



## Recommendation (Cont...)

- Carefully assess the possibility of multi-functionality of technologies.
- Strengths of participatory programmes as Farmer Field Schools should be reviewed for duplication.
- Close scrutiny of the existing policies and commitments to harmonize contradictory policies is necessary to ensure that GT policies and programs are not developed, implemented, or evaluated in isolation.





**THANK YOU**