Soil Carbon Sequestration and Greenhouse Gases Mitigation in Selected Ecosystems in the Philippines

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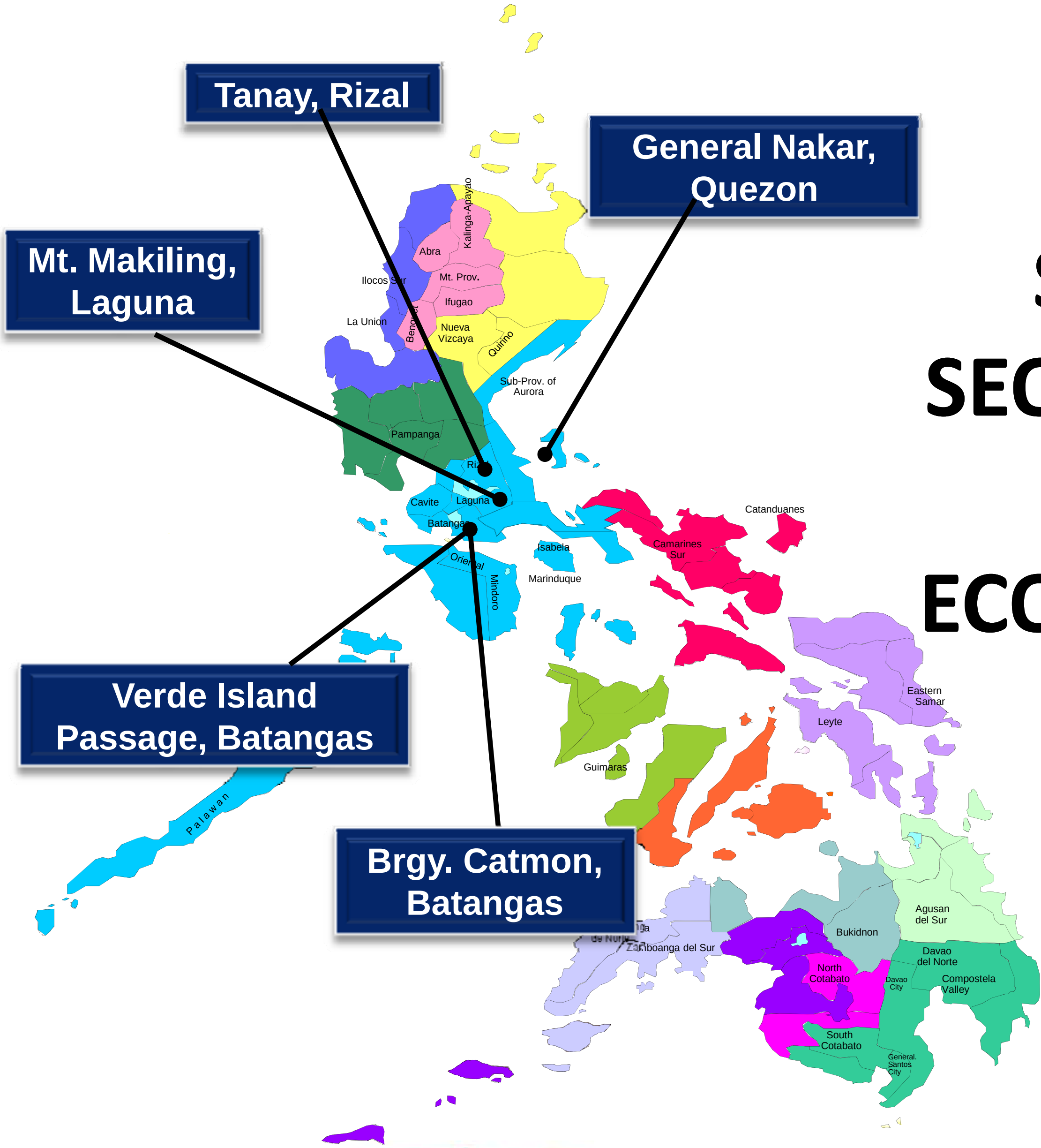


SOIL CARBON SEQUESTRATION IN SELECTED ECOSYSTEMS IN THE PHILIPPINES

SOIL CARBON SEQUESTRATION

Secondary Forests

Factors affecting SOC sequestration in the Philippines:

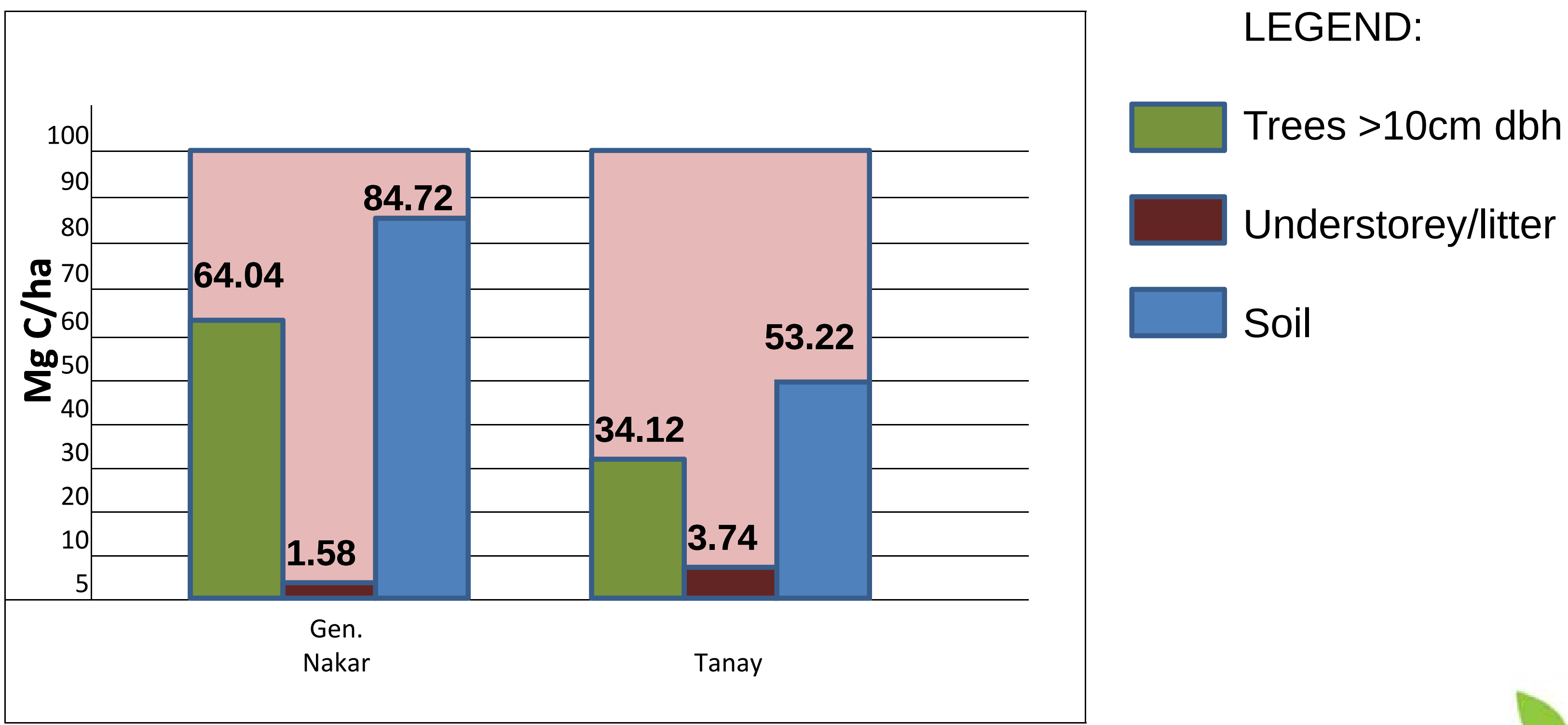
1. Natural factors
    - Climate – large soil organic carbon (SOC) is associated with higher precipitation
    - Topography – higher SOC is found in higher elevation areas
    - Natural disturbance
2. Anthropogenic

Secondary Forests

Carbon density in biomass and soil in the secondary forests

Sink/carbon pool	Carbon Density (Mg/ha)	
	General Nakar, Quezon	Tanay, Rizal
Trees > 10cm dbh	64.04 (42%)	34.12 (37%)
Understory/litter	1.58 (1%)	3.74 (4%)
Soil	84.72 (57%)	53.22(59%)
Total	150.34 (100%)	91.08 (100%)

Secondary Forests



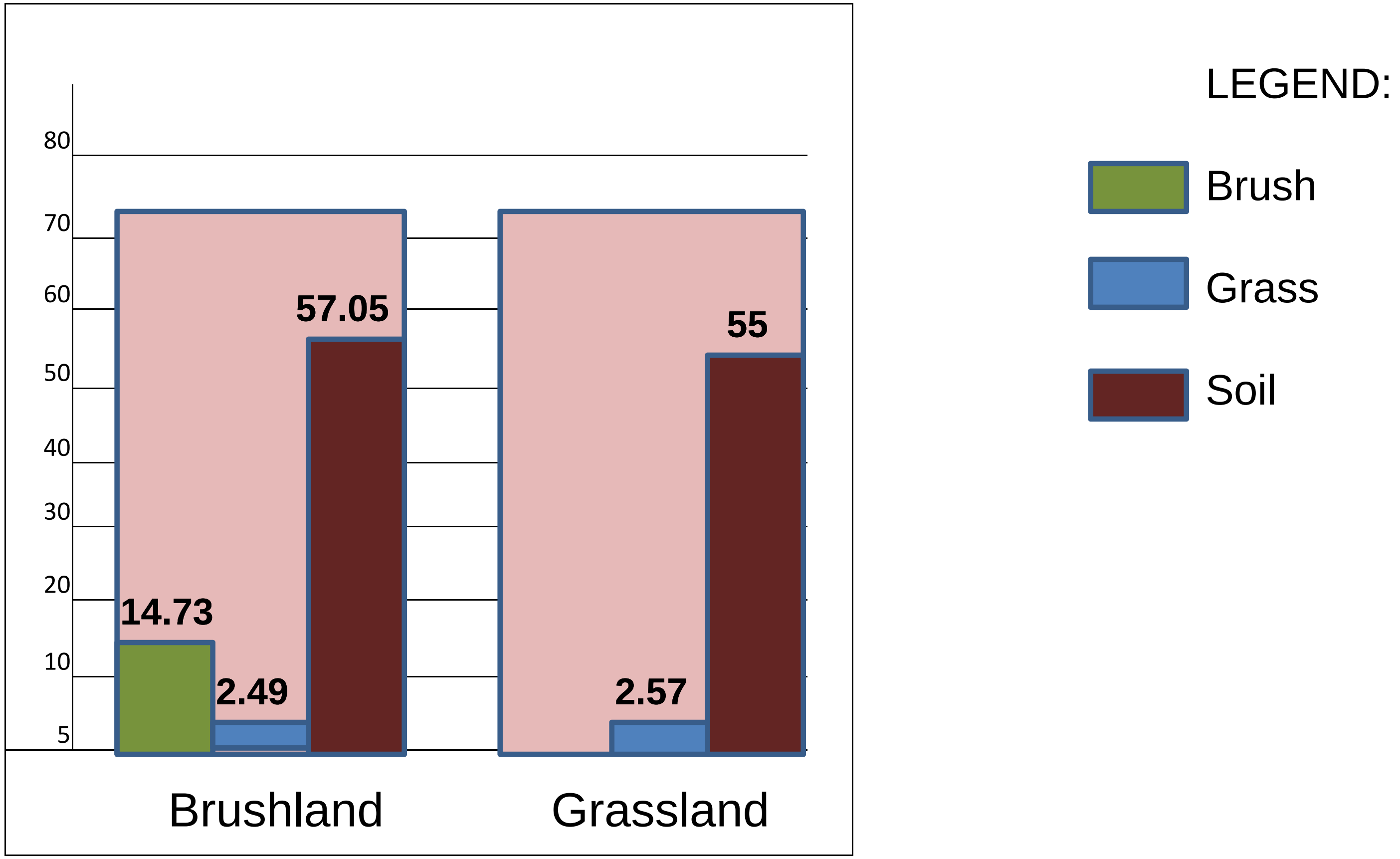
Carbon density in biomass and soil in the secondary forests

Brushland and Grassland

Carbon density of the different land use types.

Sink/carbon pool	Carbon density (Mg/ha)	
	Brushland	Grassland
Brush	14.73 (20%)	
Grass	2.49 (3%)	2.57 (4%)
Soil	57.05 (77%)	55.00 (96%)
Total	74.27 (100%)	57.57 (100%)

Brushland and Grassland



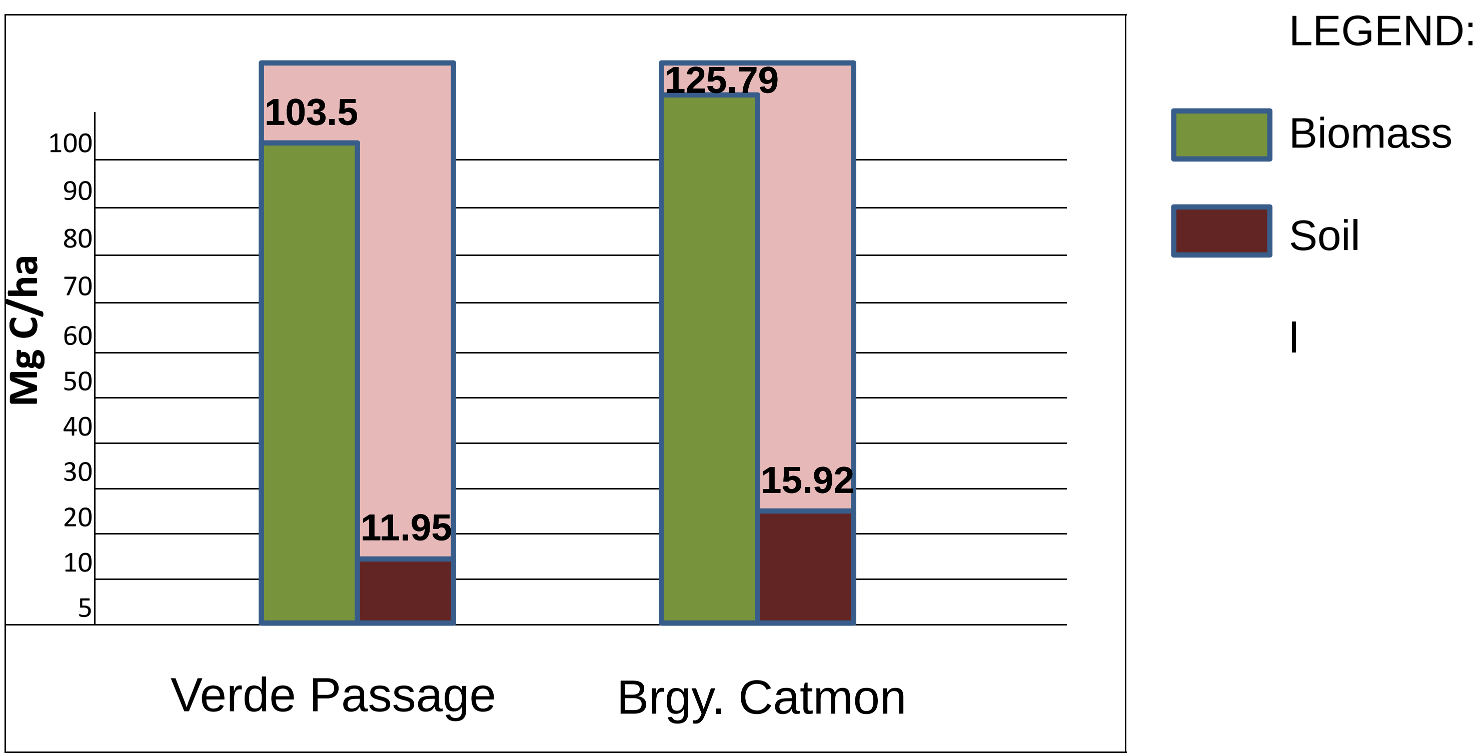
Carbon density of the different land use types

Mangrove

Carbon pool status, biomass and carbon density distribution in mangrove ecosystem

Sink/carbon pool	Carbon density (Mg/ha)	
	Verde Passage	Brgy. Catmon
Biomass	103.50 (90%)	125.79 (89%)
Soil	11.95 (10%)	15.92 (11%)
Total	115.45 (100%)	141.71 (100%)

Mangrove



Carbon pool status, biomass and carbon density distribution in mangrove ecosystem

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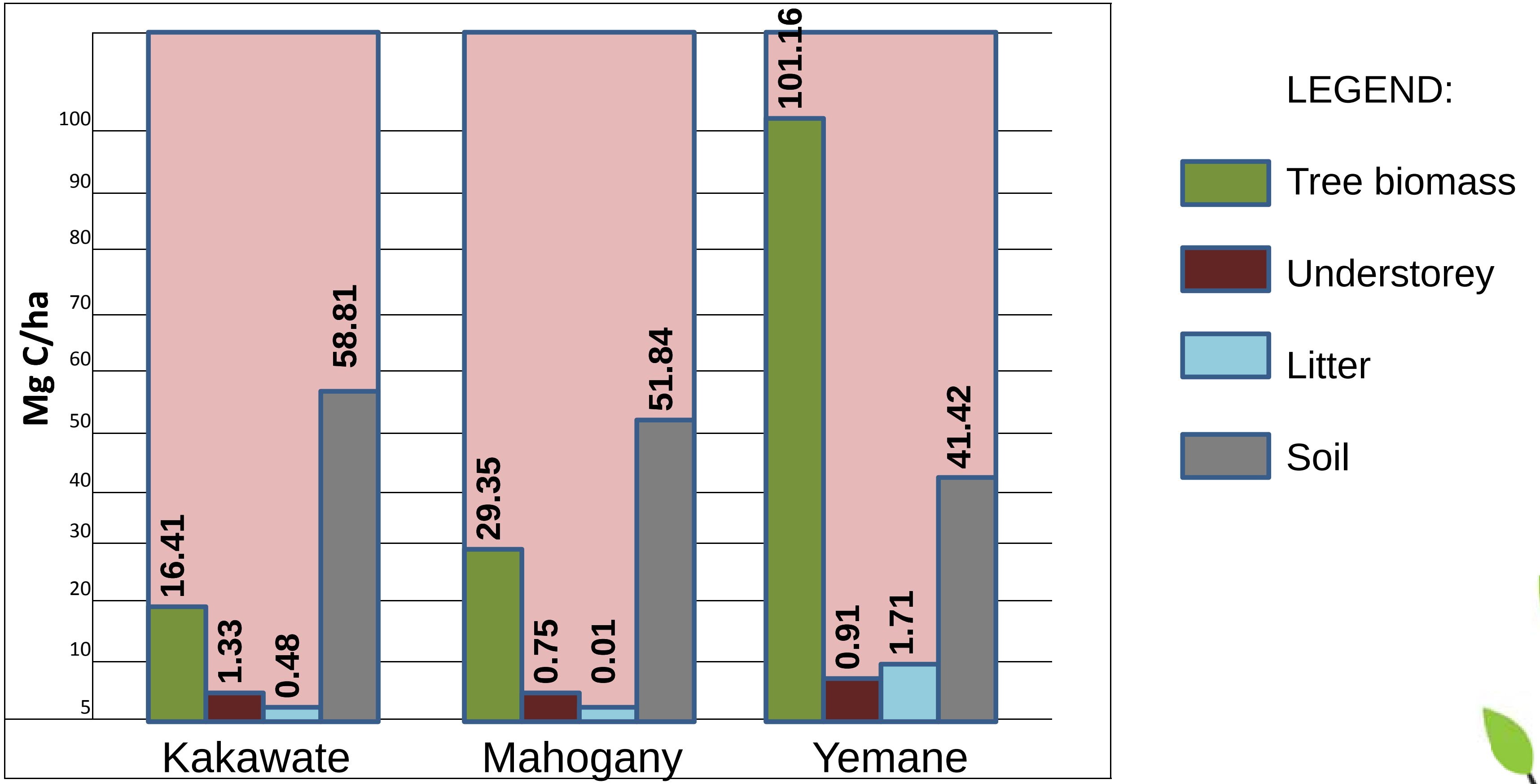
Degraded pastureland

Degraded pastureland with kakawate, mahogany, and yemane stands

Sink/carbon pool	Carbon density (Mg/ha)		
	Kakawate	Mahogany	Yemane
Tree biomass	16.41 (21.04%)	29.35 (35.82%)	101.16 (66.96%)
Understorey	1.33 (1.7%)	0.75 (0.92%)	0.91 (0.63%)
Litter	0.48 (0.62%)	0.01 (0.01%)	1.71 (1.18%)
Soil	58.81 (76.35%)	51.84 (63.27%)	41.42 (28.53%)
Total	77.03 (100%)	81.94 (100%)	145.21 (100%)

Degraded pastureland



Carbon pool status, biomass and carbon density distribution in mangrove ecosystem

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Agroforestry

Carbon status in degraded pastureland planted to fast-growing tree species

Sink/carbon pool	Carbon density (Mg/ha)	
	Gmelina-cacao multistorey	Alley cropping system
Gmelina arborea	106.62	
Theobroma cacao	8.33	
Understorey	0.28	
Necromass	0.99	
Roots	0.24	
Gliricidia sepium		
Biomass total	116.46	1.69
Soil	68.12	91.96
Total	184.58	93.25

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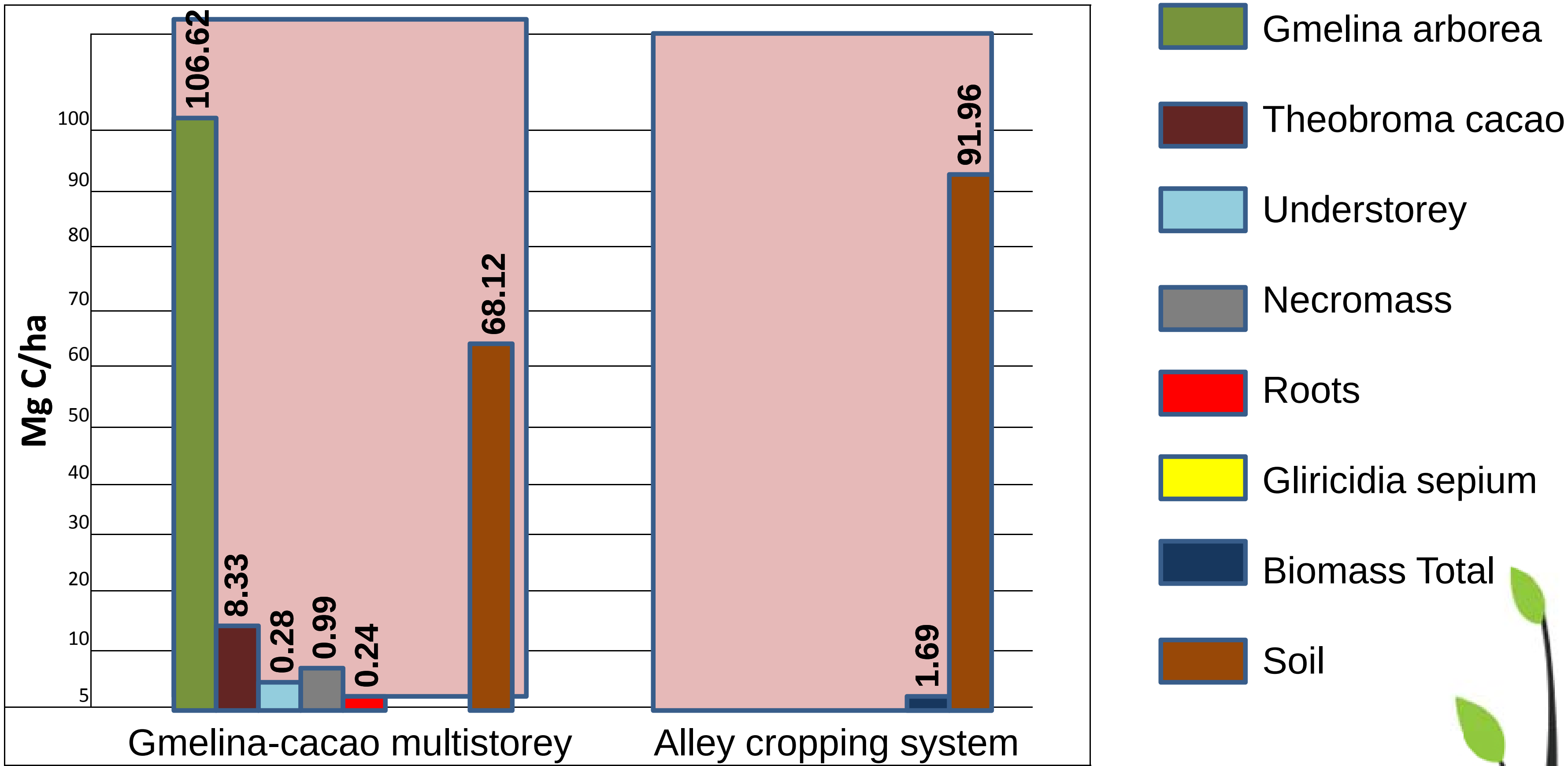
Agroforestry



Carbon pool status, biomass and carbon density distribution in mangrove ecosystem

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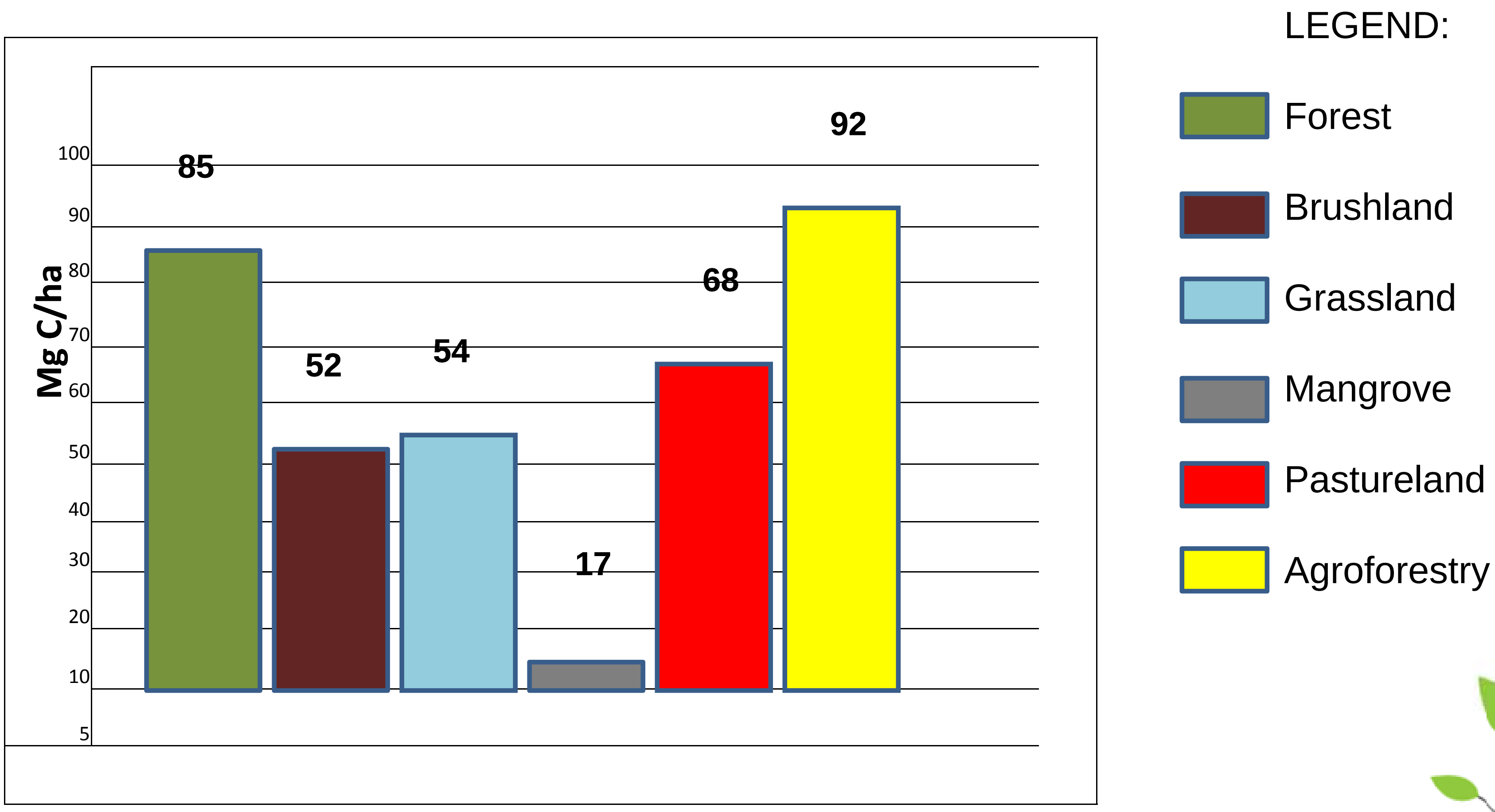
Carbon levels in selected ecosystems



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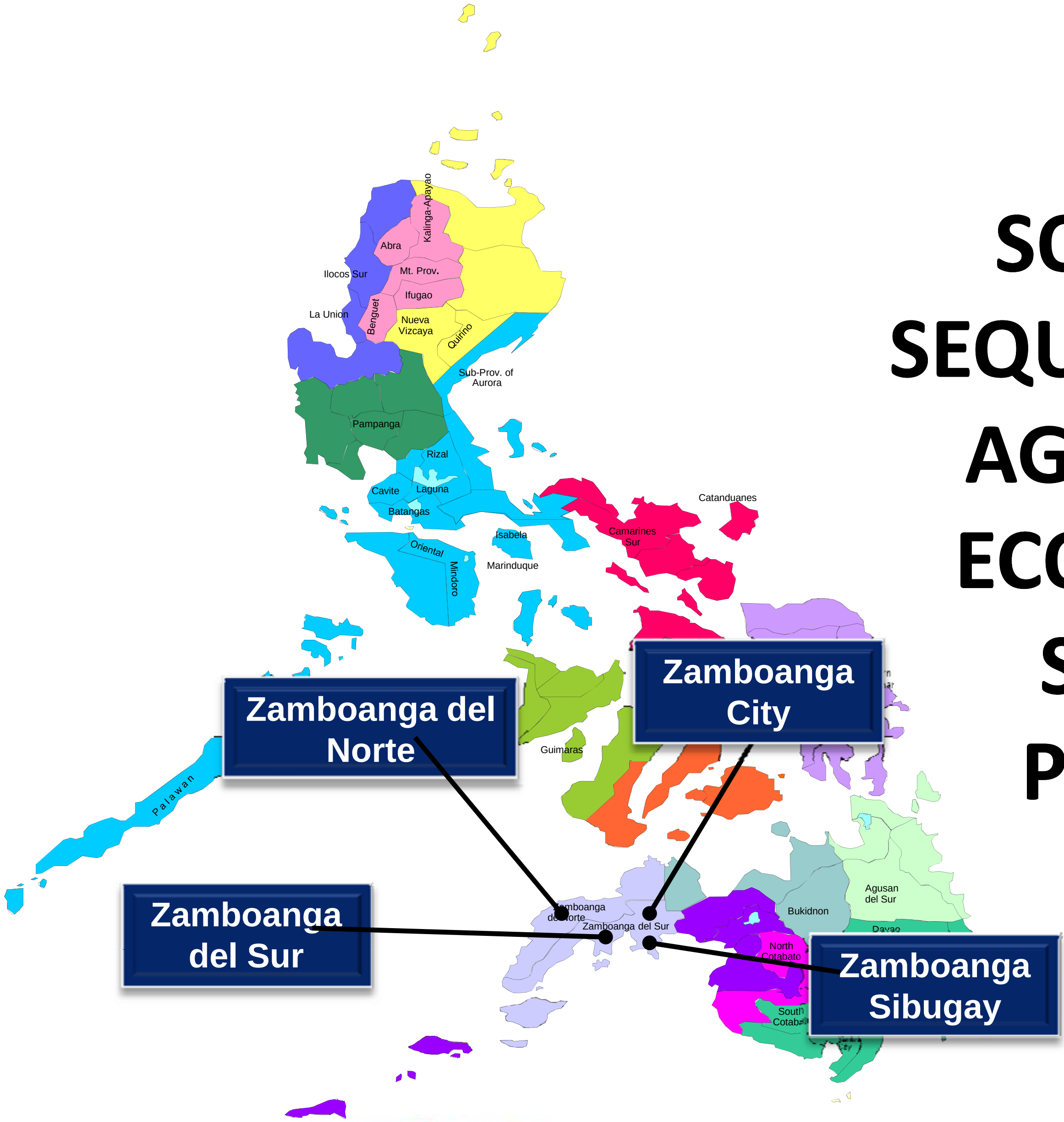

SOIL CARBON SEQUESTRATION IN AGRICULTURAL ECOSYSTEMS IN SOUTHERN PHILIPPINES

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Agricultural ecosystems

Adtuyon Soils

- developed from weathered rocks that originated from volcanic lava (lahars) chiefly composed of andesites and basalts
- pH of 5.31
- external drainage is good to excessive
- internal drainage is fair to good

Faraon Soils

- derived from weathering of coralline limestone, includes soils with rolling topography to hilly area
- pH of 7.18
- external drainage good under forest but becomes excessive in open fields.
- internal drainage is fair.

Tillage and cropping systems

- **TILLAGE SYSTEMS**
  - No-tillage
  - Conservation tillage
  - Conventional tillage

- **CROPPING SYSTEMS**
  - Corn cropping
  - Corn-legume rotation
  - Vegetables
  - Root crops
  - Cover crops
  - Pasture/grassland
  - Banana
  - Fruit crops

Effects of tillage systems on carbon of soils.

TILLAGE SYSTEMS	SOC, %	SEQUESTERED CO_2 EQUIVALENT
Faraon		
No Tillage	2.01	**256**
Conservation Tillage	2.04	**261**
Conventional Tillage	1.75	**227**
Adtuyon		
No Tillage	3.14	**393**
Conservation Tillage	3.10	**382**
Conventional Tillage	3.09	**383**

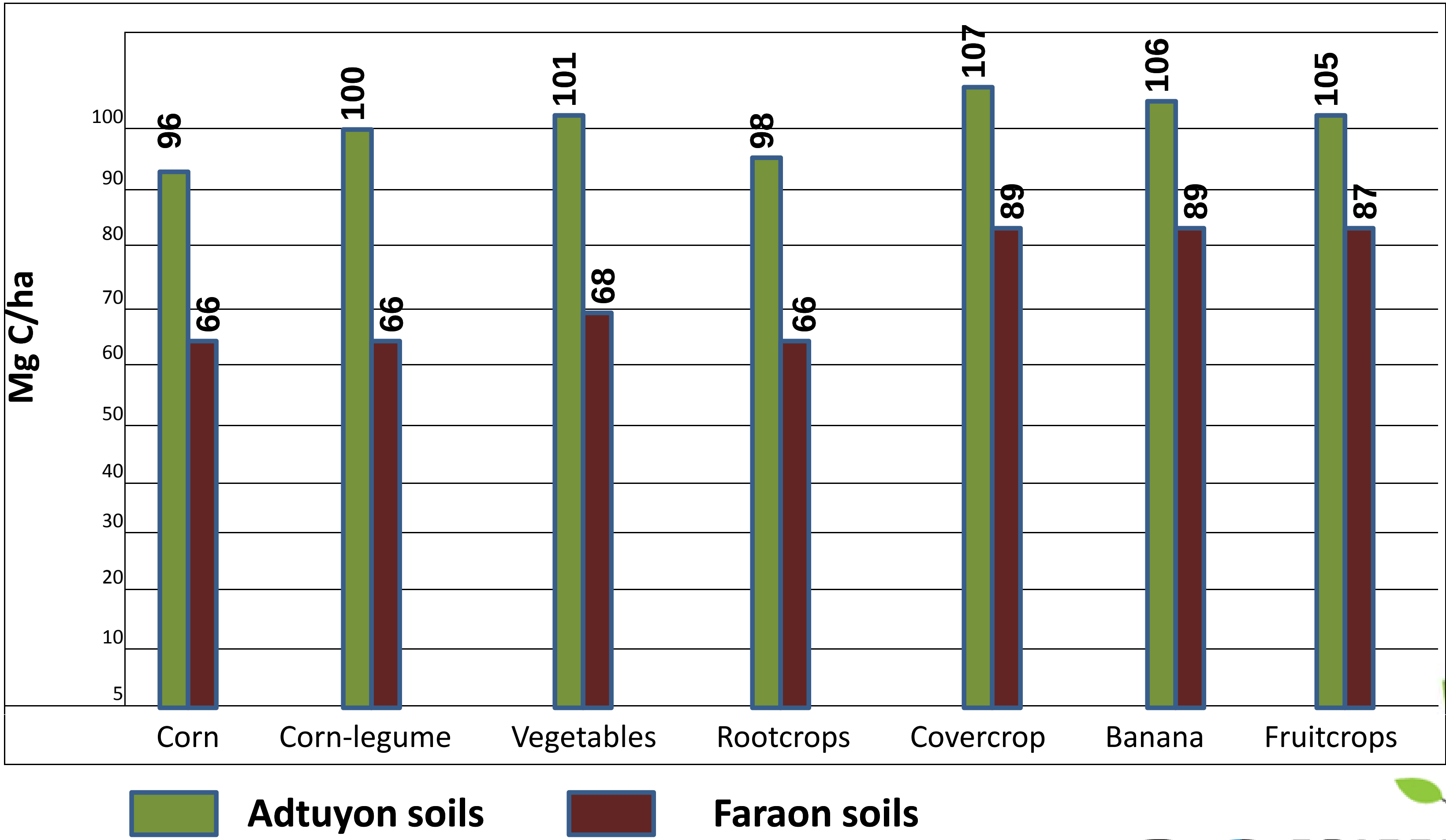
Adtuyon vs. Faraon

Effect of cropping systems on carbon of soils

CROPPING SYSTEMS	SOC, %		Sequestered CO_2 Equivalent (Mg/ha)	
	Adtuyon	Faraon	Adtuyon	Faraon
Annual cropping systems				
Corn	3.0.	1.88	352	241
Corn-Legume	3.12	1.90	368	244
Vegetables	3.0	1.86	371	249
Rootcrops	2.98	1.85	361	243
Covercrop and forage cropping systems				
Covercrop	3.29	2.59	394	328
Pastures	3.26	2.28	398	326
Perennial cropping system				
Banana	3.27	2.58	389	325
Fruitcrops	3.13	1.85	387	321

Adtuyon vs. Faraon

Soil types and soil organic carbon



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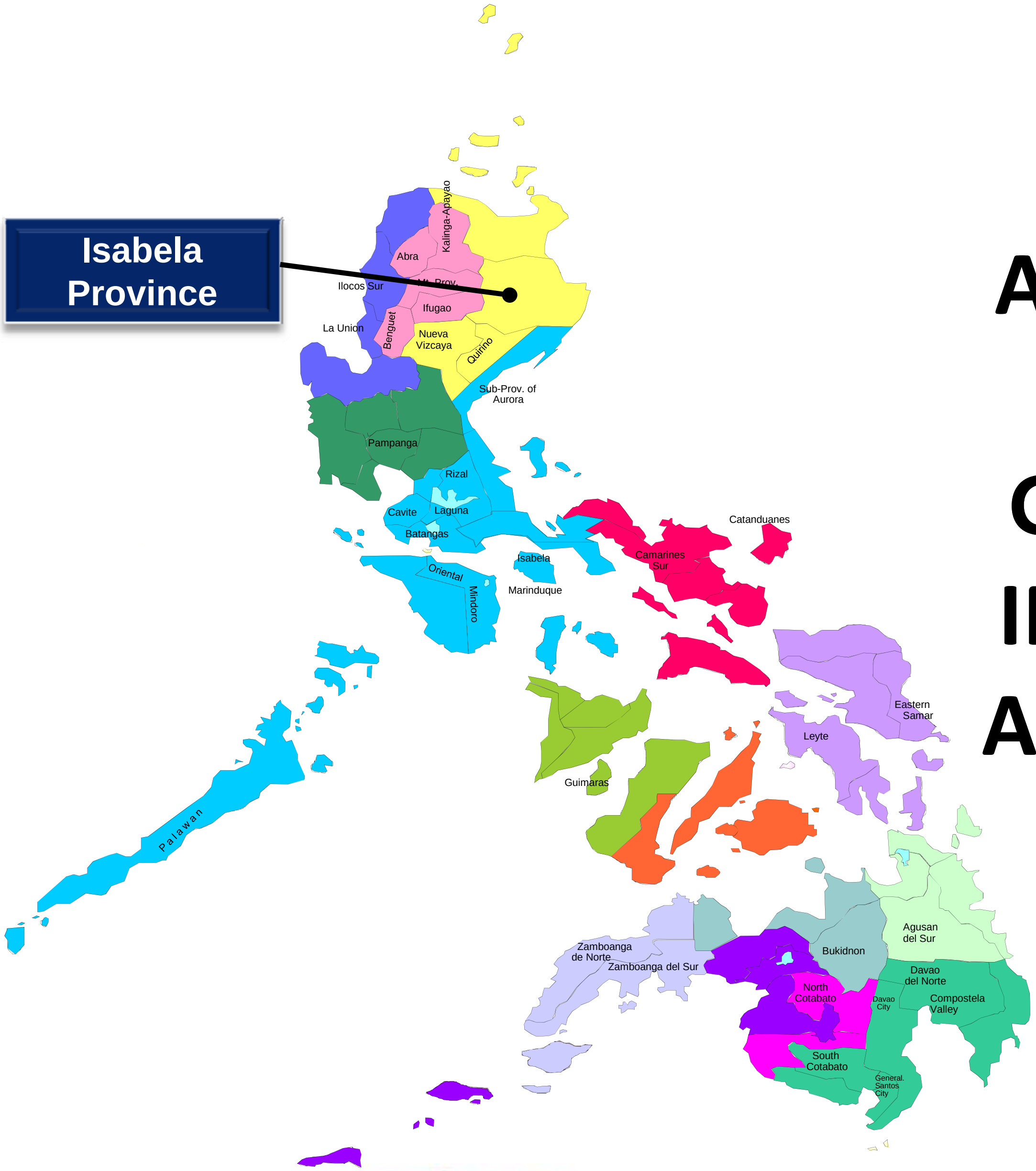
SUMMARY OF FINDINGS

1. **Soil capacity to sequester carbon is dependent on soil type, soil ph, tillage system, and type of vegetation**
2. **Adtuyon soils sequstered more carbon than faraon due to its acidity that led to less microbial decomposition**
3. **No tillage has highest carbon sequestration due mainly to no or no disturbance of soil structure**
4. **Tillage favors decomposition so less sequesterd carbon.**
5. **High bulk density of soil can be an indicator for high carbon sequestration**



ASSESSMENT AND VALUATION OF GHG MITIGATION IN LOWLAND RICE AGROECOSYSTEMS

Agroecosystem

- Provide updated information on the current GHGs emitted from rice cropping in lowland rice agroecosystems in Isabela as affected by different farm management practices and the amounts and economic values of GHG reduction of changing to a more climate-friendly farm management practices.

- Climate-friendly farm management practices in lowland rice agroecosystems include those that have less emission of GHGs by avoiding anaerobic decomposition such as reducing the amounts and duration of irrigation, use of low methane emitting variety and rice straw composting.

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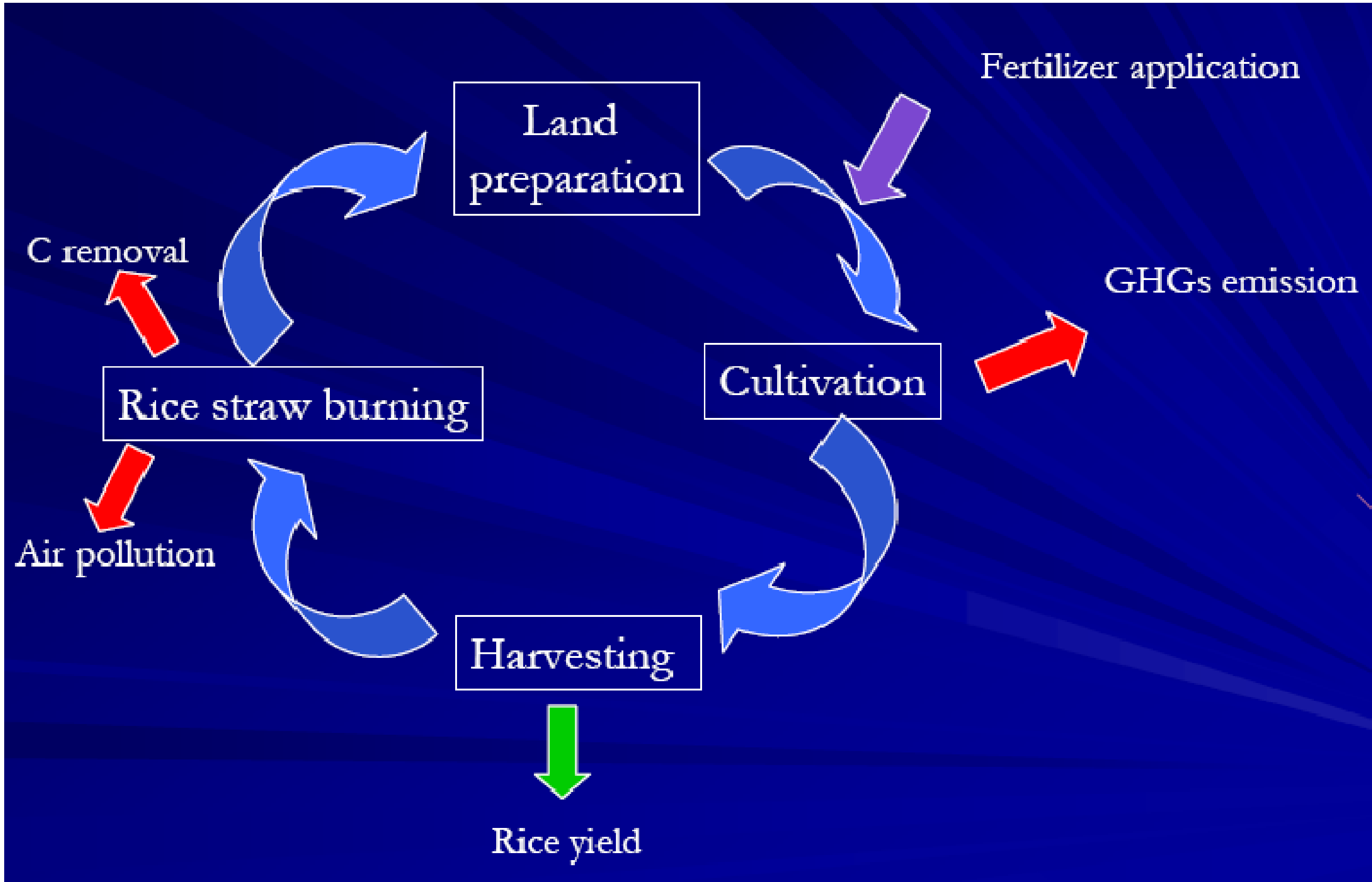
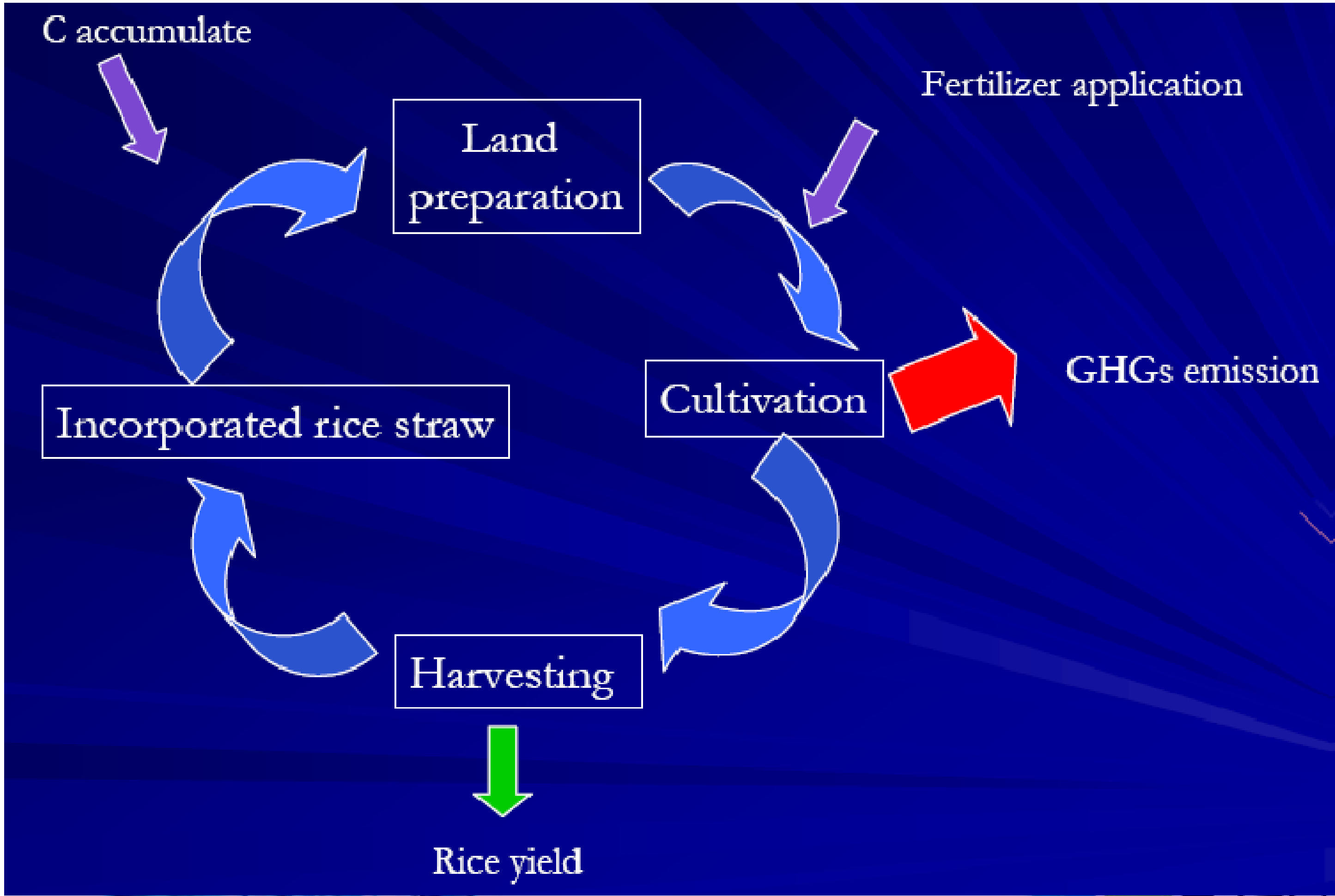
Farm management practices that add to GHG emission



Climate-friendly farm management practices



Valuation: Lowland rice field and GHG

Values of CH_4 emission reduction based on 2009 World Bank Carbon Price.

FARMING PRACTICE	ANNUAL CH_4 EMISSION tons/yr	REDUCTION			VALUE *	
		tons CH_4	%	tons CO_2e	US$/yr	P Million/yr
EXISTING PRACTICE	5,882.93	0	0	-	-	
MID-SEASON DRAINAGE	3,059.12	2,823.81	48.00	59,300.01	711,600.12	34.16
COMPOSTING	2,126.49	3,756.44	63.85	78,885.24	946,622.88	45.44
DRAINAGE + COMPOSTING	1,105.77	4,777.16	81.20	100,320.36	1,203,844.32	57.78

** WB PRICE = US$ 12/ton CO_2e; P48/US$*

SUMMARY OF FINDINGS

1. Mid-season drainage rather than continuous flooding will have 2,823.81 tons/year or **48% methane reduction** in 7,789.34 ha service area of 30 selected IAs in NIA-MRIIS District 2 with tradable **CO_2 equivalent of P34.16 million/year**.

2. Application of rice straws composted aerobically rather than incorporated in flooded rice fields will have 3,756.44 tons/year or 64% methane reduction service area with a **tradable CO_2 equivalent of PhP45.44 million/year.**

3. Simultaneous mid-season drainage and application of aerobic rice straw compost rather than existing farming practices (continuous flooding and rice straw incorporation in flooded fields) will have 4,777.16 tons/year or 81% methane reduction in the with **tradable CO_2 equivalent of PhP57.78 million/year**.

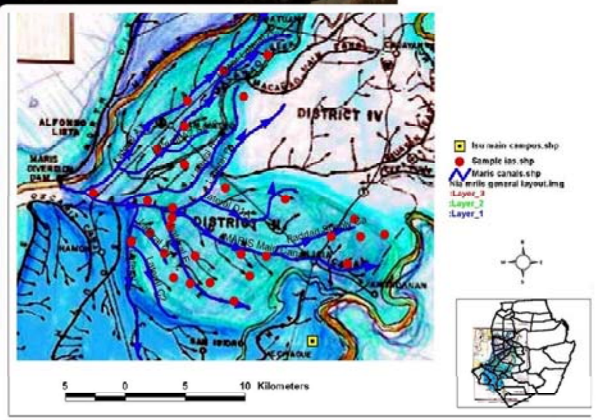
4. Incremental benefits of shifting from existing farming practices (continuous flooding and rice straw incorporation) to climate-friendly farming practices (mid-season drainage and rice straw compost application) will be PhP138.95 million/year.

SUGGESTIONS AND RECOMMENDATIONS

1. **Development of cost-effective methodological tools and techniques in analyzing and determining soil organic carbon. This will allow quantification of carbon stocks and sequestration rates of carbon in the various ecosystems. For instance, data aggregation from a plot scale to national scale is a big barrier to overcome in carbon stock assessment.**
2. **Conduct of valuation studies for carbon trading purposes. Determining the actual value of SOC will bring appreciation at its importance to policymakers.**
3. **Promoting activities that will enhance the potentials of various ecosystems to serve as carbon sinks rather than sources.**

While soil carbon storage plays a crucial role in GHG mitigation, strategies to reduce carbon emission must be carried out with full understanding that there should bebalance between environmental benefits and need for food and fiber

THANK YOU!


DISTRICT IV
ALFONSO LISTA
MARIS DIVERSION DAM
DISTRICT II
MARIS Main Canal
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:Layer_3
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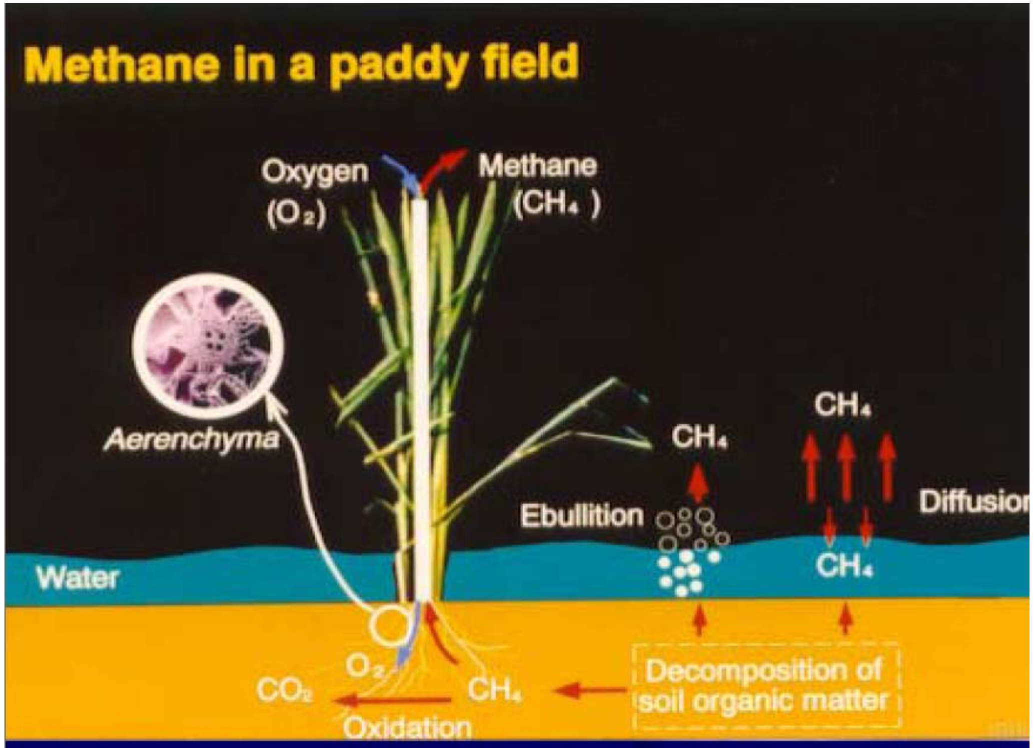
Greenhouse Gases from Rice field



Methane emission in a paddy rice field (Macandog & IRRI, 2007).

Factors affecting GHG emission:

- **Land preparation**
- **Seed preparation**
- **Rice varieties**
- **Fertilizer application**
- **Water management**
- **Harvesting and fallow period**
- **Rice straw management: burning and incorporated**