LCI2012-04NMY(R)-MACANDOG

INTEGRATED SUSTAINABILITY ASSESSMENT OF BIOENERGY POTENTIALS IN ASIA: AN APPLICATION OF A HYBRID APPROACH ON TRADE-OFFS AND PATHWAYS (PIC-STRAP)

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Institute of Biological Sciences

University of the Philippines Los Baños

November 24-26, 2014

Low Carbon Asia Research Network (LoCARNet) Third Annual Meeting, APN Side Event, Bogor, Indonesia

Project Collaborators

Source: Google Maps

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Potsdam Institute for Climate Impact Research (PIK)

Dr. K. S. Kavi Kumar
Madras School of Economics

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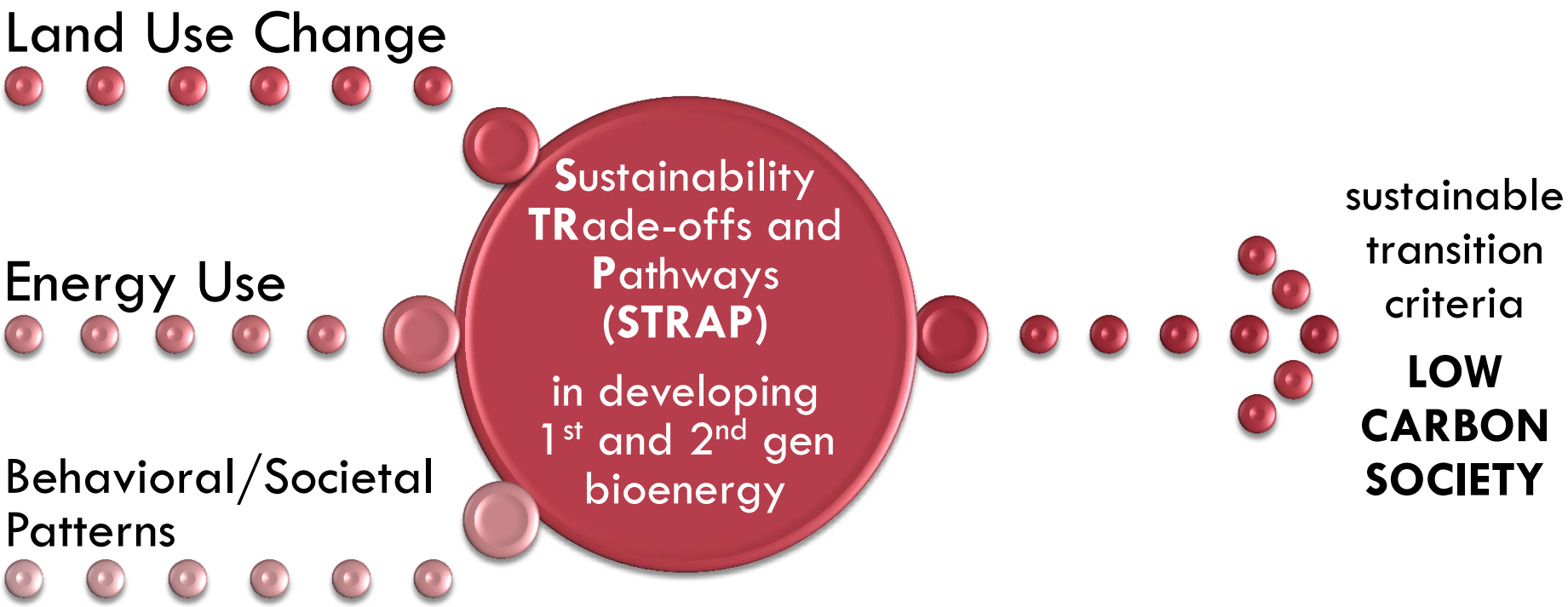
College of Global Change and Earth System Science
Beijing Normal University

PIC-STRAP and Low Carbon Initiative

Integrated and trans-disciplinary approach

social perception and policy preferences

low carbon and sustainable societies



Methodology and Expected Output

Project Duration: 2 years (May 2013 – September 2015)

Data

- Online Survey/Field Survey/Interviews
- Historical Spatial Maps
- Literature on Technological State
- Time-Series Statistics

Modelling Techniques

- Conjoint Analysis, Factor & Cluster Analyses
- GIS Analysis
- Fuzzy Logic Models
- Spatial Logistic Analysis
- Path Analysis
- Multi-criteria Decision Analysis

Model-generated Knowledge

- Preference Weights
- Sustainability Trade-off Indices
- Probabilities of Land Use Conversion
- Development Pathways

Outputs

Data	• Online Survey/Field Survey/Interviews
Modelling Techniques	• Conjoint Analysis • Factor Analysis • Cluster Analysis
Model-generated Knowledge	• Preferences and Typologies

Typology of Farmers' Awareness on Sustainability of Alternative Bioenergy Feedstocks in the Philippines

Elena A. Eugenio, Lilibeth A. Acosta, Nelson H. Enano Jr., Damasa B. Magcale-Macandog, Paula Beatrice M. Macandog and Joan Pauline P. Talubo

University of the Philippines in Los Banos, Philippines

2013 ISSAAS International Congress Linking Agriculture with Tourism:

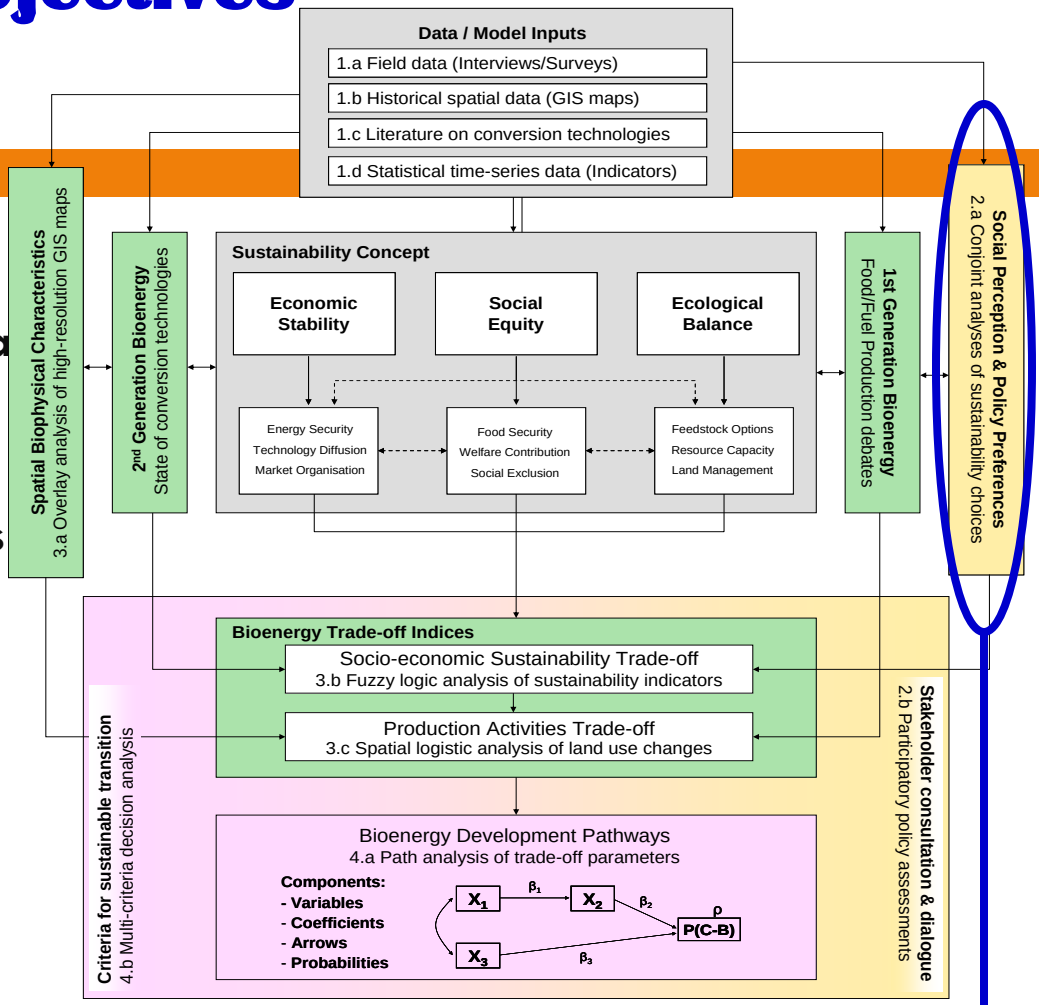
Meeting the Global Challenges of the Future.

Acacia Hotel Manila, Philippines

November 11-15, 2013

Objectives

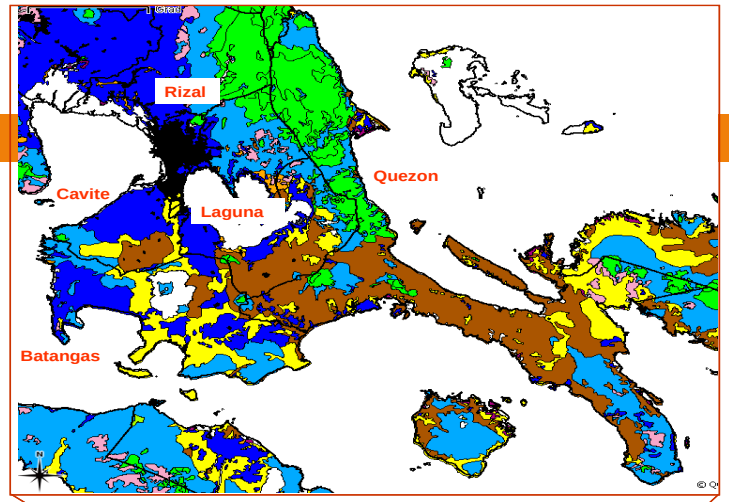
- **Project objective**:
- Develop sustainable transition criteria
- towards low-carbon societies using
- hybrid analytical tools that allows
- systematic investigation of trade-offs
- and pathways in the development.



- **This paper contributes to PIC-STRAP Project through analysis of:**
  - Awareness of farmers on bioenergy production and its sustainability
  - Socio-economic factors affecting their opinions on different bioenergy feedstock

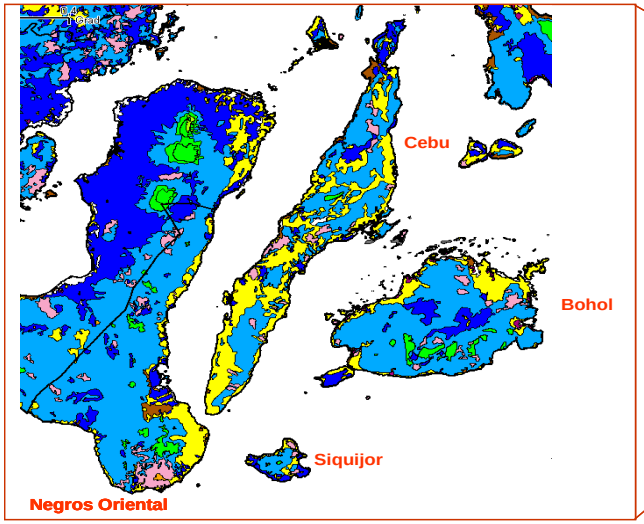
Case study areas

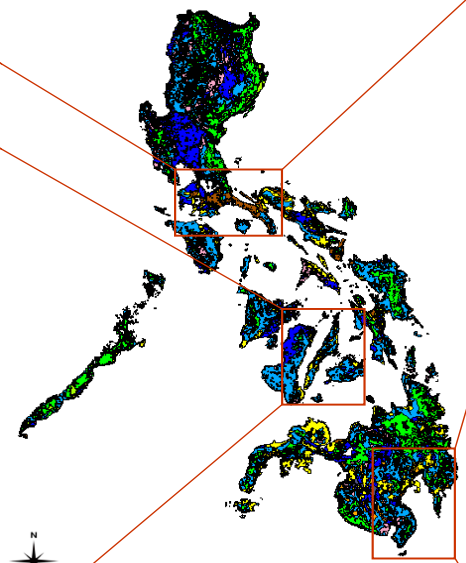
CALABARZON Region



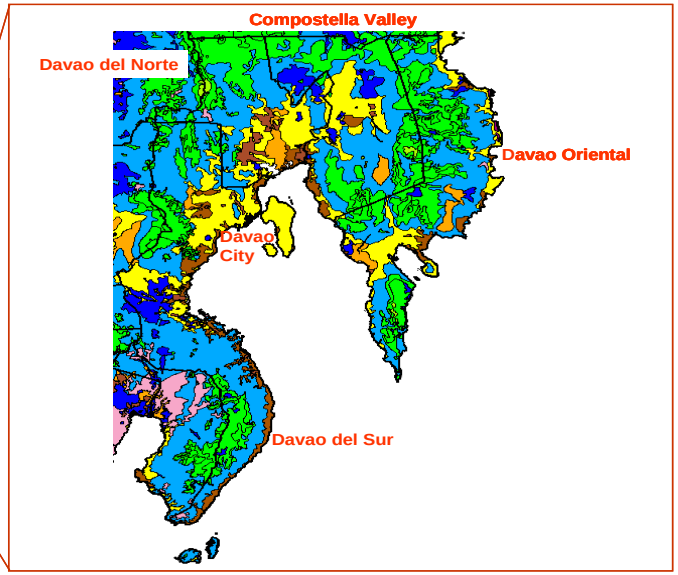
- Arable land, crops mainly cereals and sugar
- Built-up Area
- Closed canopy, mature trees covering > 50 percent
- Coconut plantations
- Crop land mixed with coconut plantation
- Crop land mixed with other plantation
- Cultivated Area mixed with brushland/grassland
- Eroded area
- Grassland, grass covering > 70 percent
- Mangrove vegetation
- Marshy area and swamp
- Mossy forest
- Open canopy, mature trees covering < 50 percent
- Other barren land
- Other plantations
- Pine forest

Central Visayas Region





Davao Region



Methods

- Data collection:
  - Survey was conducted with 234 farmers in 2012-2013 in selected provinces in Calabarzon (i.e. Batangas, Quezon), Central Visayas (e.g. Bohol, Cebu) and Davao (i.e. Davao City, Davao del Norte).
  - Questionnaire asked for four types of information on
    - (1) Socio-economic characteristics (X1)
    - (2) Sources of information on bioenergy (X2)
    - (3) Knowledge and opinion on bioenergy (X3)
    - (4) Preferences on bioenergy feedstock (X4)

Survey in Davao

Philippines' household bioenergy survey in Infanta, Quezon and Batangas









Typology of farmers by cluster

Factors	Cluster1 "Unaware"	Cluster 2 "Informed"	Cluster 3 "knowledgeable"	Cluster 4 "Misinformed"
Age	Close to retire (51-60 yrs old)	Young (30 yrs old and below)	Middle aged (31-40 yrs old)	Retirement and retired age (51-70 yrs old)
Location of Domicile	Rural	Urban	Rural	Rural
Information from family and friends	Yes	Yes	No	No
Familiar with Bioenergy	Very unfamiliar	Most familiar	Familiar	Average familiarity
Works related to Bioenergy	No	No	Yes	Yes
Perennial grasses as Bioenegy feedstocks	Very good potential	Very good high potential	Good potential	No potential

Conclusions

Central Visayas

- **INFORMED typology**
- **High support for bioenergy production**
- **Limited capacity to produce bioethanol from sugarcane (79 M liters/year)**
- **Potential of bioethanol production to:**
  - increase agricultural wage
  - decrease poverty incidence

CALABARZON

- **MISINFORMED typology**
- **Highest potential for bioenergy production (347M liters/year of biodiesel and 54 M liter/year of bioethanol)**

Davao

- **UNAWARE typology**
- **First in coconut production**
- **Important to raise awareness on potential for biodiesel production**
  - contributes only 12% capacity for biodiesel production

Comparison of preferences in the Philippines and China

PIC-STRAP Project Interim Workshop

Beijing, 21-24 July, 2014

Opinions on the contribution of different energy sources to economic growth

Opinion on Bioenergy Feedstocks	China			Philippines		
	Very low/ Low	High/ Very High	Do not know	Very low/ Low	High/ Very High	Do not know
Energy sources						
Fossil	19.01	**78.51**	2.48	31.73	**59.62**	8.65
Bioenergy	38.02	**48.76**	13.22	13.46	**78.36**	8.17
Other Renewables	31.40	**52.07**	16.53	13.46	**75.00**	11.54
Combined	24.79	**52.07**	23.14	12.98	**76.44**	10.58
First generation						
Sugar-rich crops	33.88	**53.72**	12.40	25.97	**65.86**	8.17
Starch-rich crops	25.62	**65.29**	9.09	29.81	**62.50**	7.69
Oil-rich crops	27.27	**62.81**	9.92	19.23	**73.56**	7.21
Second generation						
Agric./forest residues	33.88	**58.68**	7.44	20.68	**65.86**	13.46
fast-growing trees	33.88	**58.68**	7.44	29.33	**59.13**	11.54
perennial grasses	42.15	**42.15**	15.70	36.54	**47.12**	16.35

Biofuel Feedstock Cultivation in India: *Food Security and Rural Livelihoods*

PIC-STRAP Project Interim Workshop

Beijing, 21-24 July, 2014

K.S. Kavi Kumar

Jatropha in Kudankulam – inadequate water supply has resulted in stunted growth with few leaves (and seeds)

Another plot in Kudankulam – plants closer to the residential area survived due to seepage of water supplied to coconut trees

Field Survey – Insights

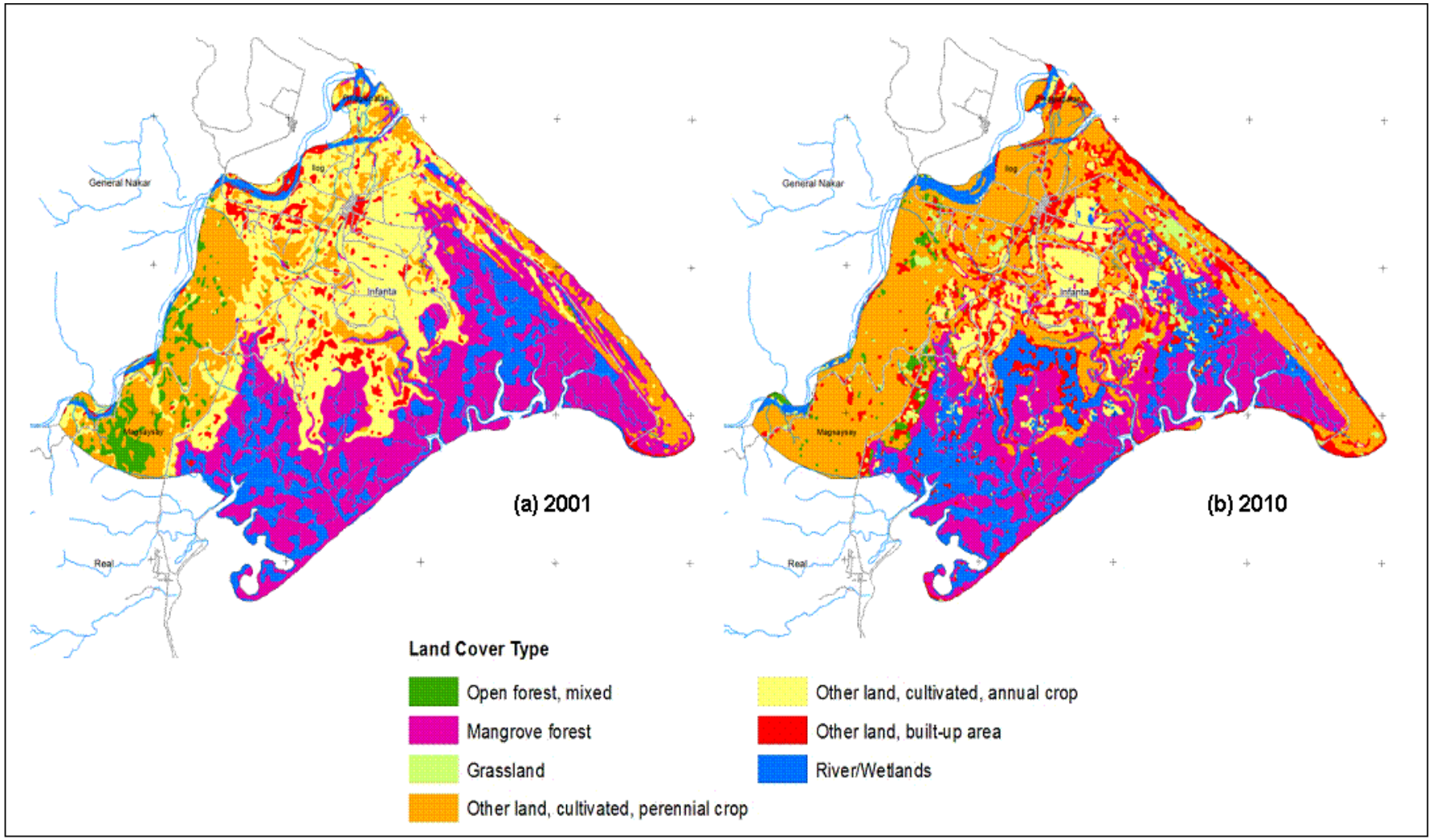
- Far lower yields with inadequate supply of water acting as major constraint
- High initial investment requirements favoring larger land holders compared to small and marginal land holders
- Government initiatives cast shadow on the notion of wastelands – especially because at the village level the wastelands are often CPRs utilized by multiple stakeholders
- Government agencies viewed *jatropha* cultivation broadly similar to several other tree plantation programs!
- Lack of employment opportunities make *jatropha* less attractive – especially compared to prosopis
- The land targeted for *jatropha* is occupied by prosopis – historically promoted by several governments (starting from Anna Durai's period)

Land Use Mapping

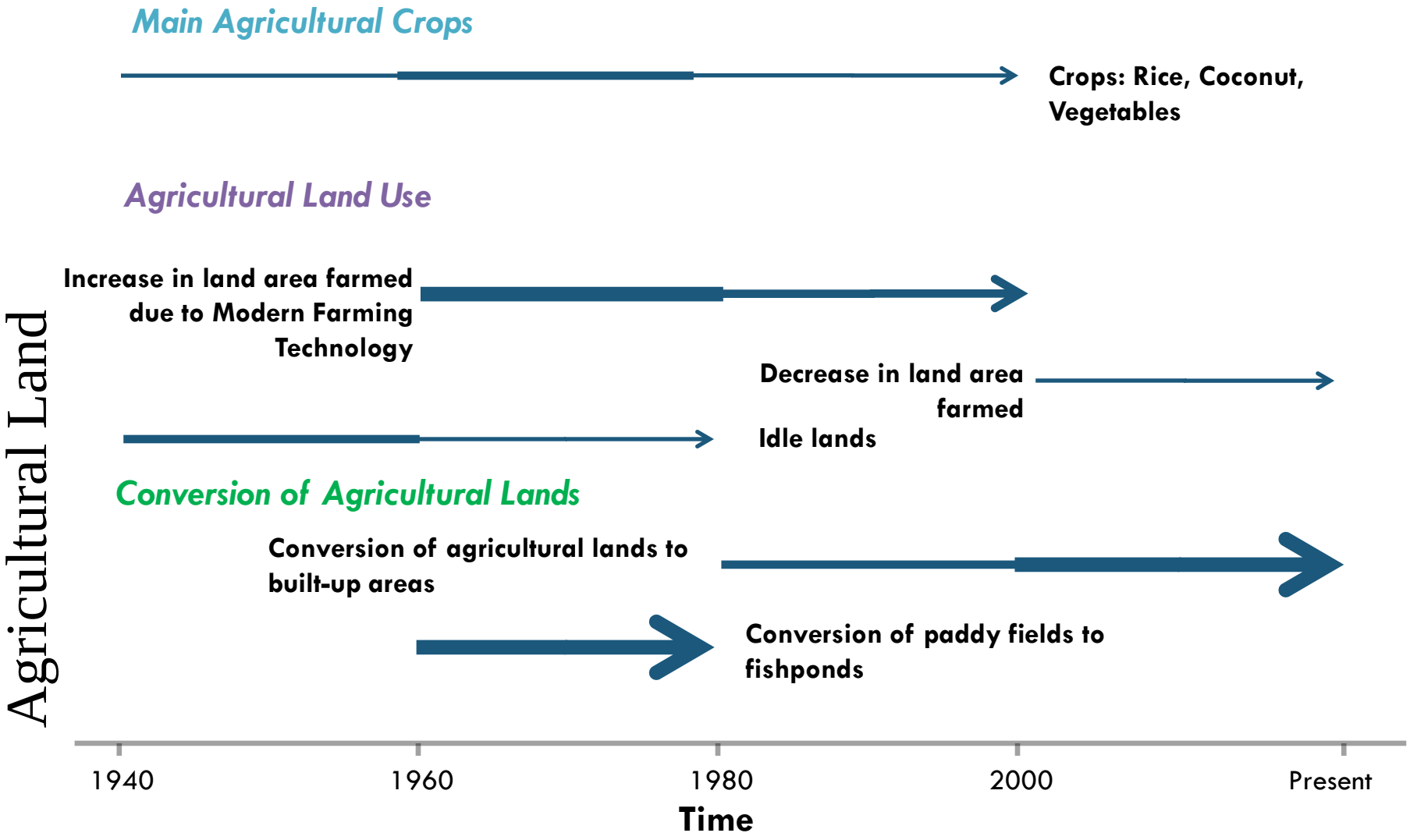
Data	• PRA
Modelling Techniques	• GIS Analysis
Model-generated Knowledge	• Community-based Historical Land Use Maps

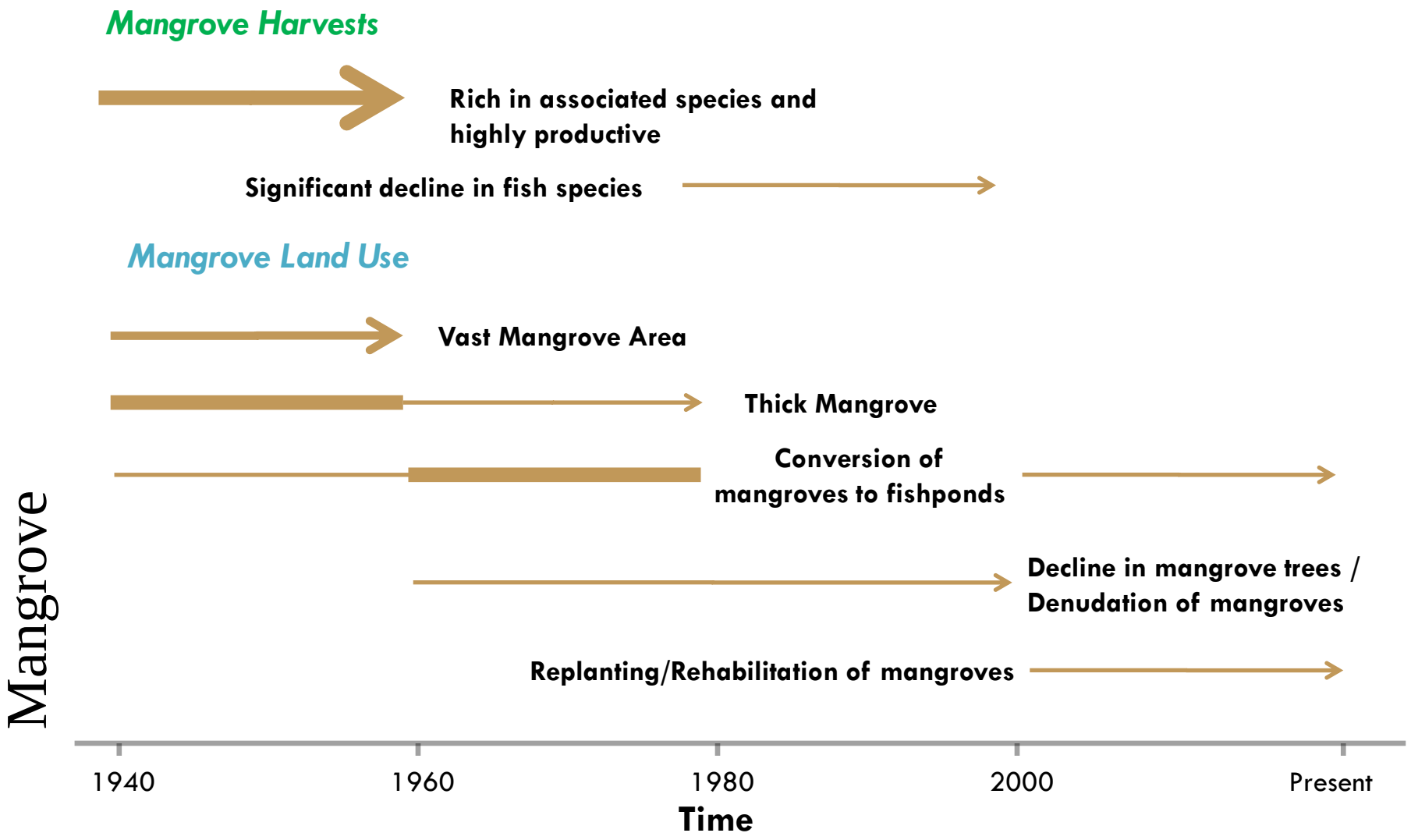
Case study area

Land use change in Infanta, 2001 and 2010



Time Line


Main Agricultural Crops
Crops: Rice, Coconut, Vegetables
Agricultural Land Use
Increase in land area farmed due to Modern Farming Technology
Decrease in land area farmed
Idle lands
Conversion of Agricultural Lands
Conversion of agricultural lands to built-up areas
Conversion of paddy fields to fishponds
Agricultural Land
1940
1960
1980
2000
Present
Time

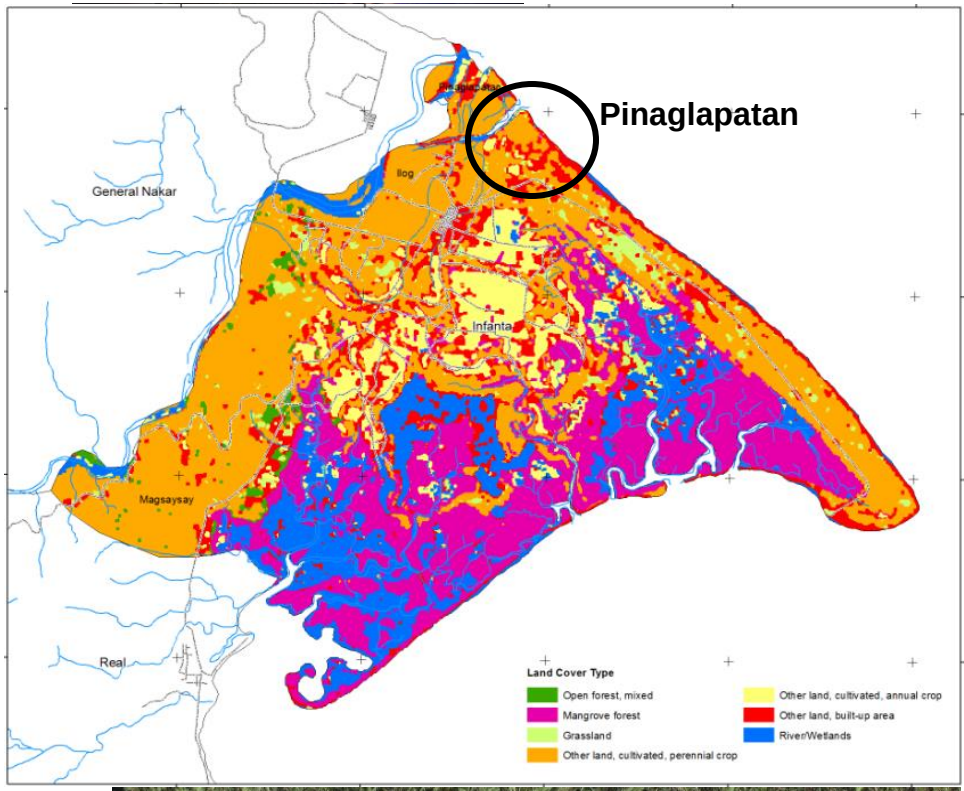

Mangrove Harvests
Rich in associated species and highly productive
Significant decline in fish species
Mangrove Land Use
Vast Mangrove Area
Thick Mangrove
Conversion of mangroves to fishponds
Decline in mangrove trees / Denudation of mangroves
Replanting/Rehabilitation of mangroves
Mangrove
1940
1960
1980
2000
Present
Time

Results

Long-term adaptation practices through shifts in farming in other villages in Infanta (2013):

<u>Binonoan Producers' Cooperative</u> (BiPCo)

- Mixed plantation
  - Aviccennia planted at coastal areas
  - Nipa were planted at relatively higher lands
- Nipa is more resilient to typhoons than coconuts
- By-products of Nipa tree include nipa sugar, lambanog, vinegar
- There are currently 100 ha planted with Nipa in Brgy. Binonoan. While there are 80 ha in Brgy Alitas, a neighbour barangay.
- 15 barangays in Infanta plant Nipa trees



Community-based Participatory Land Use Mapping

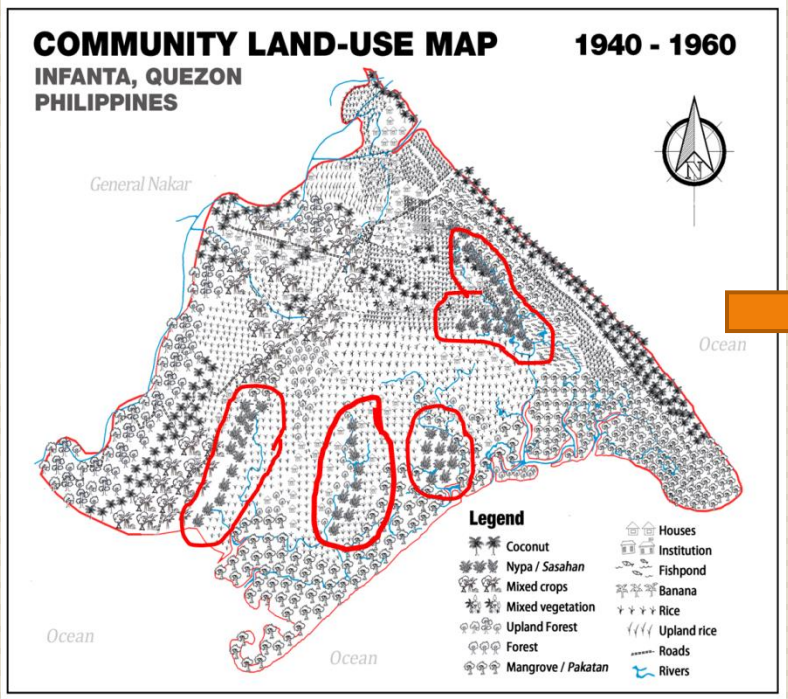


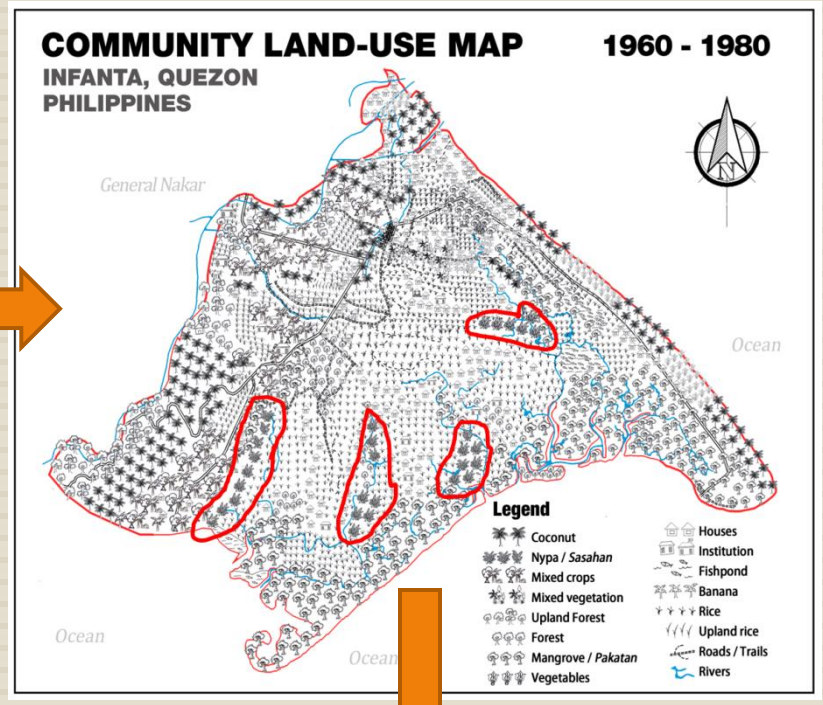


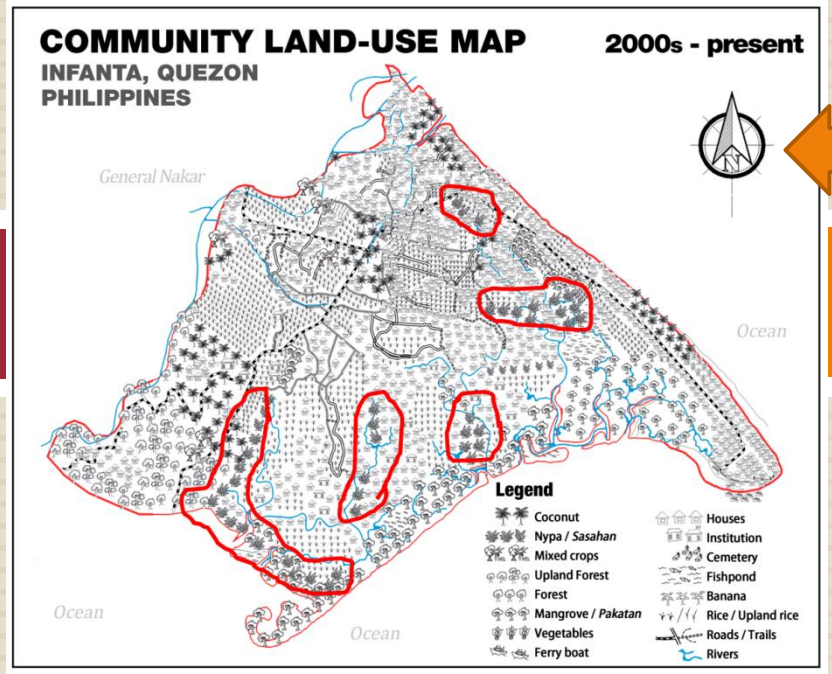


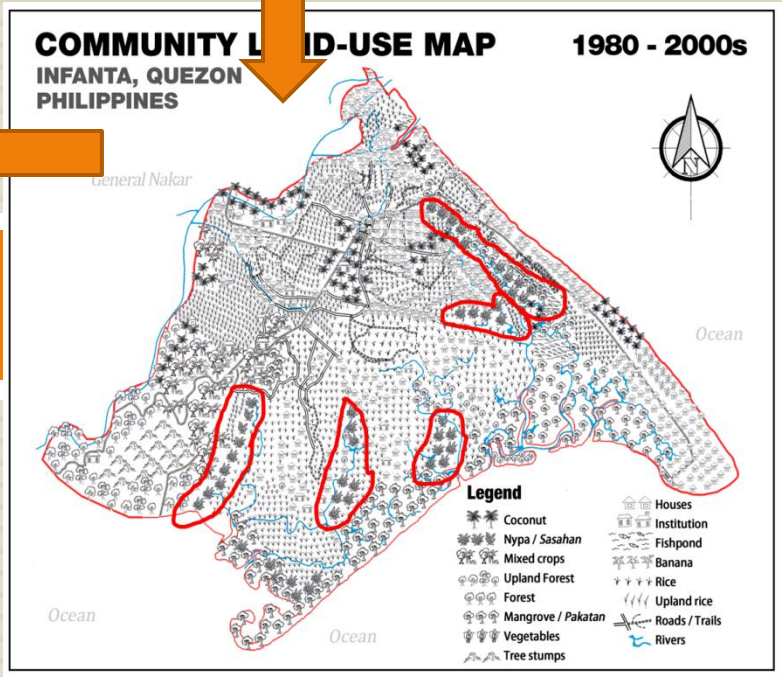


1. Boundary map – 4 clusters of barangays
2. Community mapping – bi-decadal
3. Scanning
4. Georeferencing
5. Mosaicking
6. Symbols and icons using Photoshop
7. Final map lay-outing


COMMUNITY LAND-USE MAP
1940 - 1960
INFANTA, QUEZON
PHILIPPINES
General Nakar
Ocean
Ocean
Ocean
Legend
Coconut
Nypa / Sasahan
Mixed crops
Mixed vegetation
Upland Forest
Forest
Mangrove / Pakatan
Houses
Institution
Fishpond
Banana
Rice
Upland rice
Roads
Rivers


COMMUNITY LAND-USE MAP
1960 - 1980
INFANTA, QUEZON
PHILIPPINES
General Nakar
Ocean
Ocean
Ocean
Legend
Coconut
Nypa / Sasahan
Mixed crops
Mixed vegetation
Upland Forest
Forest
Mangrove / Pakatan
Vegetables
Houses
Institution
Fishpond
Banana
Rice
Upland rice
Roads / Trails
Rivers


COMMUNITY LAND-USE MAP
2000s - present
INFANTA, QUEZON
PHILIPPINES
General Nakar
Ocean
Ocean
Ocean
Legend
Coconut
Nypa / Sasahan
Mixed crops
Upland Forest
Forest
Mangrove / Pakatan
Vegetables
Ferry boat
Houses
Institution
Cemetery
Fishpond
Banana
Rice / Upland rice
Roads / Trails
Rivers

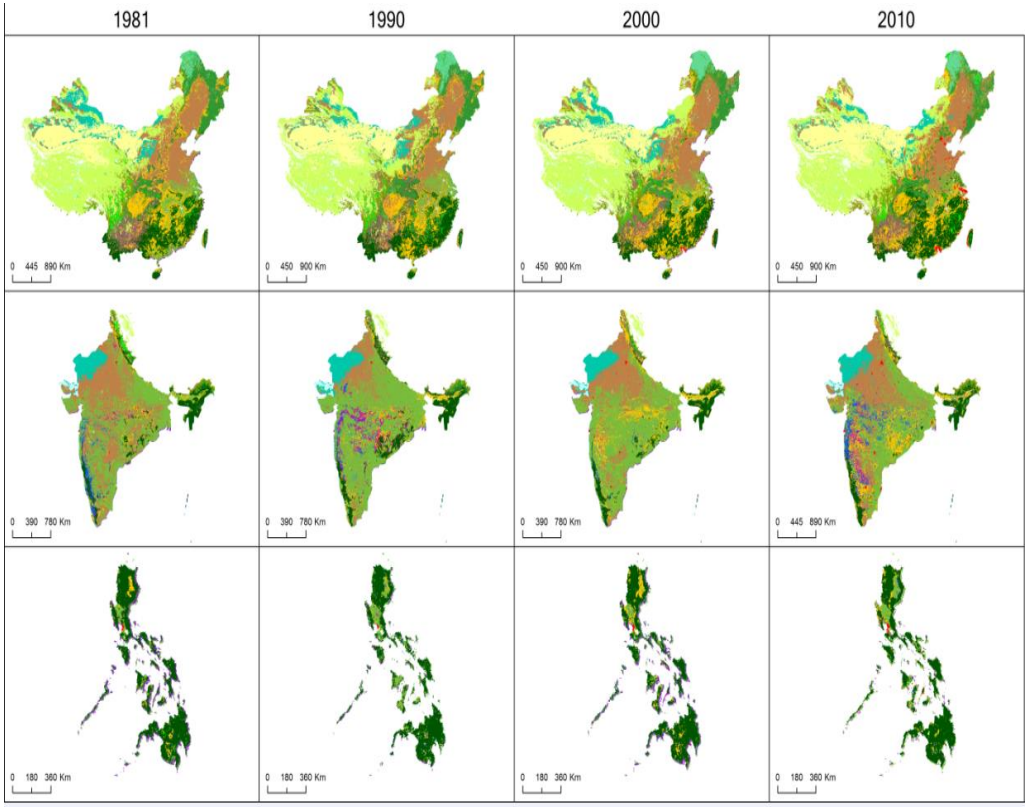

COMMUNITY L ID-USE MAP
1980 - 2000s
INFANTA, QUEZON
PHILIPPINES
General Nakar
Ocean
Ocean
Ocean
Legend
Coconut
Nypa / Sasahan
Mixed crops
Upland Forest
Forest
Mangrove / Pakatan
Vegetables
Tree stumps
Houses
Institution
Fishpond
Banana
Rice
Upland rice
Roads / Trails
Rivers

Historical land Use Mapping

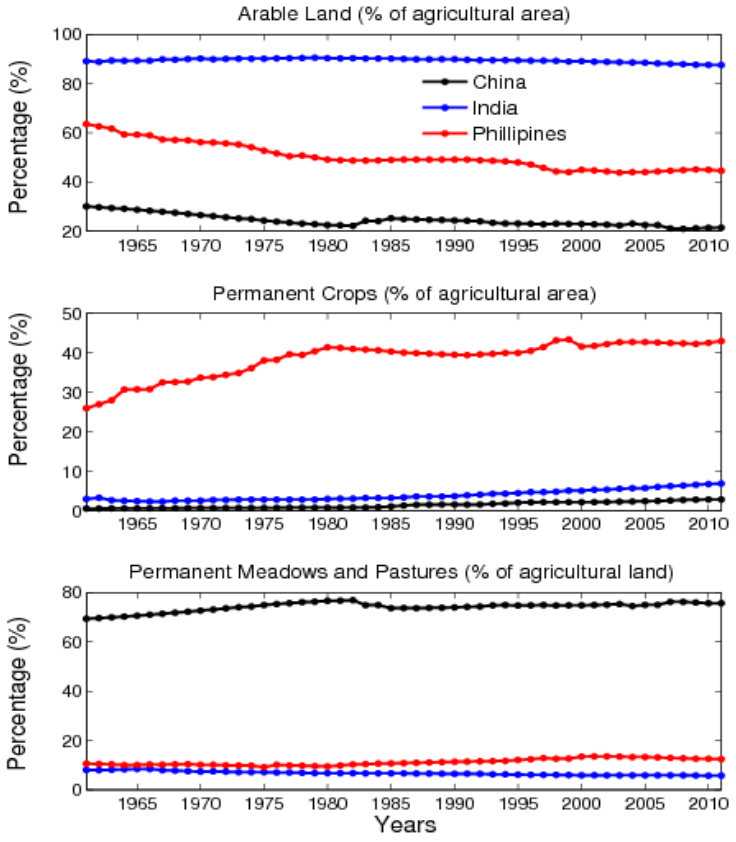
Data	• Historical Spatial Maps
Modelling Techniques	• GIS Analysis
Model-generated Knowledge	• Historical Land Use Maps • Suitability Indices

Historical land use maps between 1980 and 2010 for China, India and Philippines

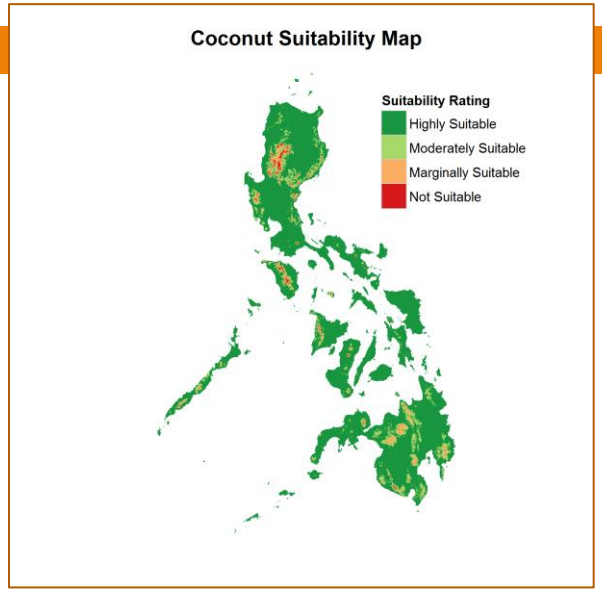
(a) Maps of land use pattern

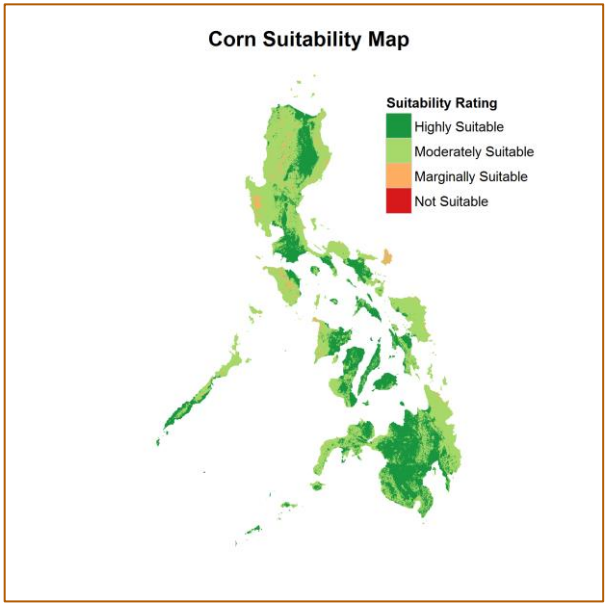


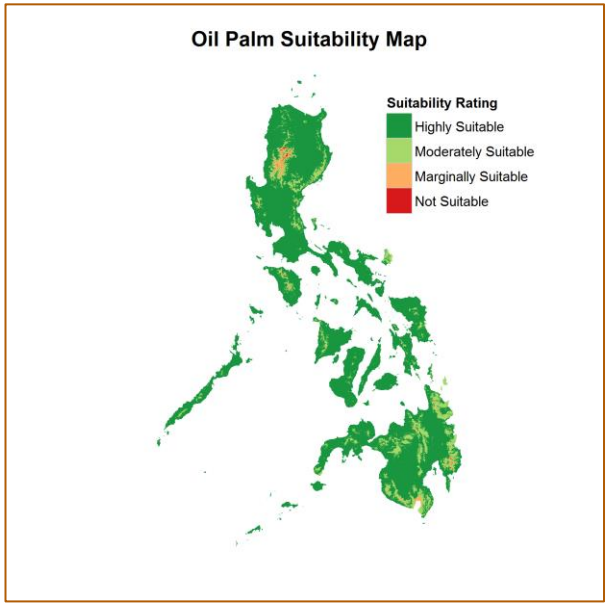
(b) Trend in major land use

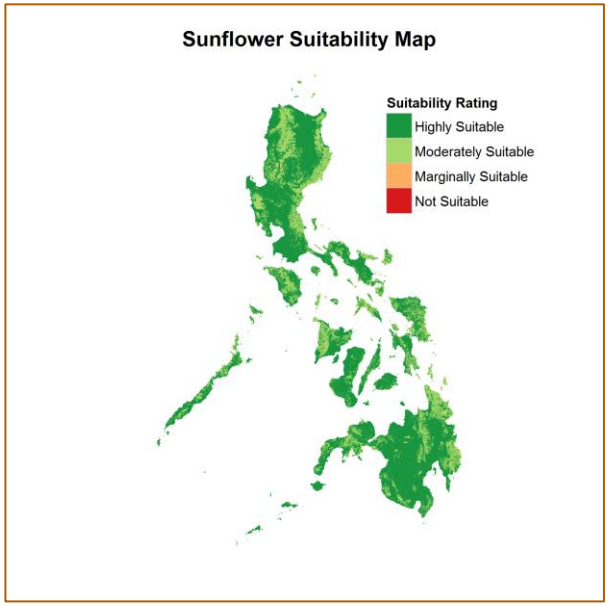


Crop Suitability Maps





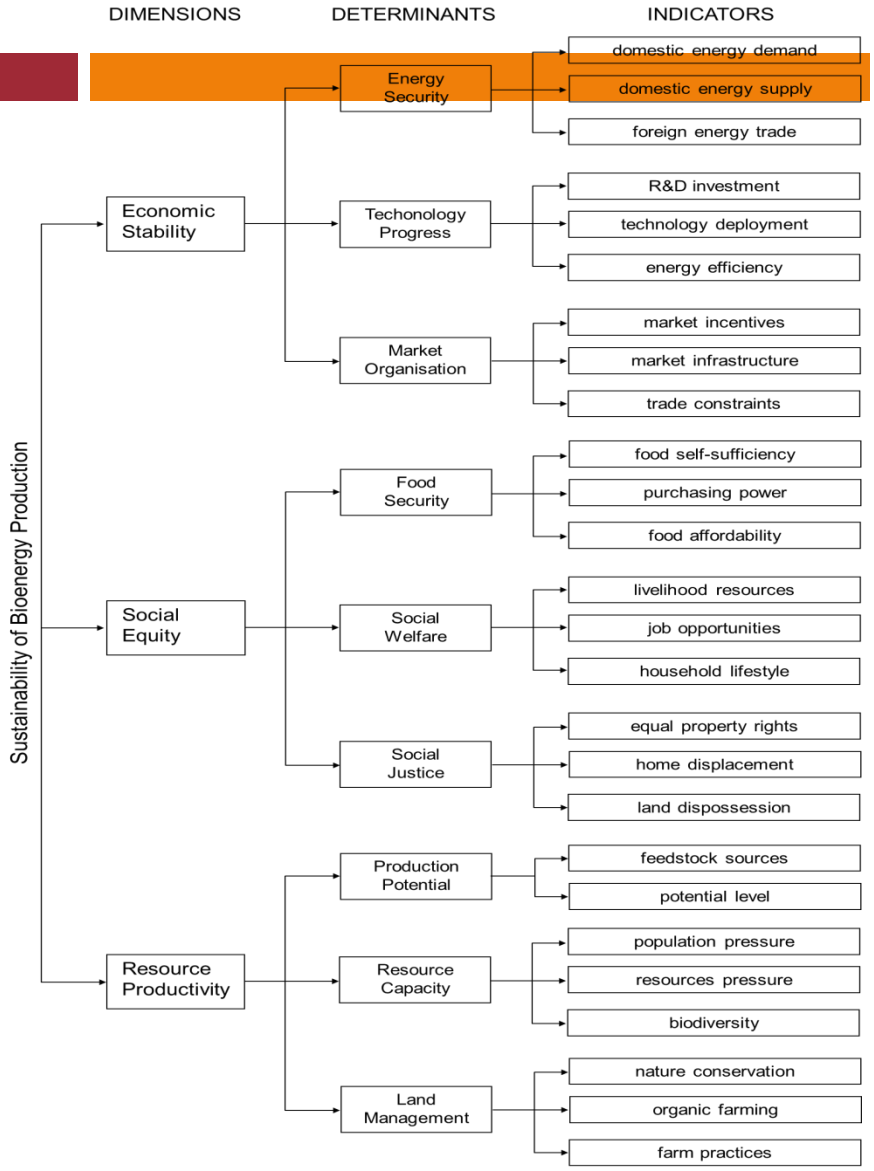


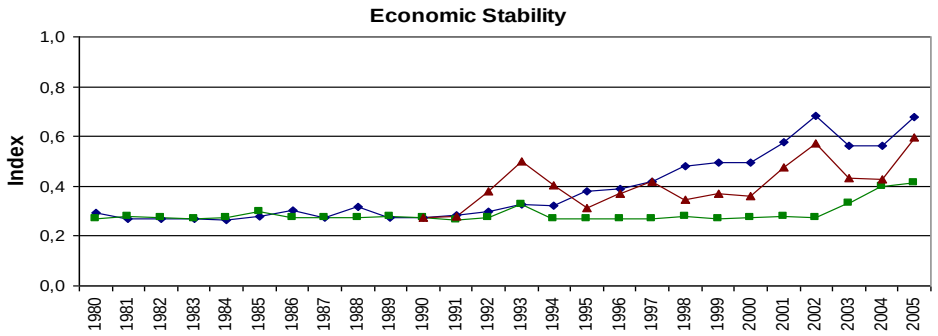


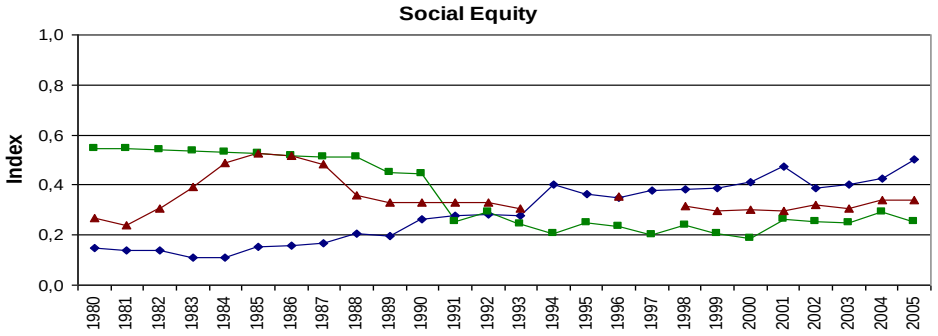
Sustainability Trade-Off Indices

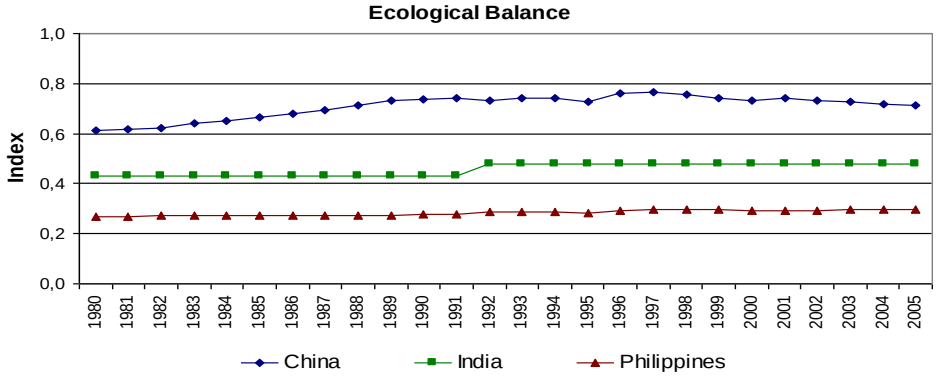
Data	• Time-Series Statistics
Modelling Techniques	• Fuzzy Logic Models
Model-generated Knowledge	• Sustainability Trade-off Indices

Framework


DIMENSIONS
DETERMINANTS
INDICATORS
Sustainability of Bioenergy Production
Economic Stability
Social Equity
Resource Productivity
Energy Security
Techonology Progress
Market Organisation
Food Security
Social Welfare
Social Justice
Production Potential
Resource Capacity
Land Management
domestic energy demand
domestic energy supply
foreign energy trade
R&D investment
technology deployment
energy efficiency
market incentives
market infrastructure
trade constraints
food self-sufficiency
purchasing power
food affordability
livelihood resources
job opportunities
household lifestyle
equal property rights
home displacement
land dispossession
feedstock sources
potential level
population pressure
resources pressure
biodiversity
nature conservation
organic farming
farm practices


Economic Stability
Index
1,0
0,8
0,6
0,4
0,2
0,0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005


Social Equity
Index
1,0
0,8
0,6
0,4
0,2
0,0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005


Ecological Balance
Index
1,0
0,8
0,6
0,4
0,2
0,0
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005
China
India
Philippines

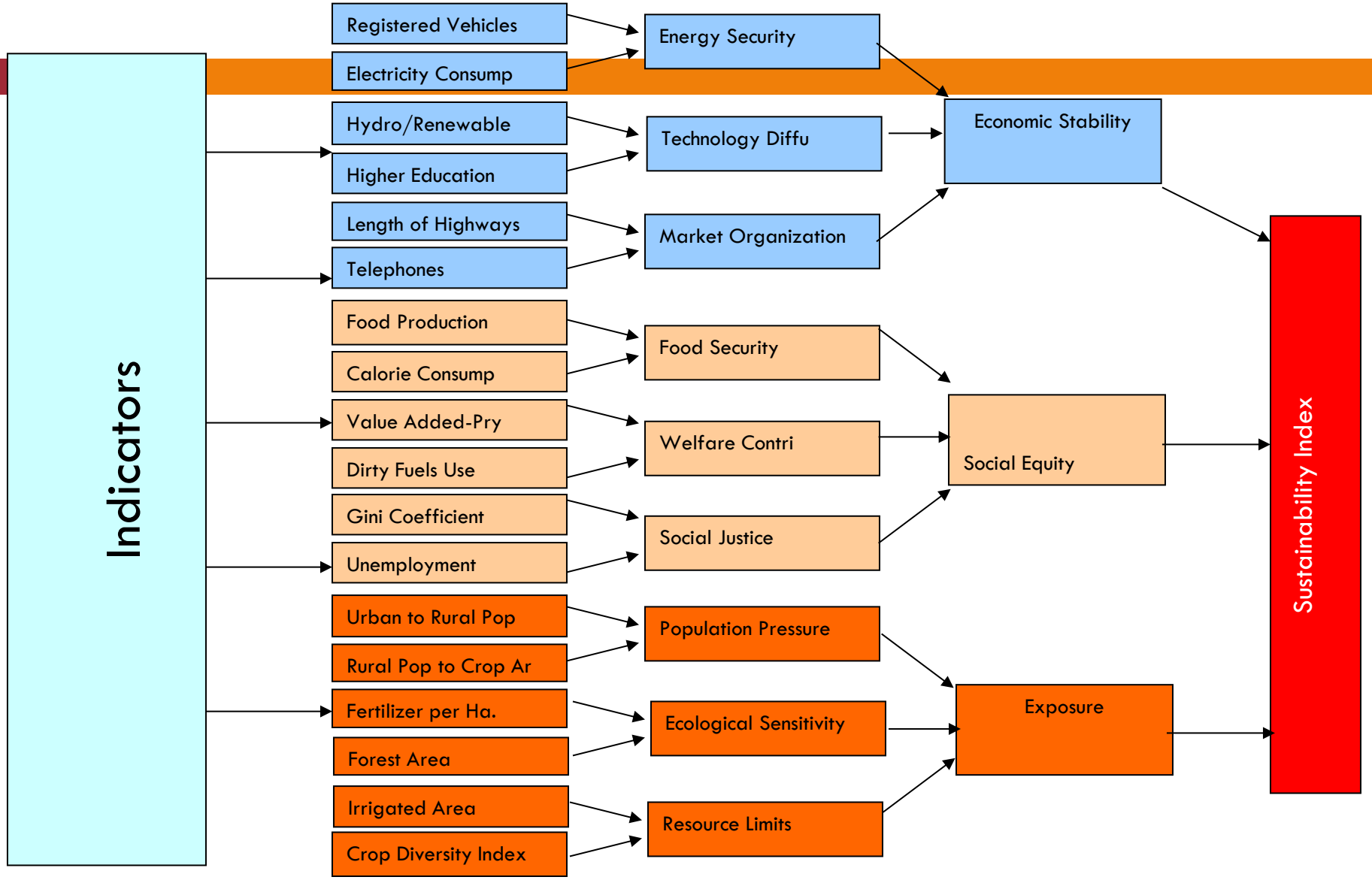
BIOFUELS: SUSTAINABILITY INDEX *FUZZY INFERENCE SYSTEM FIRST-CUT ANALYSIS FOR INDIA*

K.S. Kavi Kumar

PIC-STRAP Project Interim Workshop

Beijing, 21-24 July, 2014

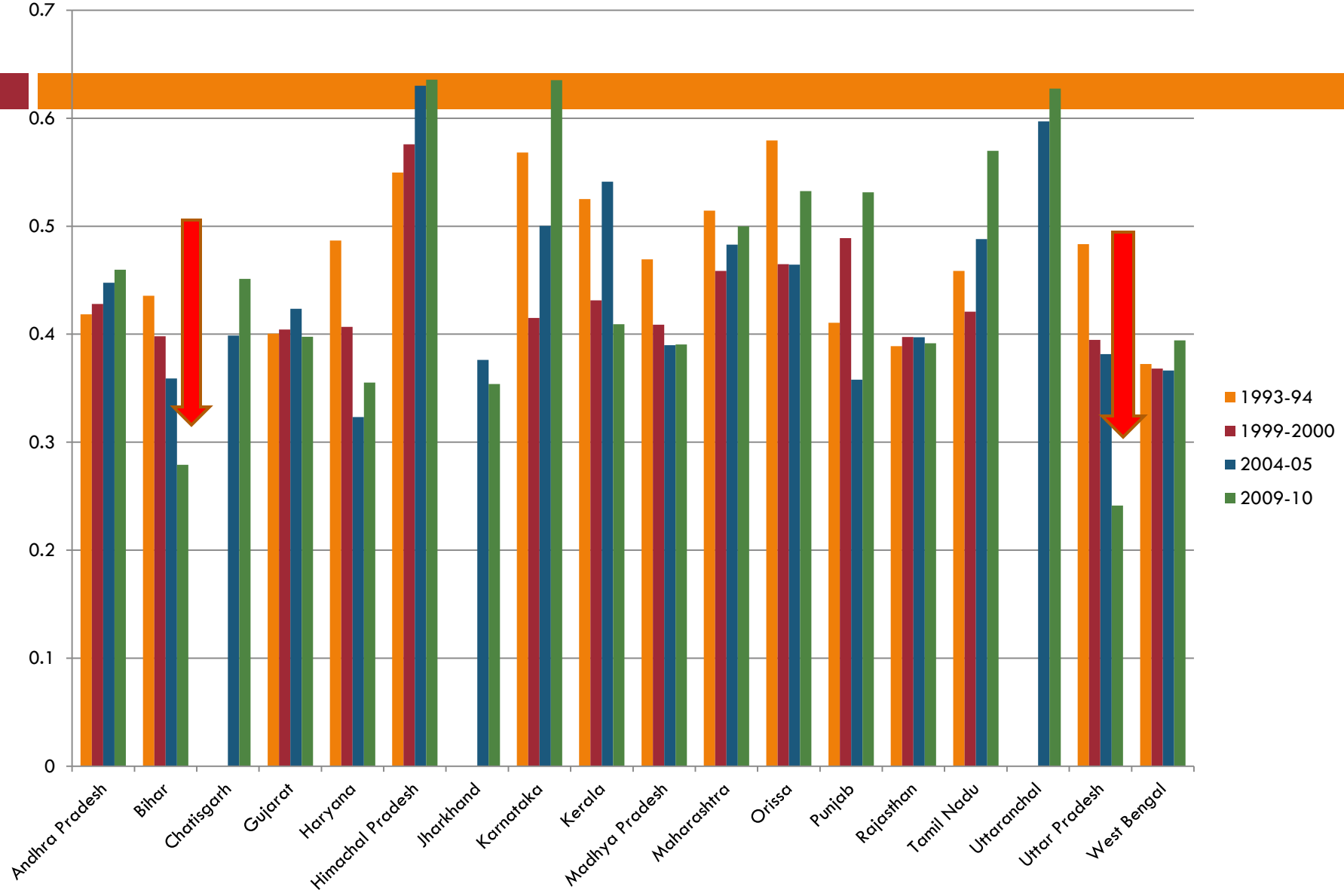
Framework


Indicators
Registered Vehicles
Electricity Consump
Hydro/Renewable
Higher Education
Length of Highways
Telephones
Food Production
Calorie Consump
Value Added-Pry
Dirty Fuels Use
Gini Coefficient
Unemployment
Urban to Rural Pop
Rural Pop to Crop Ar
Fertilizer per Ha.
Forest Area
Irrigated Area
Crop Diversity Index
Energy Security
Technology Diffu
Market Organization
Food Security
Welfare Contri
Social Justice
Population Pressure
Ecological Sensitivity
Resource Limits
Economic Stability
Social Equity
Exposure
Sustainability Index

Units of Analysis

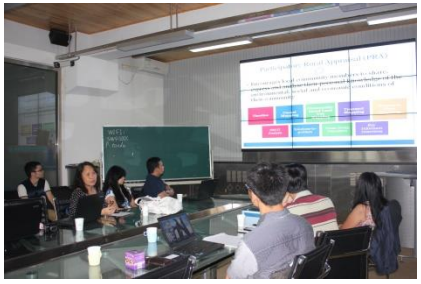
- State level data – all the major states are covered, excluding the North-Eastern states and small states
- Time points – four points covering the decades of 1990s and 2000s; 1993-94; 1999-2000; 2004-05; 2009-10
  - These years were chosen keeping in view data availability from large scale sample surveys of NSS rounds

Sustainability Index

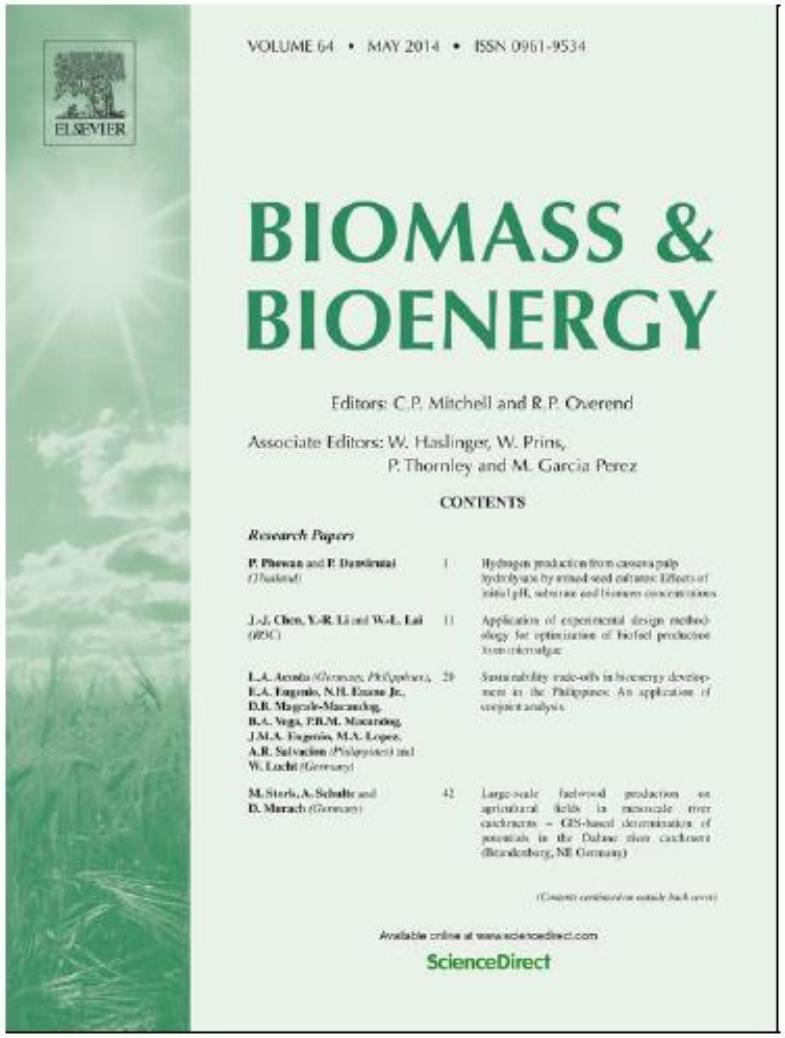


Framing Workshop

Beijing, China
July 20-27, 2014



Journal Publication



VOLUME 64 • MAY 2014 • ISSN 0961-9534

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BIOMASS & BIOENERGY

CONTENTS

Research Papers

BIOMASS AND BIOENERGY 64 (2014) 20–41

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Sustainability trade-offs in bioenergy development in the Philippines: An application of conjoint analysis

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ARTICLE INFO

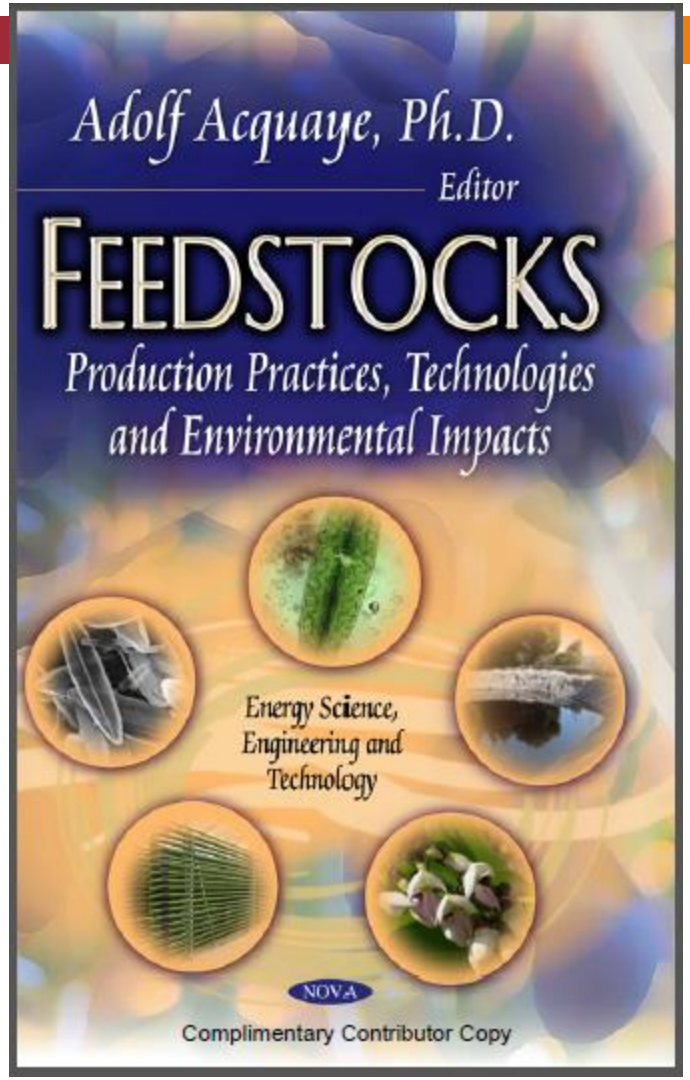
Article history:
Received 15 July 2013
Received in revised form
4 March 2014
Accepted 11 March 2014
Available online 8 April 2014

Keywords:
Bioenergy
Biofuels
Conjoint analysis
Philippines
Sustainability
Trade-off analysis

ABSTRACT

Sustainability assessments of bioenergy production are essential because it can have both positive and negative impacts on society. Human preferences that influence trade-off decisions on the relevant determinants and indicators of sustainability should be taken into account in these assessments. In this paper, we conducted a survey with five groups of respondents including government officials and employees, academic and research professionals, private company managers and workers, farm owners and workers, and others (e.g. students, residents, etc.) to assess their trade-off decisions on bioenergy development in the Philippines. The analyses of the survey results reveal that sustainability of bioenergy production will depend on the choice of biomass feedstock and these choices depend on people's perceptions. Heterogeneous perceptions among the different groups of respondents on the appropriate bioenergy feedstock to achieve economic, social and ecological sustainability suggest that sustainability of bioenergy is not a generic concept. The use of aggregate indices for sustainability assessments that ignore these perceptions on bioenergy production can thus be very misleading. The preference weights from conjoint analysis, which measure human preferences on different determinants and indicators of economic, social and ecological sustainability, can help improve sustainability assessments.

Chapter in a Book



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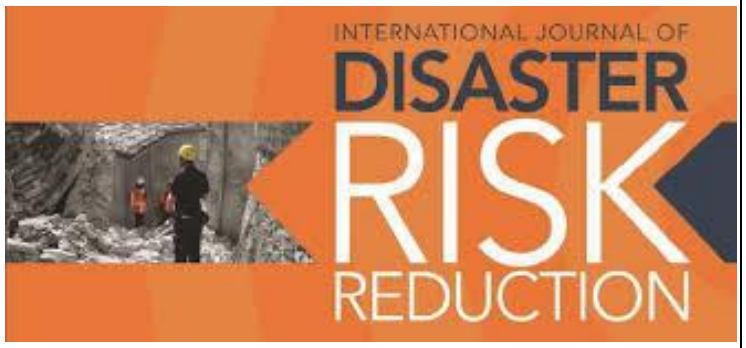

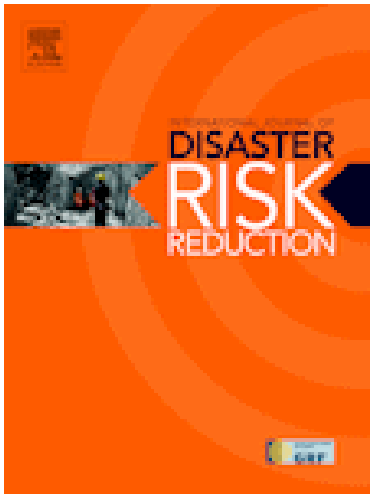

Elsevier Editorial System(tm) for International Journal of Disaster Risk Reduction
Manuscript Draft

Manuscript Number:

Title: Livelihood adaptation to impacts of extreme events in the Philippines: A decade after the typhoon-induced disasters in Infanta, Quezon

Article Type: Scientific Article

Keywords: Adaptation, Climatic Extremes, Disasters, Floods and landslides, Typhoons, Philippines

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Abstract: Four successive typhoons (Unding, Violeta, Winnie and Yoyong) hit Infanta, Quezon in December 2004 inducing landslides in the upland areas and inundating the lowland and coastal areas where flashfloods carrying logs, rocks and thick mud covered community settlements and agricultural farm. Farms in the lowland areas were buried in mud and rocks preventing cultivation for many years and causing communities to shift livelihood. The paper aims to understand the influence of the natural resource degradation on the typhoon-induced floods and landslides as well as to identify measures to reduce risk from and adapt to the impacts of these disasters. Household survey and participatory rural appraisal were conducted in three ecological zones (upland, lowland and coastal ecosystem) of the municipality of Infanta to study their livelihood adaptations. The survey data were analysed using factor, cluster and conjoint techniques. Using these analyses, adaptation gaps were identified and policy recommendations were presented including (i) develop vulnerability profile of communities to particular disaster impacts; (ii) enhance awareness on the available sources and types of adaptation support; (iii) provide loan for livelihood recovery at affordable repayment condition and with uncomplicated procedure; and (iv) strict implementation of environmental regulations and sustainable measures of integrating communities in environmental programs.

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