Experiences in Ecosystem Services Valuation in the Philippines

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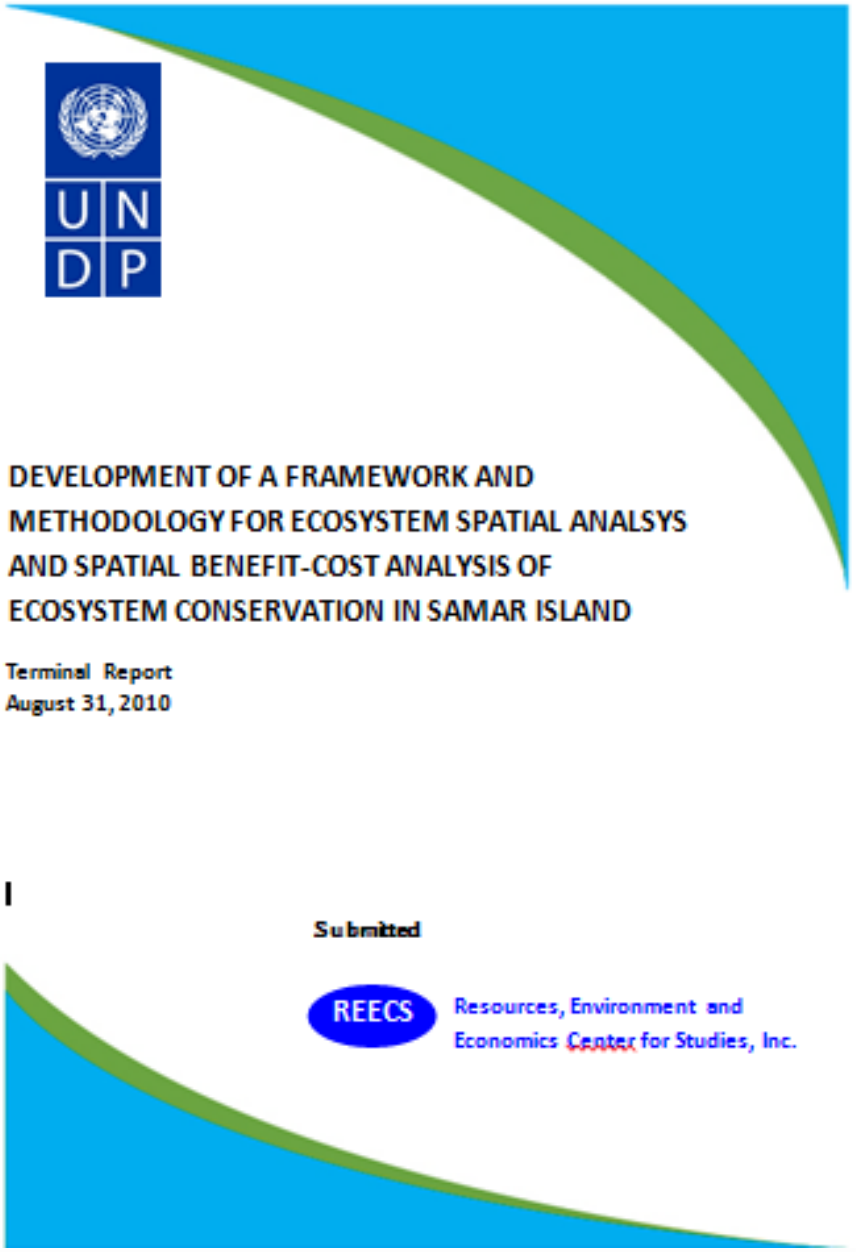
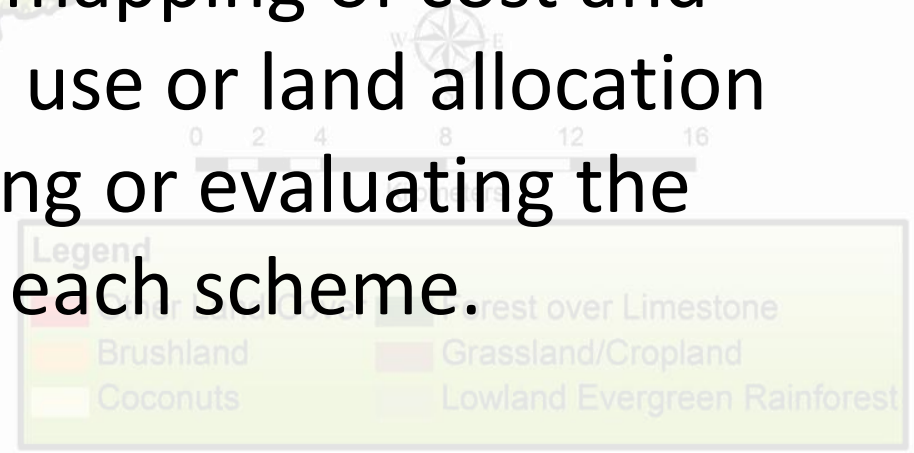
Wealth Accounting and Valuation of Ecosystem Services

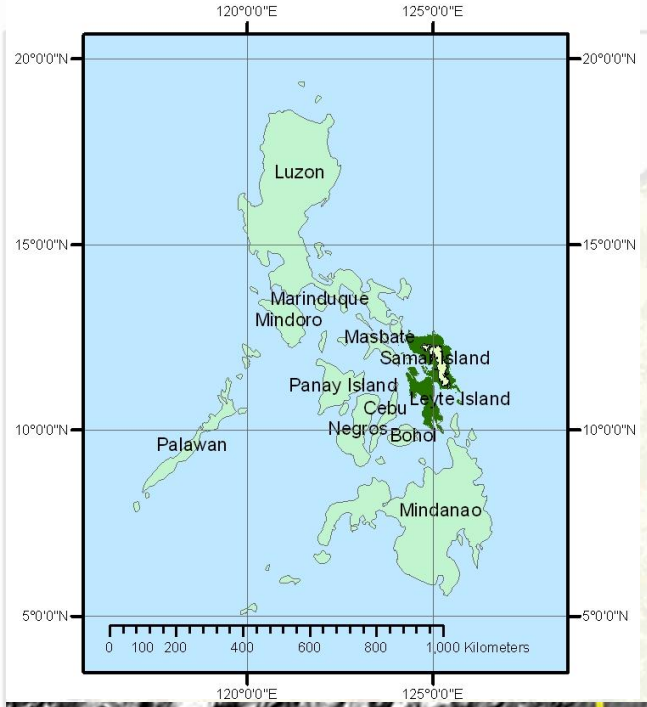
- Largely based on the UNDP-funded project conducted by Resources, Environment and Economics Center for Studies, Inc.
- Developing a framework for spatial cost-benefit analysis
- Based on valuation of ecosystem services
- Most values used are “benefits transfer”

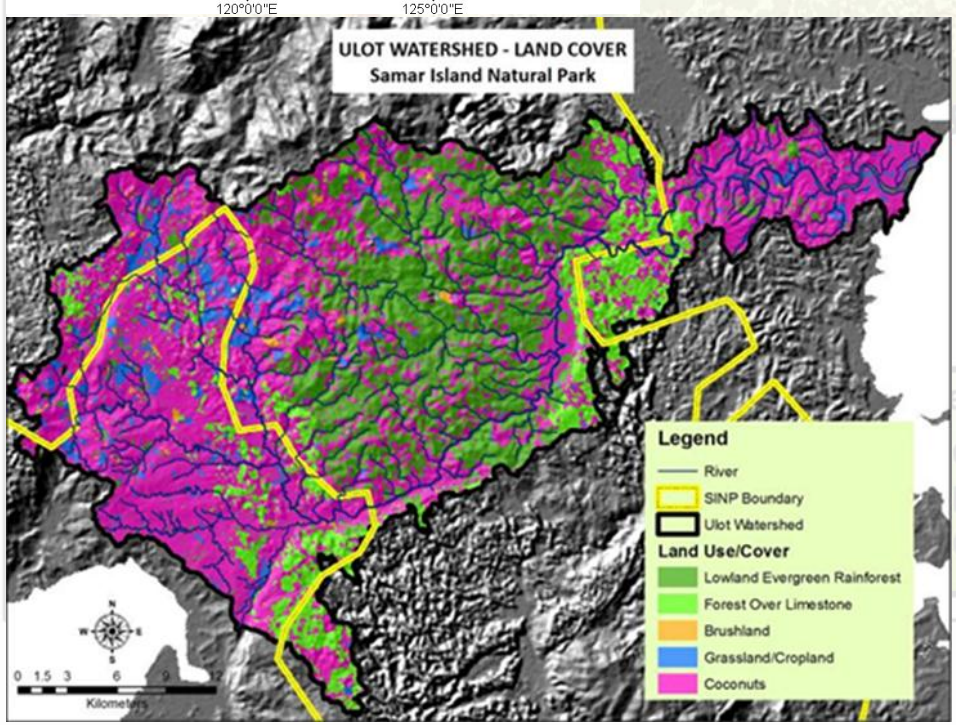


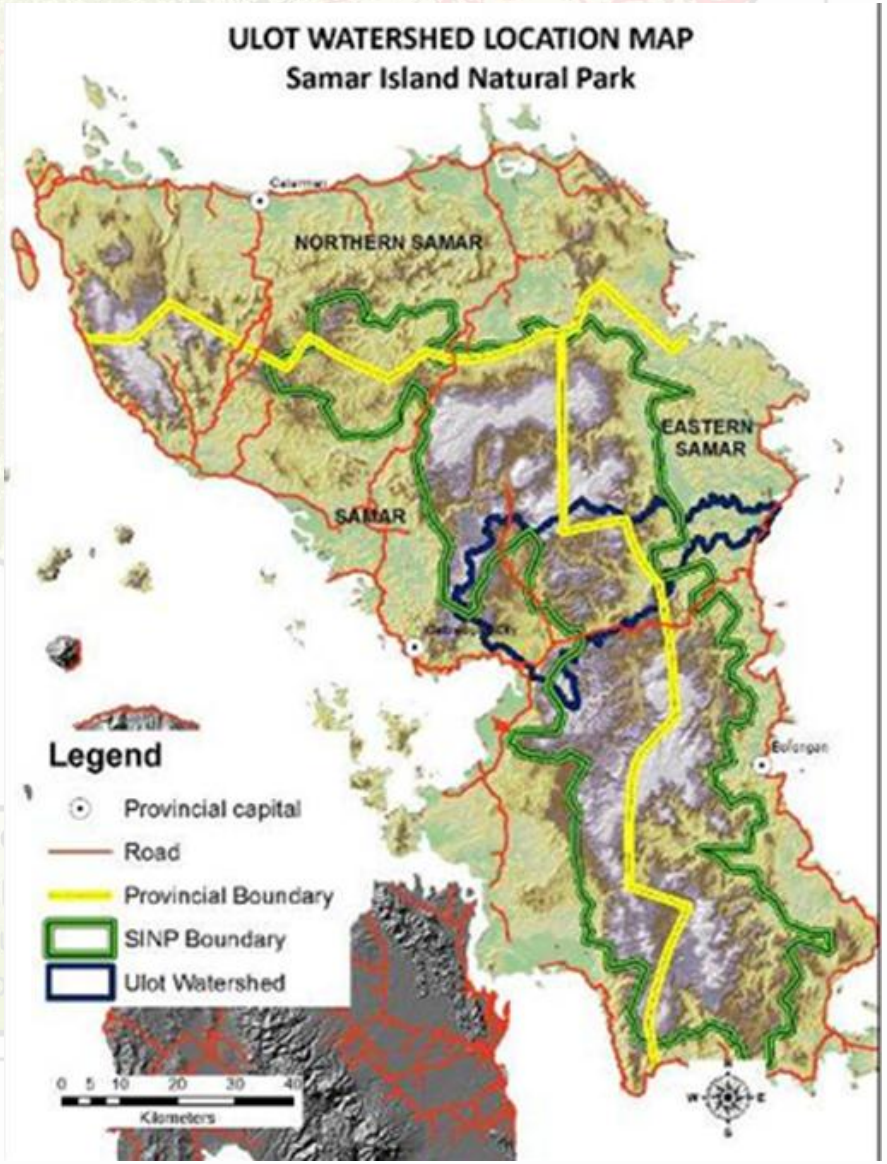
- Spatial BCA is simply incorporating spatial dimensions into the values derived from the BCA through application of mapping and other tools of spatial analysis.
- It is spatially explicit mapping of cost and benefits data of land use or land allocation schemes and analyzing or evaluating the opportunity costs of each scheme.



Samar Island Natural Park, Ulot Watershed

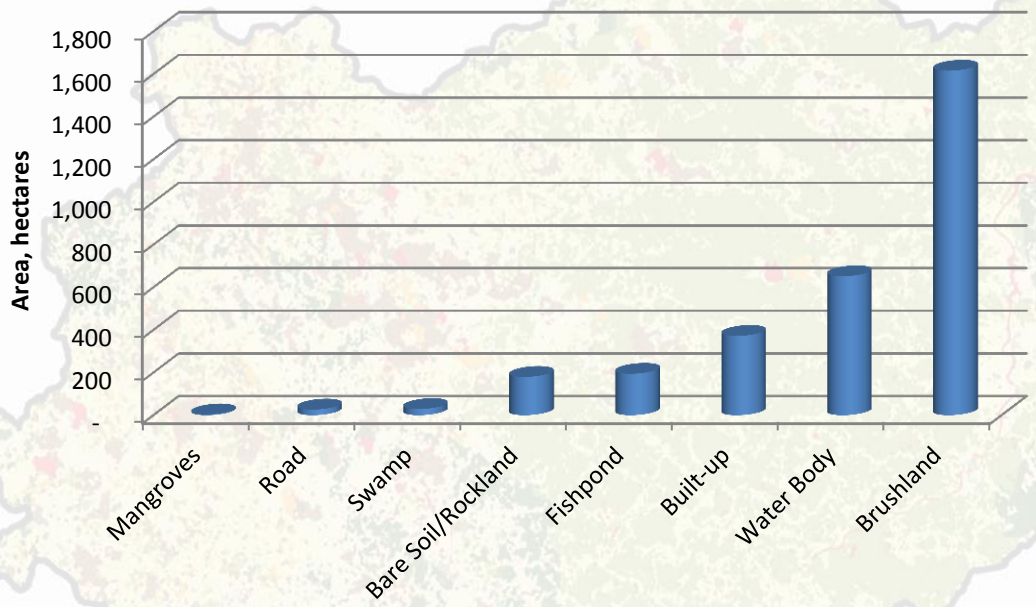




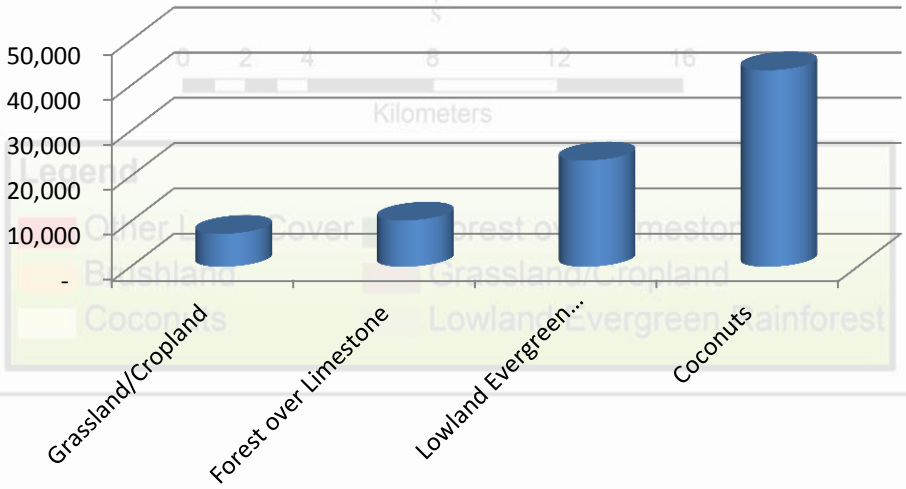


Land Cover Composition of the Ulot Watershed in the Samar Island Natural Park

Land Cover in the Ulot Watershed (Part 1)

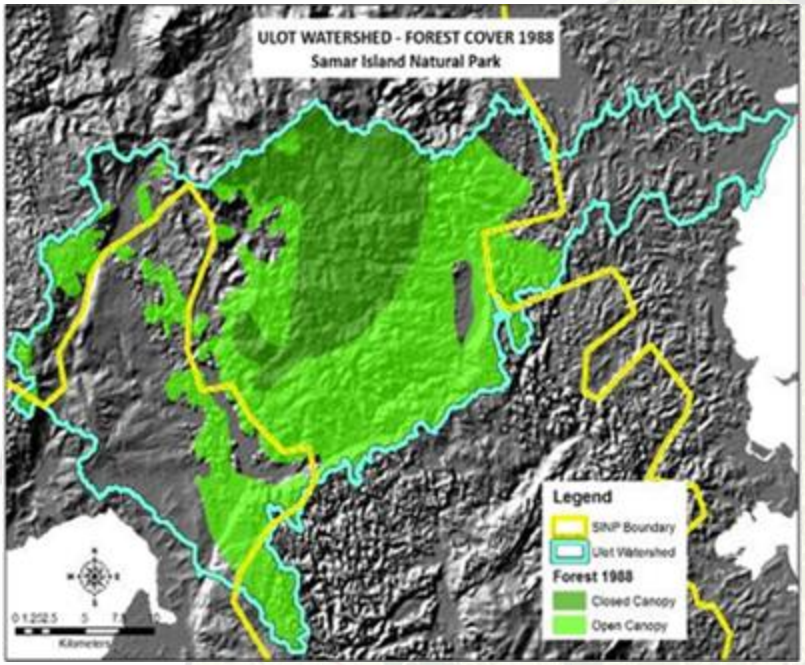


Land Cover in the Ulot Watershed (Part 2)

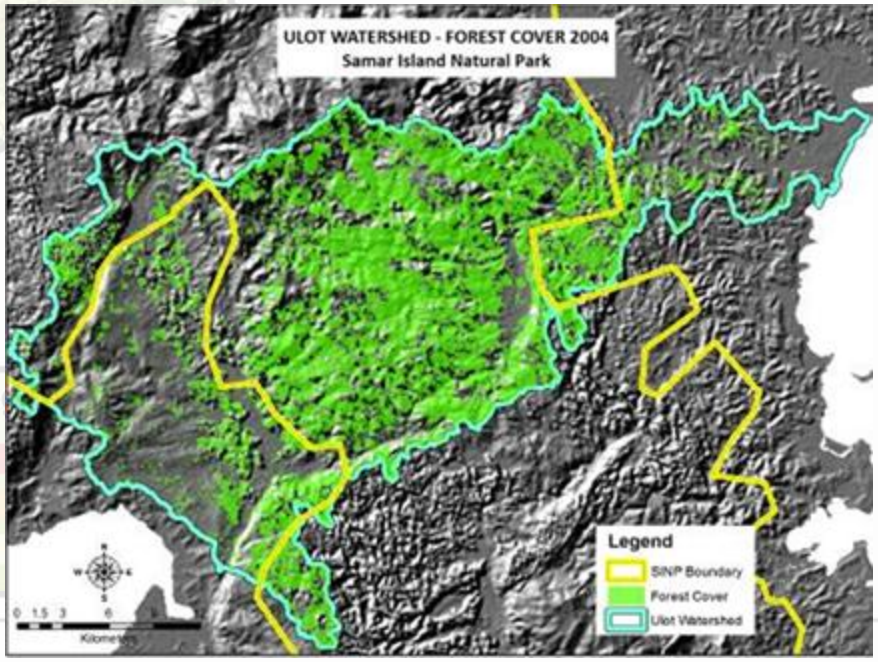


Forest Cover Change in the Ulot Watershed

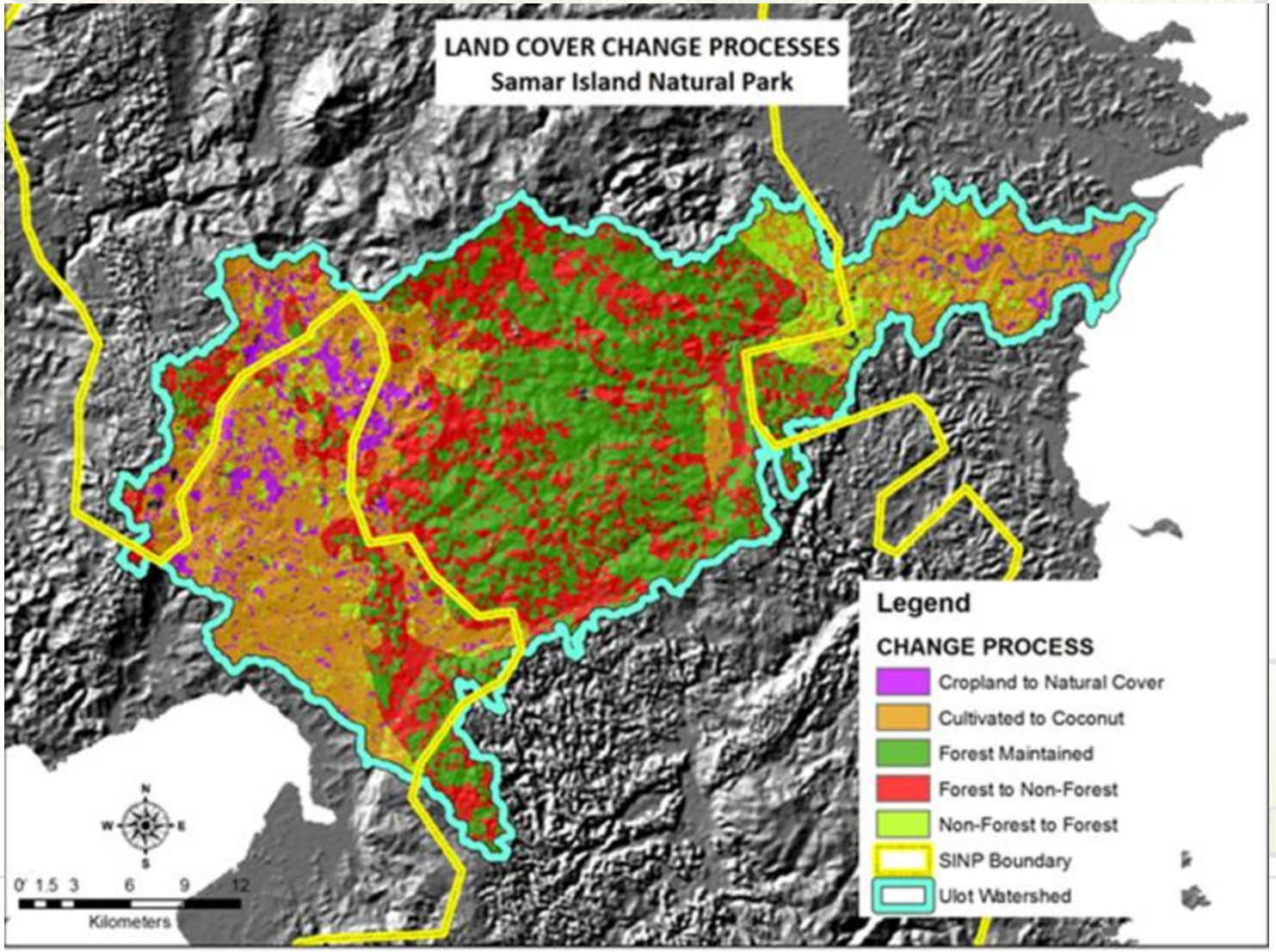
Forest Cover 1998



Forest Cover 2004

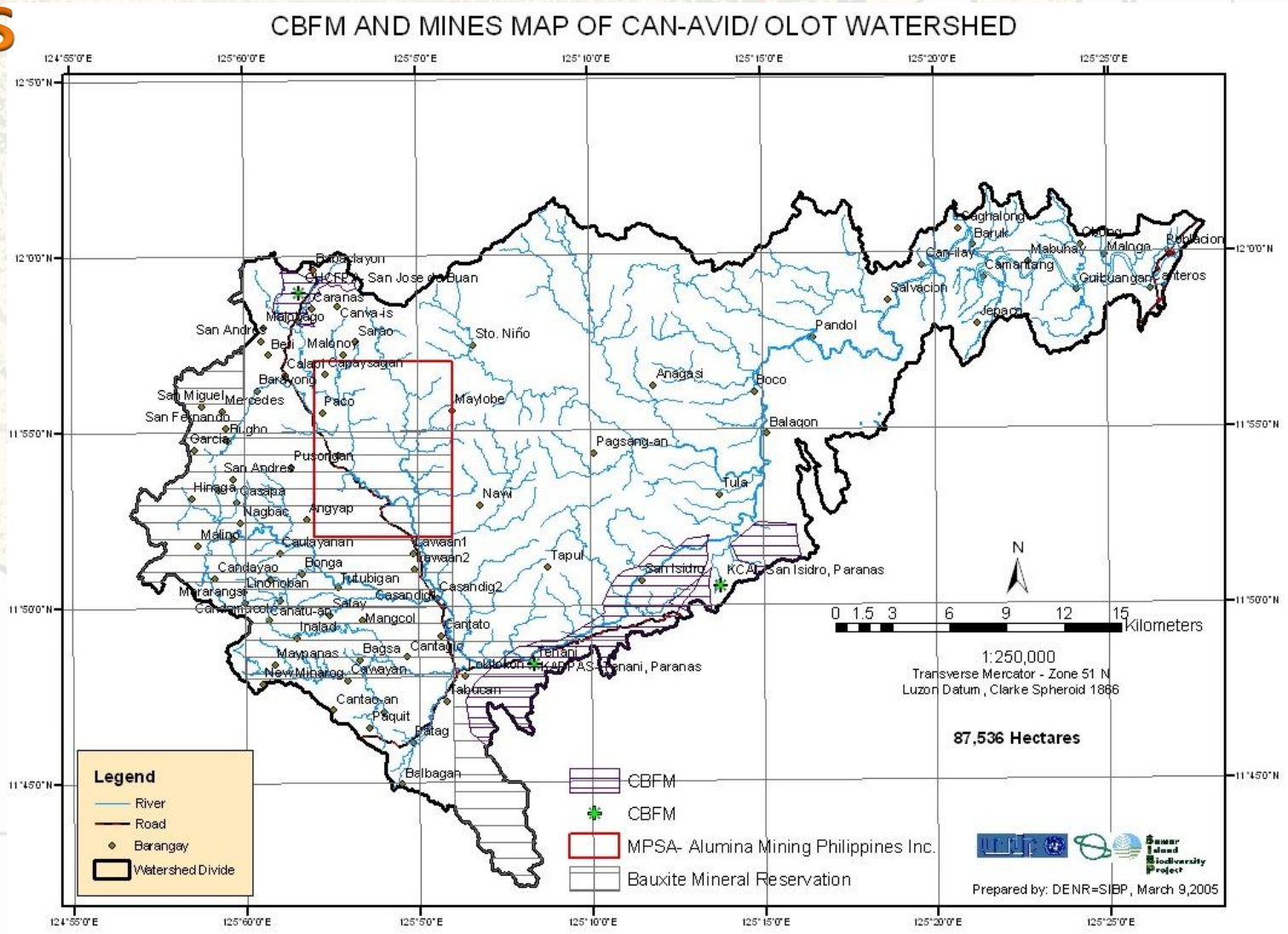


Land Cover Change Process

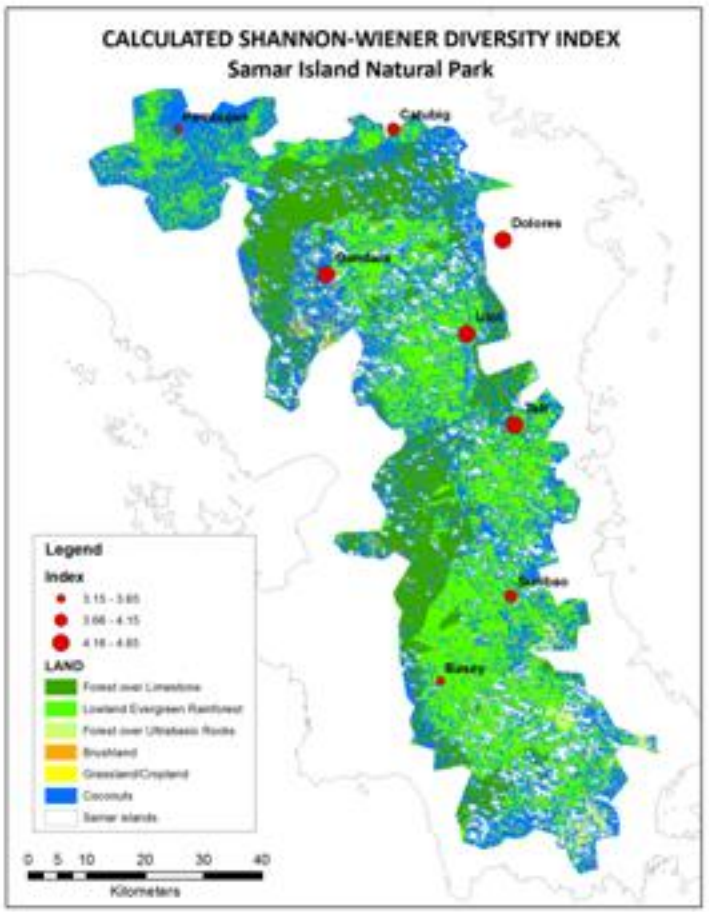


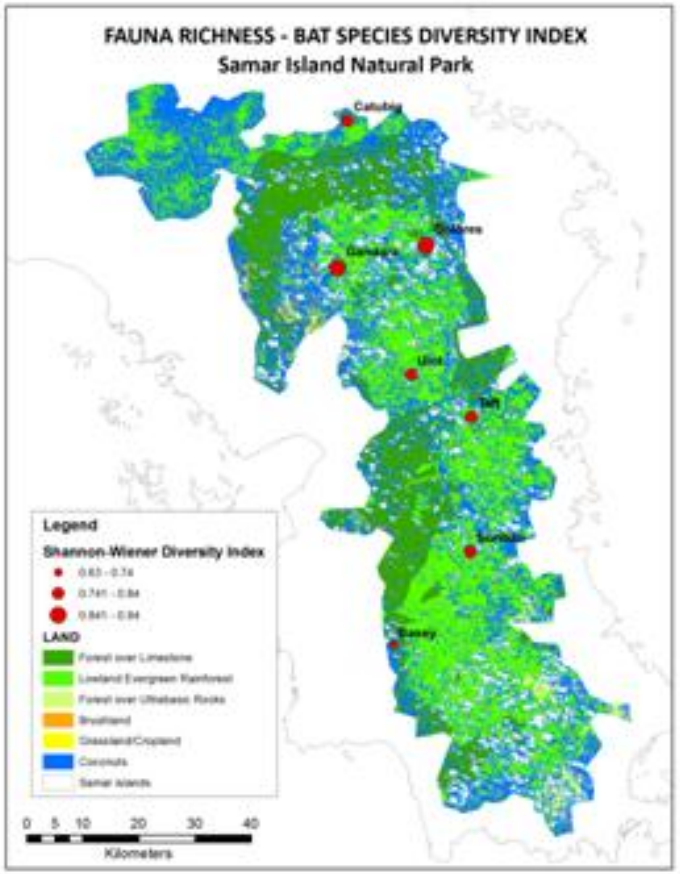
Land use conflicts

- **Conflicts of land use:**
  - **Protected Area**
  - **Community-based Forest Management**
  - **MPSA**
  - **Bauxite Mineral Reservation**

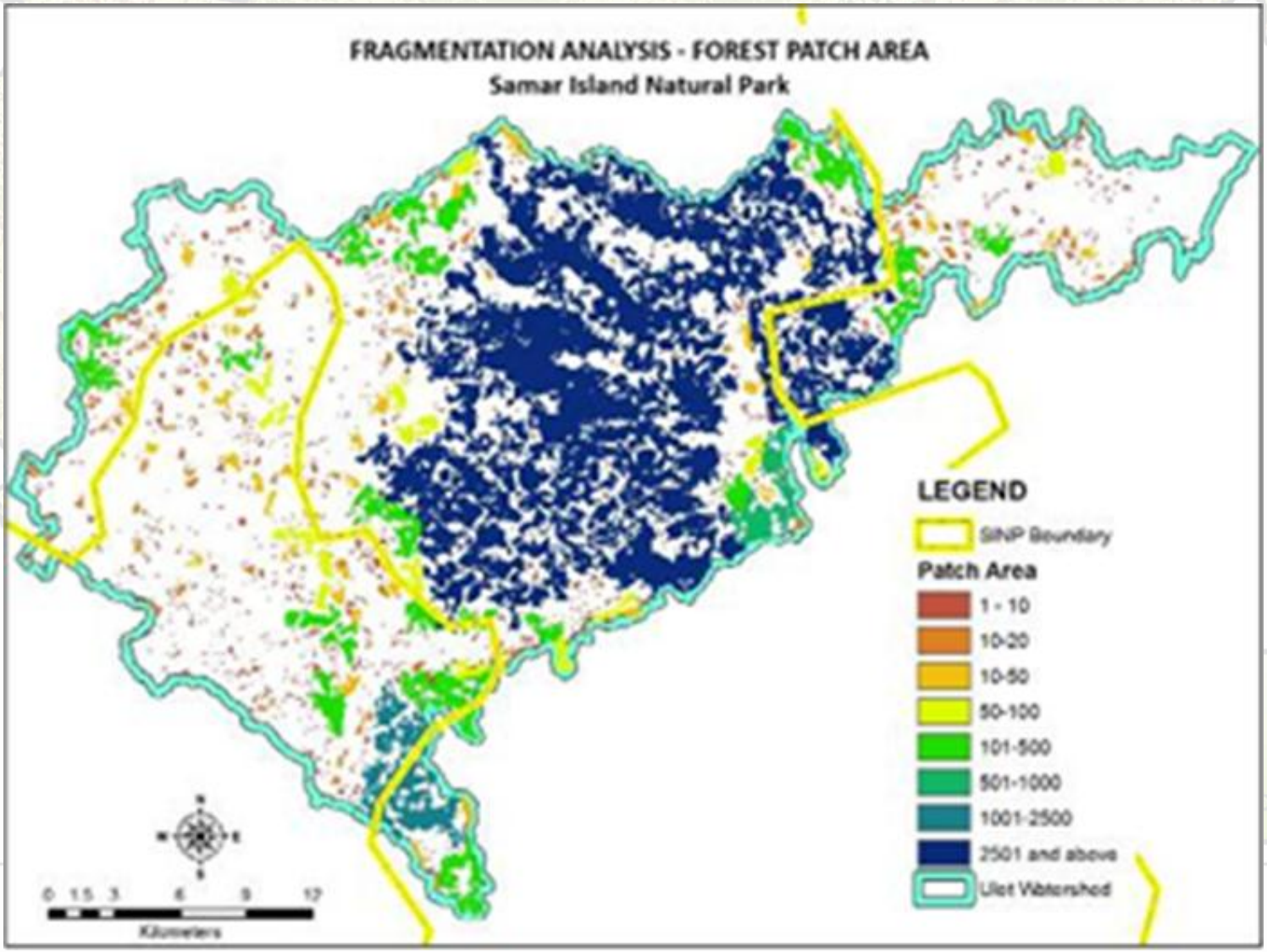


Biodiversity Information





Land cover fragmentation



Summary of Analysis of Structure

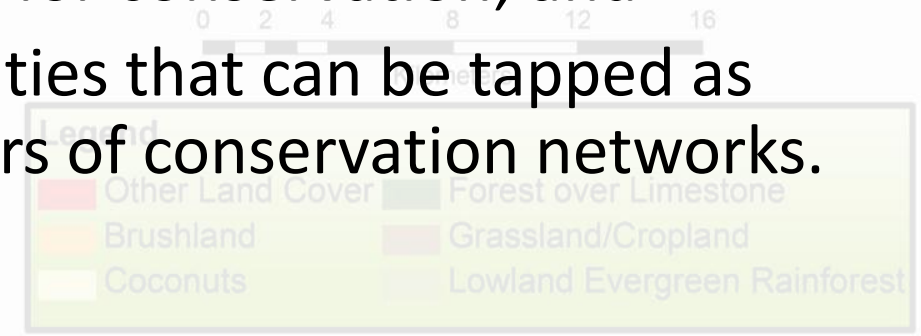
Area Metric	Number of Patches	% of No Patches	Area in Hectares	% of Total Area
1-10	1,045	87.37	2,549	8.41
11-20	68	5.69	997	3.29
21-50	42	3.51	1,282	4.23
51-100	17	1.42	1,279	4.22
101-500	20	1.67	1,279	4.22
500-18,266	4	0.33	22,933	75.64
Total	**1,196**		**30,319**	

Objectives of the ESA and Spatial BCA

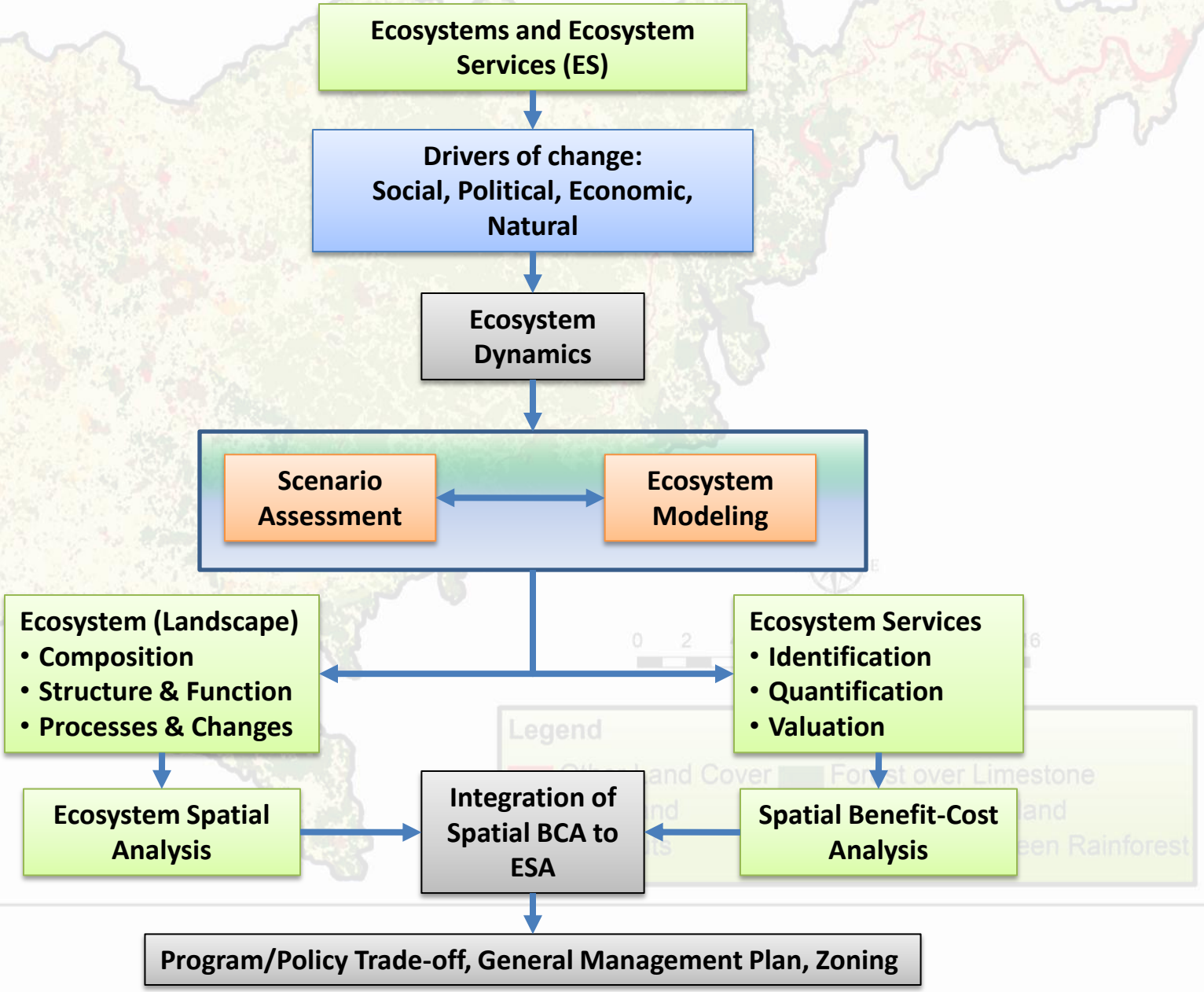
1. Present biodiversity and sustainable management areas within the SINP and provide spatial explicit information of its present condition;
2. Explicitly identify focal ecosystem services such (e.g. watershed services) provided by the SINP to be recommended for sustained management;
3. Identify habitats of viable populations of terrestrial species (endangered or threatened) within the Park to be recommended for maintenance and protection;

Objectives of the ESA and Spatial BCA

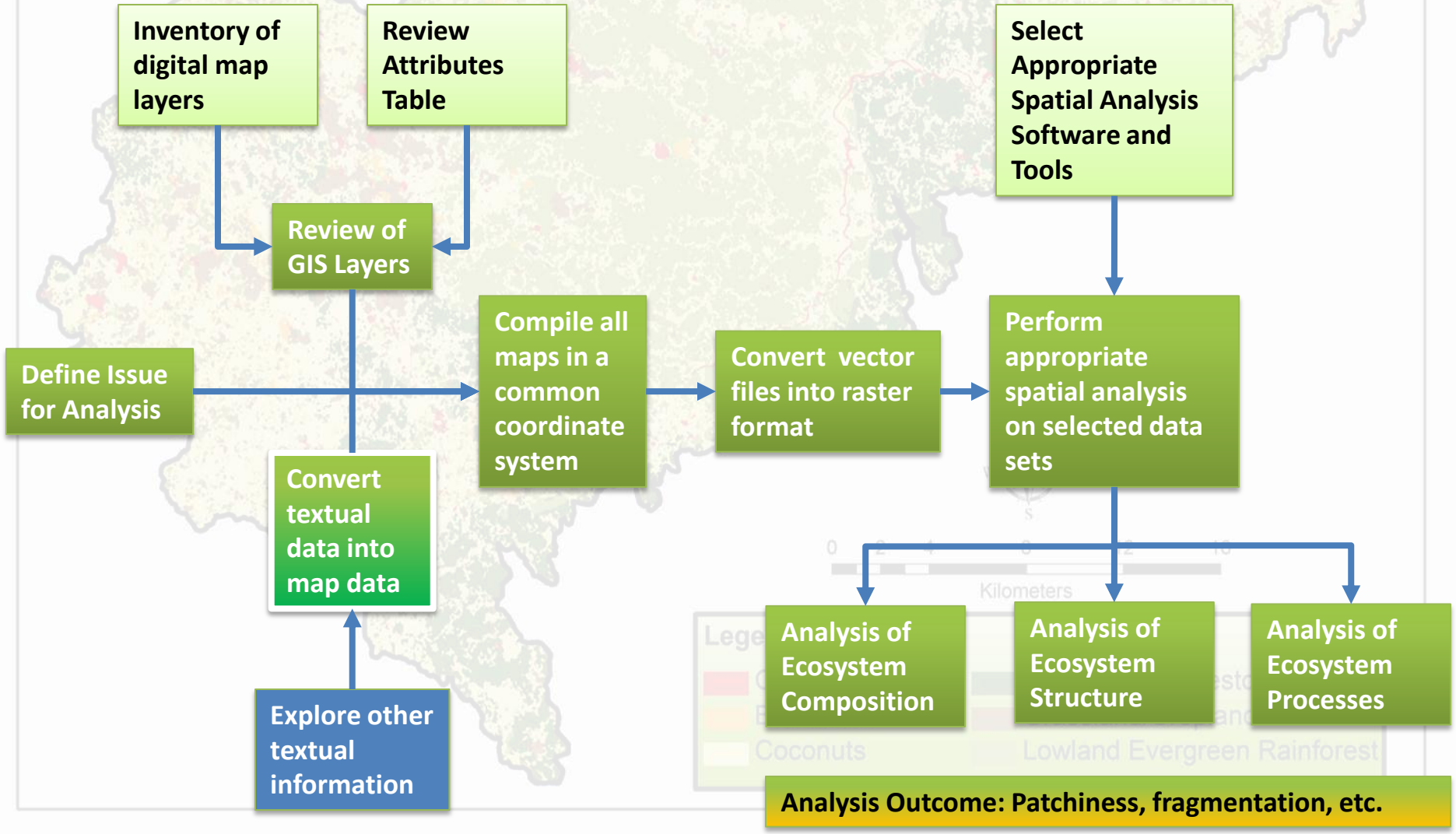
4. Identify a network of areas for cost-effective conservation that will be resilient to environmental change, and areas where sustainable use can be allowed for the welfare of communities within the Park;
5. Spatially incorporate ecological and economic criteria for prioritizing and management of conservation areas and focal species for conservation; and
6. Identify focal communities that can be tapped as partners or co-managers of conservation networks.



Ecosystem Spatial Analysis and Valuation Framework



General Steps in ESA

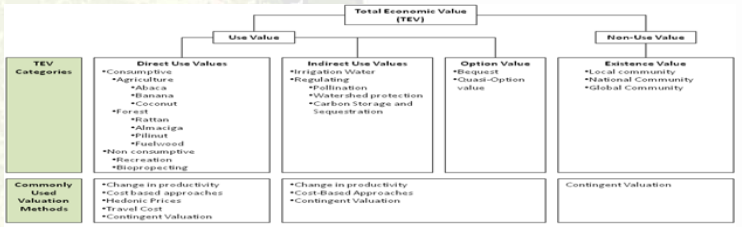


General Steps in Spatial CBA

1. Identification of Ecosystem Services

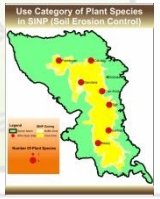
2. Quantification of Ecosystem Services

3. Valuation of Ecosystem Services



4. Analysis of Benefits and Costs of Ecosystems

5. Integration of ecosystem values to geospatial data and analysis



Ecosystem Services Identified

Classification of Ecosystems
- *Forest*
- *Brushland*
- *Grassland*
- *Agriculture*
- *Coastal*
- *Others*

Classification of Ecosystem Services by Ecosystems
- *Provisioning*
- *Regulating*
- *Cultural*
- *Supporting*

Regulating
Carbon Sequestration
Agroforestry
Brushland
Grassland
Mangrove
Mossy
Old Growth
Residual
Tree Plantation
Carbon Storage
Agroforestry
Brushland
Grassland
Mangrove
Mossy
Old Growth
Residual
Tree Plantation
Pollination
Watershed Protection

Provisioning
Abaca
Almaciga
Banana
Bioprospecting
Coconut
Fuelwood
Irrigation water
Mineral
Pilinut
Rattan
Recreation/Tourism
Timber (natural)
Vines

Cultural
Existence/Bequest Values
Global Community
Local community
National community

Supporting
Biodiversity
Depletion of soil

Quantifying Ecosystem Services

1. **Identification of Ecosystem Services**
2. **Quantify Ecosystem Services**
3. **Valuation of Ecosystem Services**
4. **Analysis of Benefits and Costs of Ecosystems**
5. **Integration of ecosystem values to geospatial data and analysis**

Measurement of Ecosystem Services
- *Distances*
- *Weights*
- *Areas*
- *Number*
- *Frequencies*
- *Visits*

Estimation of Component Services by Ecosystems
- *Forest*
- *Brushland*
- *Grassland*
- *Agriculture*
- *Aquatic*

Conversion to per hectares quantities
(Spatially-explicit ES)

Application of ES Quality Weights by Ecosystems
- *% ES in Forest*
- *% of ES in Brushland*
- *% of ES in Grassland*
- *% of ES in Agriculture*
- *% of ES in Aquatic*

Quantifying Ecosystem Services

Ecosystem Services	Brushland	Coconut	Forest Over Limestone	Grassland/Cropland	Lowland Evergreen
Abaca	0%	0%	30%	0%	30%
Banana	0%	0%	20%	0%	20%
Coconut	0%	100%	10%	0%	50%
Rattan	0%	0%	100%	0%	100%
Almaciga	0%	0%	100%	0%	50%
Pilinut	0%	0%	20%		
Fuelwood	100%	100%	100%		
Irrigation water	0%	0%	100%		
Recreation/Tourism	0%	0%	100%		
Bioprospecting	0%	0%	100%		
Pollination	0%	0%	100%		

Ecosystem Services	Brushland	Coconut	Forest Over Limestone	Grassland/ Cropland	Lowland Evergreen
Watershed Protection	0%	0%	100%	0%	100%
Carbon Sequestration					
Old Growth	0%	0%	100%	0%	100%
Residual	0%	0%	100%	0%	100%
Mossy	0%	0%	0%	0%	0%
Mangrove	0%	0%	0%	0%	0%
Tree Plantation	0%	0%	100%	0%	100%
Agroforesti					
Brushland					
Grassland					
Carbon Storag					
Old Grow					
Residual					
Mossy					
Mangrove					
Tree Plan					
Agrofores					
Brushland					
Grassland					

Ecosystem Services	Brushland	Coconut	Forest Over Limestone	Grassland/ Cropland	Lowland Evergreen
Existence/Bequest Values					
Local community	0%	0%	100%	0%	100%
National community	0%	0%	100%	0%	100%
Global Community	0%	0%	100%	0%	100%
Mineral	100%	100%	0%	100%	0%
Water Pollution	100%	100%	0%	100%	0%
Soil Erosion	50%	50%	25%	50%	25%
Forest Fire Suppression	100%	0%	100%	100%	100%
Timber (natural)	0%	0%	0%	0%	0%
Biodiversity	0%	0%	100%	0%	100%
Vines	0%	0%	100%	0%	100%
Soil Erosion Control	100%	100%	100%	100%	100%

Step 1- Occurrence of Ecosystem Services

(a) Mapping/remote sensing

(b) Field Surveys

(c) Experts assessment

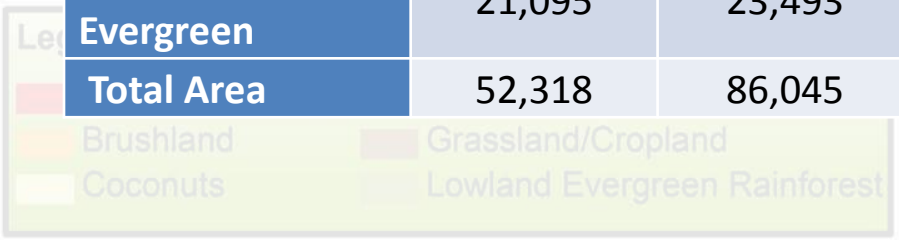
Quantifying .... Coverage of the Project

Land Cover

Map Coverage	Count of COVER	Total Area, Hectares
(Bare Soil/Rockland)	172	180
Brushland	789	1,616
(Built-up)	194	372
Coconuts	21,751	43,413
(Fishpond)	294	194
Forest over Limestone	5,189	10,228
Grassland/Cropland	3,494	7,295
Lowland Evergreen	21,095	23,493
(Mangroves)	12	3
(Road)	5	27
Swamp	68	29
(Water Body)	4	652
Grand Total	16,935	87,503

Ecosystems Covered

COVER	Count of COVER	Sum of HECTARES
Brushland	789	1,616
Coconuts	21,751	43,413
Forest over Limestone	5,189	10,228
Grassland/ Cropland	3,494	7,295
Lowland Evergreen	21,095	23,493
Total Area	52,318	86,045



Quantifying …

Banana Production	Year 1	2	3	4	5	Total	ave
Total yield per hectare (kg)		38,200	27,600	14,800	11,300	91,900	22,975
Class A (kg)	12,060	22,920	16,560	8,880	6,780	67,200	13,440
Class B (kg)	6,030	11,460	8,280	4,440	3,390	33,600	6,720
Class C (kg)	2,010	3,820	2,760	1,480	1,130	11,200	2,240

Abaca Production	Total production per hectare	Projected Price/kg
Year1		
Year2	600	40
Year3	1,800	42
Year4	2,400	44
Year5	2,400	46
Year6	2,400	49
Year7	2,400	51
Year8	2,400	54
Year9	2,400	56
Year10	2,400	59
average	2,133	49

Coconut	Yield (kg)
Year 1	
Year 2	
Year 3	
Year 4	
Year 5	-
Year 6	300
Year 7	600
Year 8	900
Year 9	1,200
Year 10	1,500
Year 11	2,000
Year 12	2,000
Average	1,063

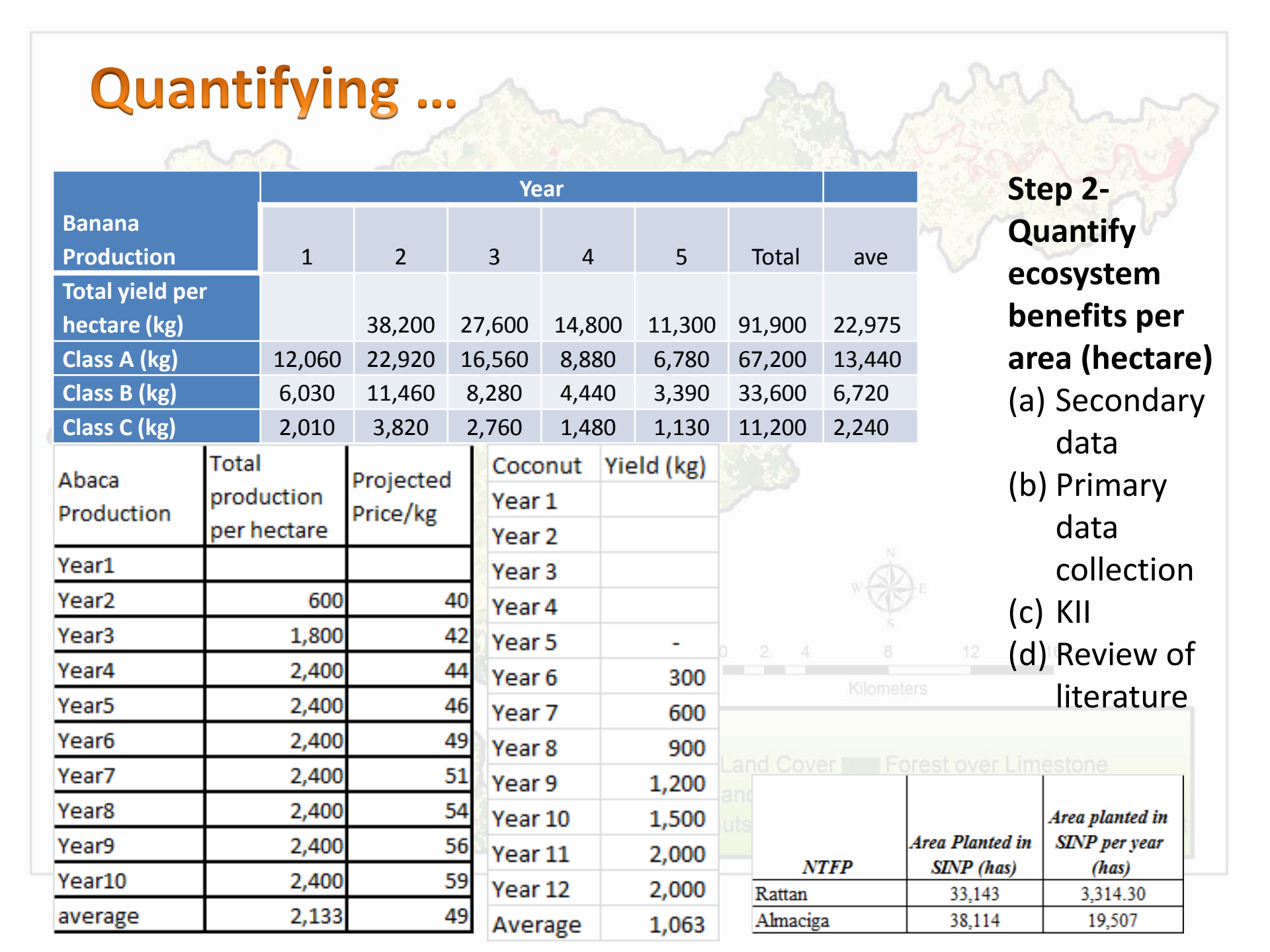
Step 2- Quantify ecosystem benefits per area (hectare)

(a) Secondary data

(b) Primary data collection

(c) KII

(d) Review of literature



NTFP	*Area Planted in SINP (has)*	*Area planted in SINP per year (has)*
Rattan	33,143	3,314.30
Almaciga	38,114	19,507

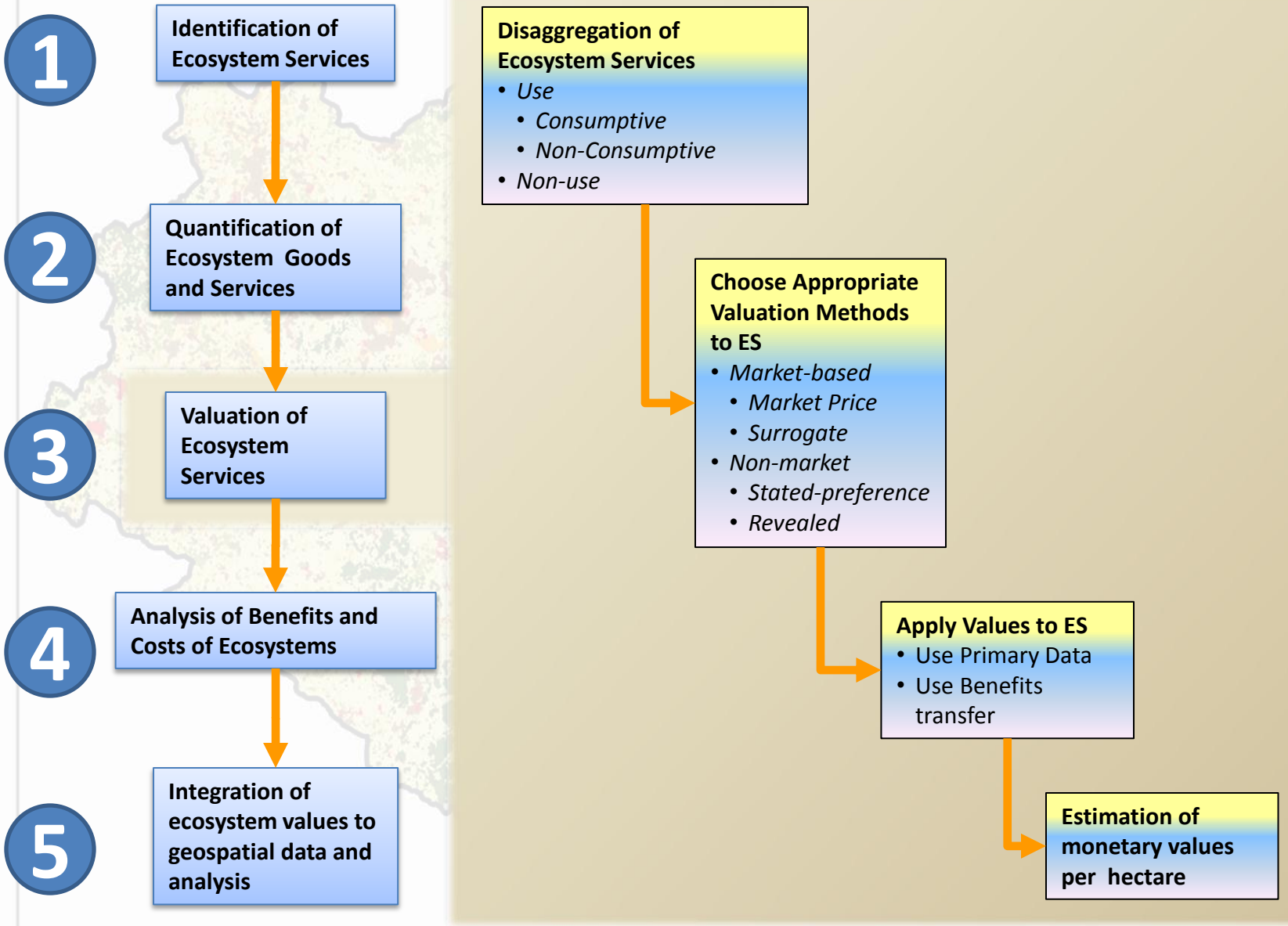
Quantifying Ecosystem ….

Tourism Data

	Tourist Arrivals						
Tourism Data	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2008 expected*
Philippines	3,233,456	13,102,755	15,170,606	16,264,651	19,853,272	16,698,793	
Region VIII	47,245	168,943	164,542	203,569	238,679	110,330	238,679
Eastern Samar	642	2,377	1,377	4,258	1,844	16,415	1,844
borongan					13843		13,843
calbayog				2254	133		133
catbalogan					6065		6,065
Samar					1438	2035	1,438
Northern samar					23975	6555	23,975
growth rate		258%	-3%	24%	17%		
average growth rate, 2003-2007		74%					

Carbon Storage and Sequestration Data

Ecosystems/Forestlands	Carbon Content	Carbon, t/ha	Carbon Sequestration, t/ha/yr
Old Growth Forest	50%	212.5	0.9
Mossy	45%	183.8	nd
Pine	49%	90.1	nd
Sub-marginal Forest	nd	nd	nd
Mangrove	44%	176.8	
Second Growth Forest	45%	207.9	1.1
Brushland	45%	29	4.3
Tree Plantations	varies widely	59	4.2
Openland/Grassland	43%	12.1	nd
Agroforestry	45%	45.4	5.3
Agricultural crops/Kaingin			
Non-vegetated Land		0	
Built-up area			


1
Identification of Ecosystem Services
2
Quantification of Ecosystem Goods and Services
3
Valuation of Ecosystem Services
4
Analysis of Benefits and Costs of Ecosystems
5
Integration of ecosystem values to geospatial data and analysis
Disaggregation of Ecosystem Services
• Use
• Consumptive
• Non-Consumptive
• Non-use
Choose Appropriate Valuation Methods to ES
• Market-based
• Market Price
• Surrogate
• Non-market
• Stated-preference
• Revealed
Apply Values to ES
• Use Primary Data
• Use Benefits transfer
Estimation of monetary values per hectare

Valuation of Ecosystem Services

(a) Price Data on Provisioning Services

(Adjusted for inflation, exchange rates, traded goods distortions shadow wage rates, purchasing power parity)

(b) Benefits transfer values adjusted to local condition

Water quality improvement: Choe, K.C., Whittington, D., & Lauria, D.T. (1996). The economic benefits of surface water quality improvements in developing countries: a case study of Davao, Philippines. Land Economics, 72(4), 519-537.

Carbon storage and sequestration: Leonor I. Castro, January 2000. Estimation and valuation of the carbon storage function of the Angat River Watershed and Forest Area. ENRAP IV Technical Paper

Others…

(a) Valuation studies in the same site

Valuation of Ecosystem Services

(d) Obtain values per hectare of ecosystem services benefits

Ecosystem Services	Unit of Measure	Unit Values, PhP
Carbon Sequestration Old Growth	PhP/ha	1,204
Carbon Sequestration Residual	PhP/ha	1,472
Carbon Sequestration Mossy	PhP/ha	1,204
Carbon Sequestration Mangrove	PhP/ha	1,204
Carbon Sequestration		
Carbon Sequestration		
Carbon Sequestration		
Carbon Sequestration		
Carbon Storage Old G		
Carbon Storage Resid		
Carbon Storage Moss		
Carbon Storage Mang		
Carbon Storage Tree I		
Carbon Storage Agrof		
Carbon Storage Brush		
Carbon Storage Grass		

Ecosystem Services	Unit of Measure	Unit Values, PhP
Existence/Bequest Values Local comm	PhP/area	9
Existence/Bequest Values National cor	PhP/area	4,948
Existence/Bequest Values Global Com	PhP/area	41,136
Depletion of soil	PhP/ha	38,825
Mineral (Extraction)	PhP/ha	1,000,000
Water Pollution (Lost fishing income fr	PhP/area	6,717
Soil Erosion from Upland Farming	PhP/ha	4,965
Forest Fire	PhP/ha	935
Timber harvest in natural forests	PhP/ha	34,630
Biodiversity	PhP/ha	1,413
Tourism	PhP/Area	37,883
Vines	PhP/ha	
Mining Damage Remediation	PhP/ha	3,259
Watershed Management Cost	PhP/ha	12,231
Soil Erosion from Infrastructure Develc	PhP/ha	
Surface reclamation (dirt-moving, reco	PhP/ha	372,315

Ecosystem Services	Unit of Measure	Unit Values, PhP
Abaca	PhP/ha	4,487
Banana	PhP/ha	148,562
Coconut	PhP/ha	693
Rattan	PhP/ha	859
Almaciga	PhP/ha	440
Pilinut	PhP/ha	698
Fuelwood	PhP/ha	3,850
Irrigation water	PhP/cum	49,815
Recreation	PhP/Area/ Person	295
Bioprospecting	PhP/ha	548
Pollination	PhP/ha	-
Watershed Protection	PhP/Unit	855

Data on Coconut

- DATA USED
  - Cost and returns of planting hybrid or coconut in a 1 hectare plantation
  - Annual Farmgate Prices of copra
- Sources of Data
  - Philippine Coconut Authority
  - Bureau of Agricultural Statistics
  - In the Philippines, around 10% of all coconut planted are hybrid while the rest are local variety (PCA)
- Margin of profit is 30% of production cost

Valuation of Coconut

1. Set up the costs and returns table for both coconut varieties
2. Compute the average price of copra for 2008
3. Adjust the prices in the costs and returns tables
4. Subtract from net income the margin of profit to obtain the resource rents
5. Multiply the resource rent to the area devoted to coconut to get aggregate economic value
6. Compute the weighted average of the resource rents of hybrid and local varieties of coconut to get the approximation of the coconut value/hectare

Per hectare value of coconut = Resource $rent_{hybrid}$(.10) + Resource $Rent_{local}$ (.90)

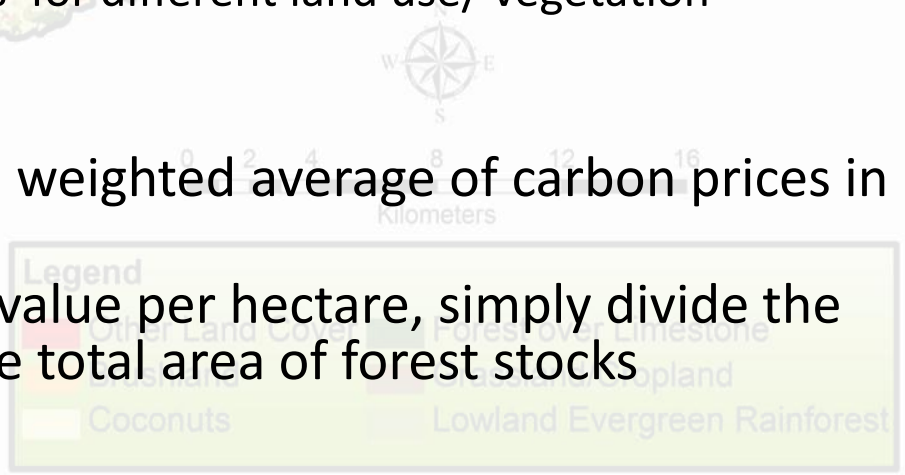
Sample Spreadsheet

COST AND RETURN OF PLANTING HYBRID COCONUT													
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Average
Yield					200	700	1300	1800	2300	2800	2800	2800	1837.5
Price per unit (kg)	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26	25.26
Revenue	0	0	0	0	5052	17682	32838	45468	58098	70728	70728	70728	30943.5
Production costs	17680	6260	7240	8800	10404	13864	16576	18836	21096	23356	23356	23356	15902
Labor costs	9520	2800	2800	2800	3564	5474	7766	9676	11586	13496	13496	13496	
Material inputs	8160	3460	4440	6000	6840	8390	8810	9160	9510	9860	9860	9860	
Net Income	-17680	-6260	-7240	-8800	-5352	3818	16262	26632	37002	47372	47372	47372	15041.5
Margin of Profit (loss) 30% of Prod. Cost	5304	1878	2172	2640	3121.2	4159.2	4972.8	5650.8	6328.8	7006.8	7006.8	7006.8	4770.6
Resource Rent	-22984	-8138	-9412	-11440	-8473.2	-341.2	11289.2	20981.2	30673.2	40365.2	40365.2	40365.2	10270.9
Area devoted to Coconut													15090.79
Aggregated Economic Value (Php M)													155
NPV at 12%													3455.67
NPV at 15%													2935.45

Carbon Sequestration

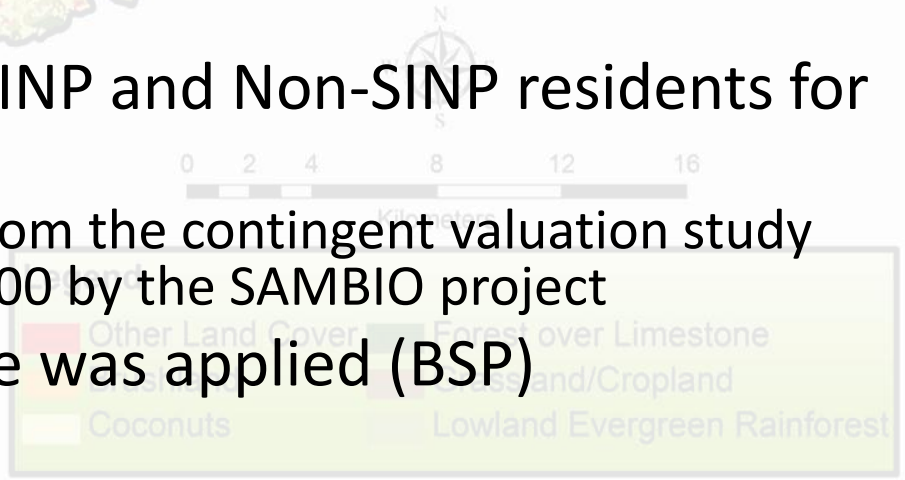
- The valuation used in the 2005 valuation study is applied
- It is based on A GHG inventory manual and workbook developed by Villarin et al (1999)

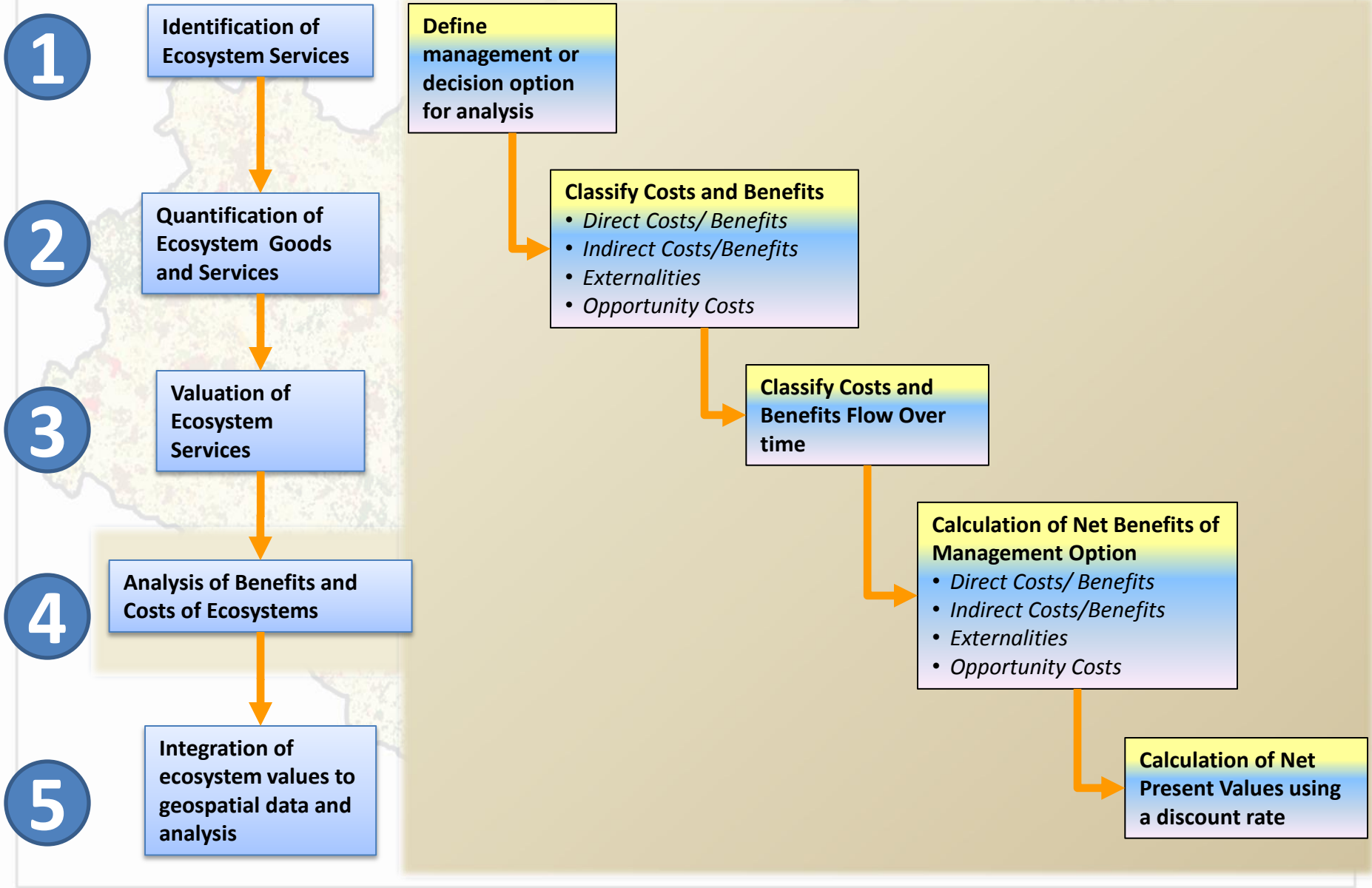
- Assumptions
  - The following are adopted from the 2005 study
    - biomass accumulated rates for different land use/ vegetation
    - Biomass accumulation
    - Sequestration rates
  - Only carbon price used is a weighted average of carbon prices in the organized markets
  - To compute the economic value per hectare, simply divide the total economic value by the total area of forest stocks



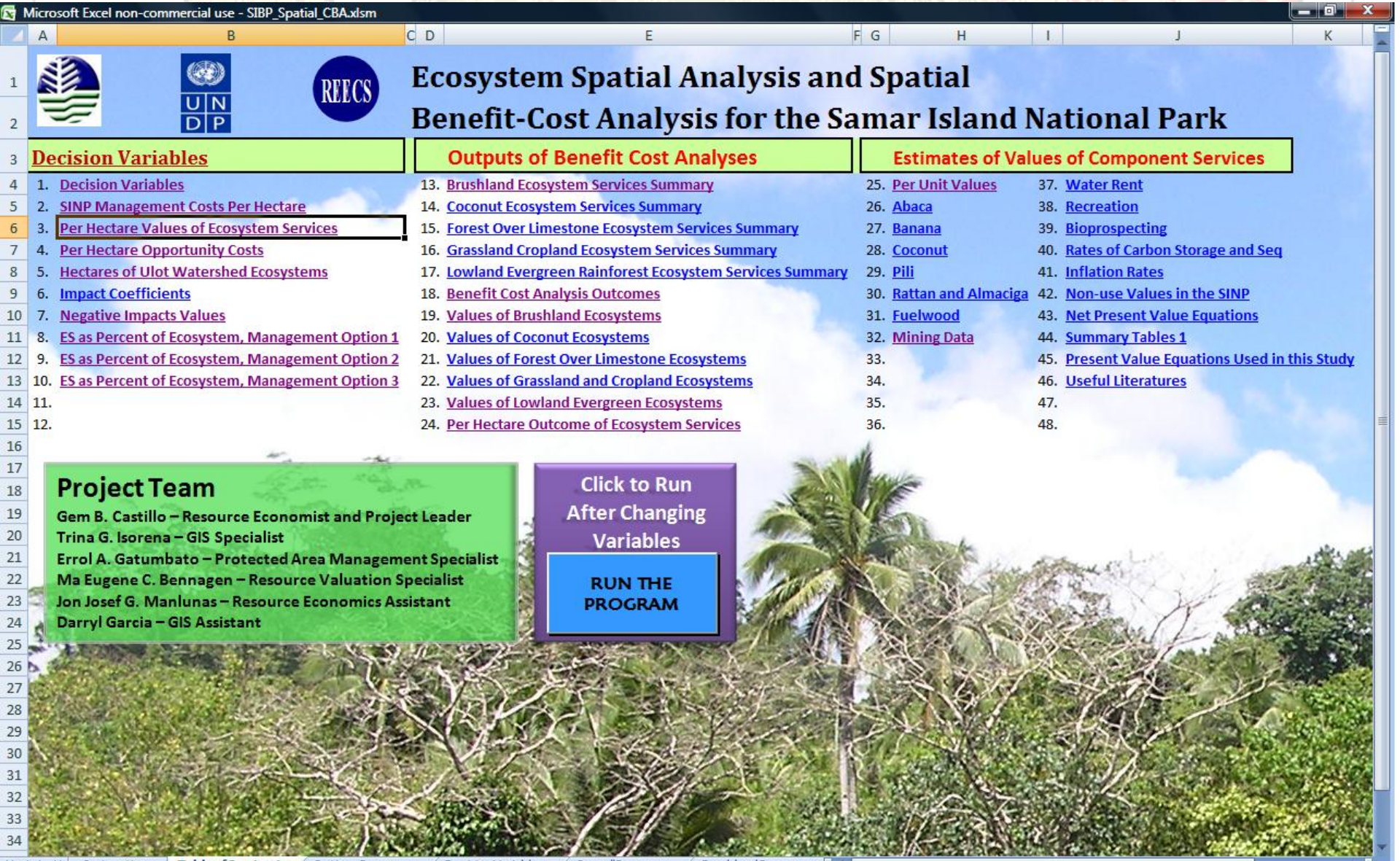
Existence Value

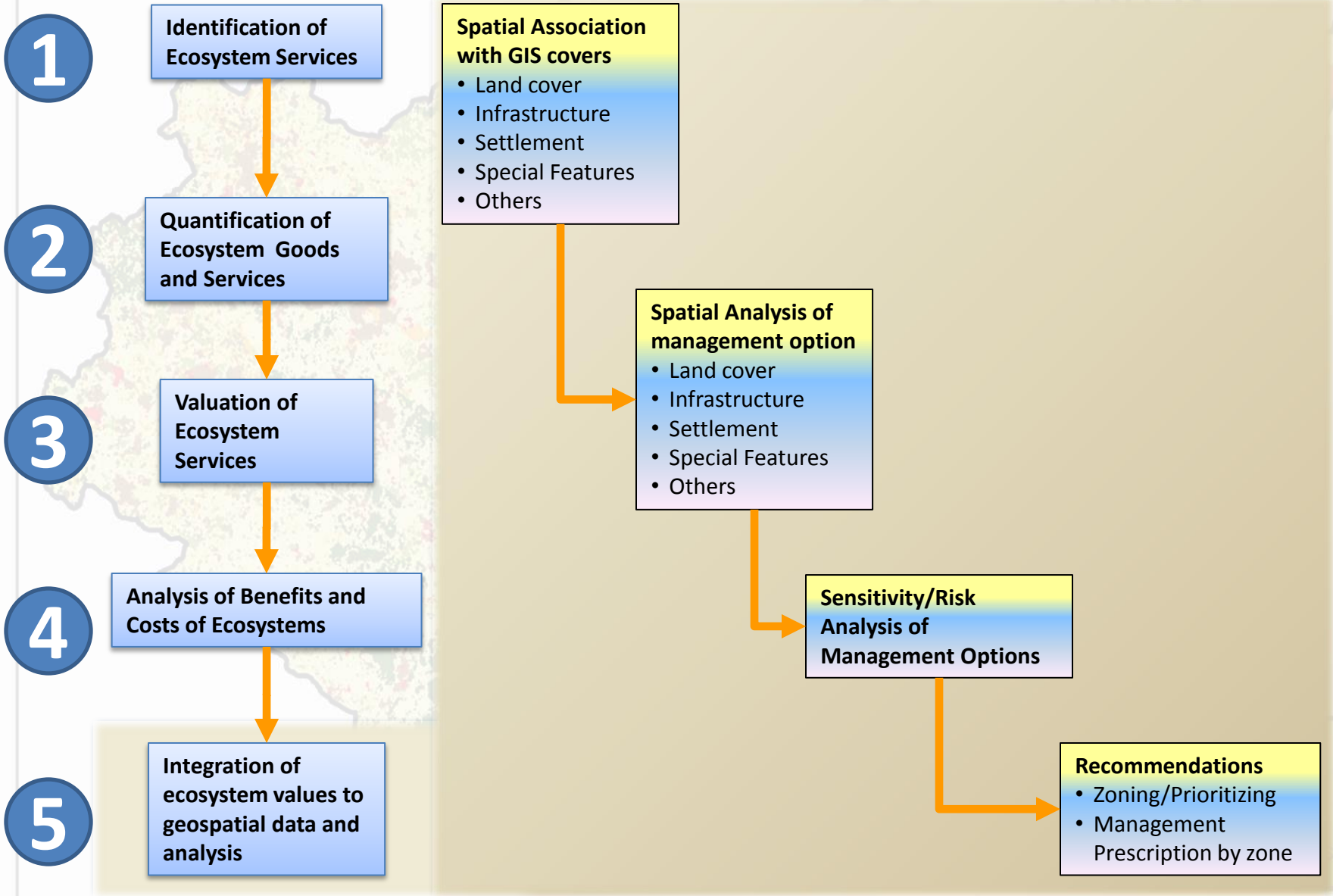
- Based on the 2005 valuation study of SINP
- It has 3 components
  - Local
  - National
  - Global
- Required data
  - Willingness to pay of SINP and Non-SINP residents for existence value
    - Values adapted were from the contingent valuation study (CVM) conducted in 2000 by the SAMBIO project
  - Philippine inflation rate was applied (BSP)




1
Identification of Ecosystem Services
2
Quantification of Ecosystem Goods and Services
3
Valuation of Ecosystem Services
4
Analysis of Benefits and Costs of Ecosystems
5
Integration of ecosystem values to geospatial data and analysis
Define management or decision option for analysis
Classify Costs and Benefits
• Direct Costs/ Benefits
• Indirect Costs/Benefits
• Externalities
• Opportunity Costs
Classify Costs and Benefits Flow Over time
Calculation of Net Benefits of Management Option
• Direct Costs/ Benefits
• Indirect Costs/Benefits
• Externalities
• Opportunity Costs
Calculation of Net Present Values using a discount rate

Microsoft Excel Spreadsheet Analysis




1
Identification of Ecosystem Services
2
Quantification of Ecosystem Goods and Services
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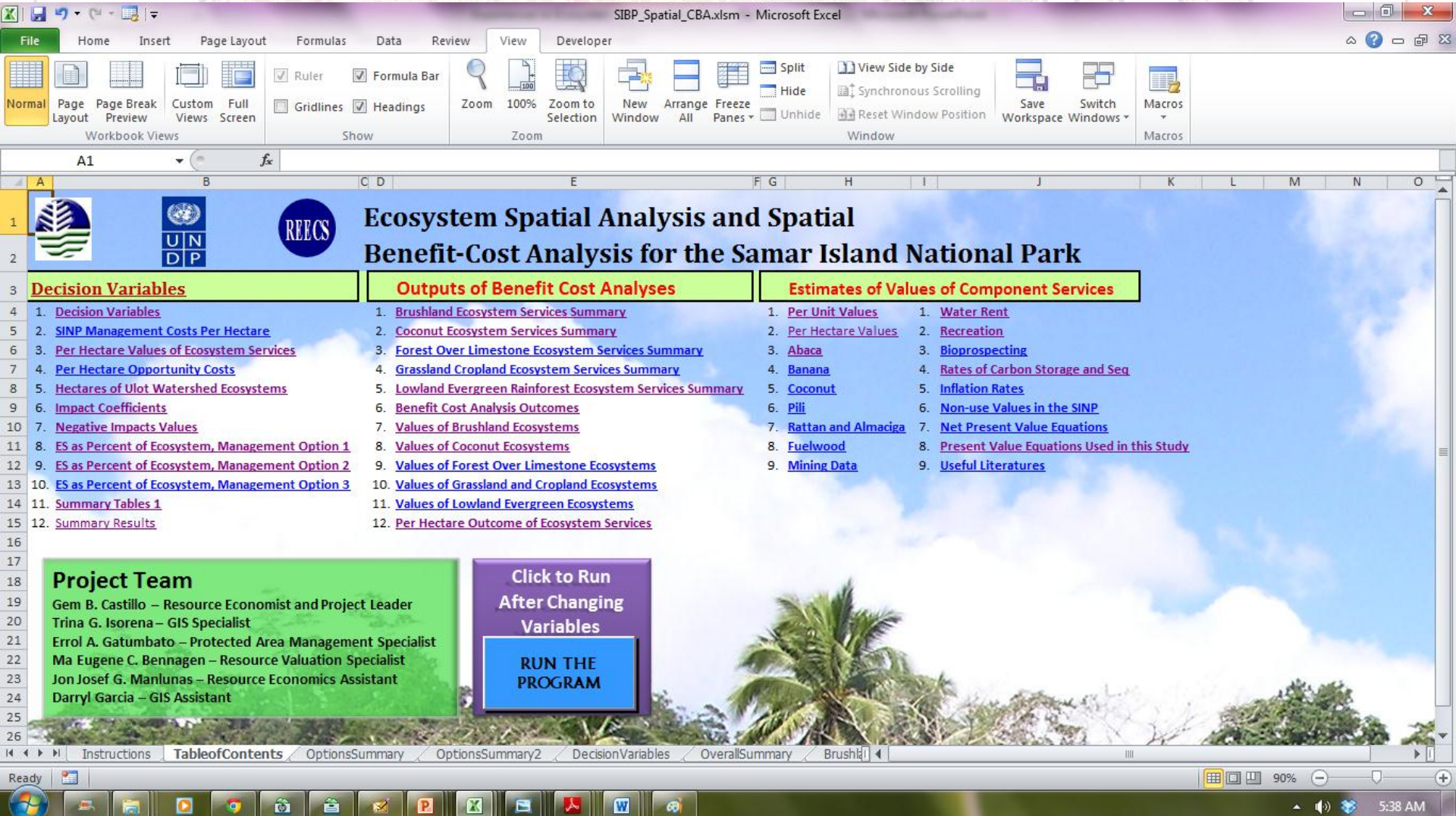
Valuation of Ecosystem Services
4
Analysis of Benefits and Costs of Ecosystems
5
Integration of ecosystem values to geospatial data and analysis
Spatial Association with GIS covers
• Land cover
• Infrastructure
• Settlement
• Special Features
• Others
Spatial Analysis of management option
• Land cover
• Infrastructure
• Settlement
• Special Features
• Others
Sensitivity/Risk Analysis of Management Options
Recommendations
• Zoning/Prioritizing
• Management Prescription by zone

Excel-based Analysis



Total Benefits/Costs to Key Stakeholders

Benefit Cost Category	**Management Option 1**: *Base Case, Business as Usual*	**Management Option 2**: *Allow Mining, Plantations, and Smallholder Agroforestry in some areas*	**Management Option 3**: *No Mining, allow plantations, and small holder agroforestry in some areas*
	25 Years Analysis Period		
	10% Discount Rate **Summary Values**	10% Discount Rate **Summary Values**	10% Discount Rate **Summary Values**
Benefit	**19,564,831**	**46,361,985**	**29,984,269**
Business	-	41,687,088	-
Farmers	3,149,781	266,590	4,827,226
Gatherers	201,546	36,204	308,882
Global Community	15,188,564	4,242,516	23,277,379
Park Visitors	348,335	124,995	533,843
Prospectors	24,582	1,794	37,674
Water Users	30,668	2,798	47,001
Wood Producers	621,354	-	952,262
Cost	**(621,450)**	**(3,701,063)**	**(950,666)**
Farmers	-	(1,067,622)	-
Global Community	(5,999)	(6,098)	(7,451)
Government	(548,635)	(840,816)	(840,816)
Local Community	-	(1,509,454)	-
Water Users	(66,815)	(277,073)	(102,398)
Net Benefit	**18,943,381**	**42,660,922**	**29,033,603**

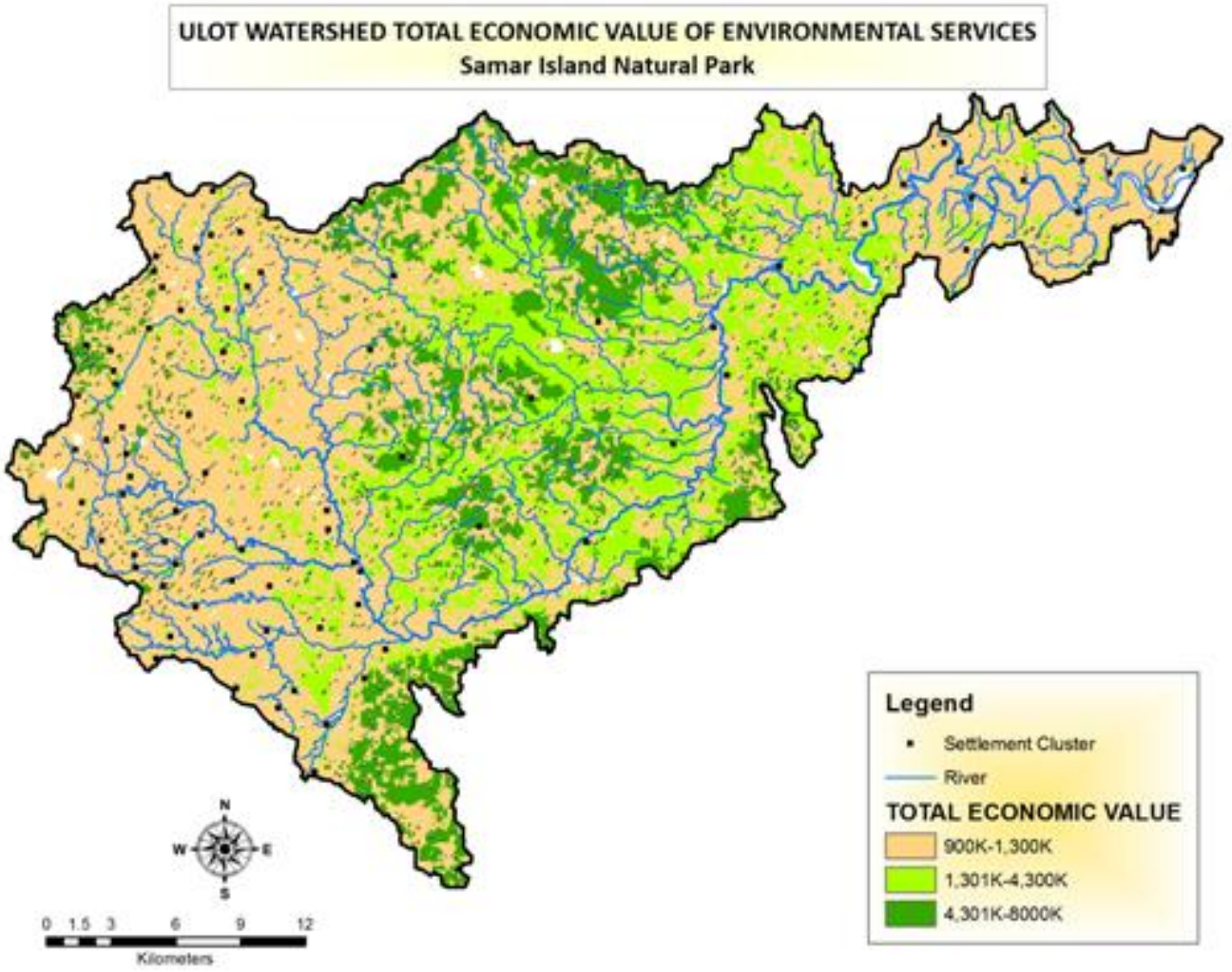
Total Benefits/Costs to Key Stakeholders

Benefit Cost Category	**Management Option 1**: *Base Case, Business as Usual*	**Management Option 2**: *Allow Mining, Plantations, and Smallholder Agroforestry in some areas*	**Management Option 3**: *No Mining, allow plantations, and small holder agroforestry in some areas*
	Values in Perpetuity		
	10% Discount Rate **Summary Values**	10% Discount Rate **Summary Values**	10% Discount Rate **Summary Values**
Benefit	**40,602,063**	**98,385,120**	**43,616,464**
Business	-	41,687,088	-
Farmers	6,986,003	3,257,108	7,021,900
Gatherers	456,298	442,329	449,314
Global Community	30,874,834	51,415,348	33,860,322
Park Visitors	776,553	1,527,141	776,553
Prospectors	54,802	21,921	54,802
Water Users	68,370	34,185	68,370
Wood Producers	1,385,203	-	1,385,203
Cost	**(1,316,580)**	**(4,763,390)**	**(1,418,978)**
Farmers	-	(1,553,011)	-
Global Community	(93,491)	(74,793)	(93,491)
Government	(1,223,089)	(1,223,089)	(1,223,089)
Local Community	-	(1,509,454)	-
Water Users	-	(403,043)	(102,398)
Net Benefit	**39,285,483**	**93,621,730**	**42,197,486**

Total Value of Ecosystems and Ecosystem Services

Benefit Cost Category	**Management Option 1**: *Base Case, Business as Usual*	**Management Option 2**: *Allow Mining, Plantations, and Smallholder Agroforestry in some areas*	**Management Option 3**: *No Mining, allow plantations, and small holder agroforestry in some areas*
	Values 25-Year Analysis Period		
	10% Discount Rate	10% Discount Rate	10% Discount Rate
	Summary Values	**Summary Values**	**Summary Values**
Benefit	**337,956,998,457**	**423,112,365,664**	**342,480,222,337**
Cultural	33,155,008,393	1,983,178,575	33,155,008,393
Provisioning	74,011,027,125	367,321,681,514	74,026,706,567
Regulating	229,930,072,223	53,296,842,595	234,437,616,660
Supporting	860,890,717	510,662,980	860,890,717
Cost	**(8,862,448,959)**	**(31,512,234,980)**	**(10,126,509,081)**
Cultural			
Provisioning	-	(13,115,958,169)	-
Regulating	(8,862,448,959)	(11,237,363,668)	(10,126,509,081)
Supporting	-	(7,158,913,143)	-
Net Benefit	**346,819,447,417**	**454,624,600,644**	**352,606,731,417**

Spatial integration of benefit values of ecosystem services to the land cover layer of the Ulot Watershed in the SINP



Maraming Salamat

WAVES

Wealth Accounting and Valuation of Ecosystem Services