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

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1. Overview:
Bioenergy development, policy and potential

Bioenergy Development

Bioenergy or biofuels are renewable energy and carbon neutral so that they are considered sustainable.

Two kinds of biofuels:

- **Biodiesel is a fuel extracted from oil-rich crops. It is a natural hydrocarbon with little sulfur content, and can be used in diesel engines with very little or without any need for engine modification.**

- **Bioethanol is a form of ethanol, a light alcohol, produced by fermenting carbohydrates from starch- or sugar-rich crops.**

Bioenergy Development

Sources of feedstocks or raw materials for producing bioenergy:

First generation – mainly based on food crops
- **sugar-rich crops (e.g. sugarcane, sugar beets)**
- **starch-rich crops (e.g. corn, sorghum, wheat, potato, cassava)**
- **oil-rich crops (e.g. soybean, rapeseed, palm, coconut)**

Second generation – mainly based on non-food
- **agriculture and forest residues (e.g. stalks, leaves)**
- **fast-growing trees (e.g. eucalyptus, poplars, jathropa)**
- **perennial grasses (e.g. switchgrass, miscanthus, bermudagrass)**

Second generation bioenergy are argued to be more sustainable because:
- **they do not use food crops and thus not affect food security**
- **they can be planted in marginal areas or less productive land (e.g. grasses)**

Bioenergy Policy

Biofuels Act of 2006 - mandatory use of biofuels to support the government's goal in reducing dependence on imported fuels

Objectives of Biofuels Act:

1. **develop and utilize indigenous renewable and sustainably-sourced clean energy sources to reduce imports of oil**
2. **mitigate toxic and greenhouse gas (GHG) emissions**
3. **increase rural employment and income**
4. **ensure availability of alternative and renewable clean energy without the detriment to ecosystem, biodiversity & food reserves**

DOE Plans:

- **up to year 2010 – Use of other feedstock and technology, 10% biodiesel and 20% ethanol fuel blends**
- **up to year 2030 - At least 20% biodiesel and 20-85% ethanol fuel blends**

Bioenergy Potential

- **Philippines is 2nd largest coconut (15,667 billion tones) and 7th largest sugarcane (32.5 million tones) producer in the world (FAOSTAT 2012).**
- **Domestic industries produced 133 million liters biodiesel and 4 million liters bioethanol in 2011, but existing production capacity is even higher**

BIODIESEL PROPONENT	CAPACITY (In Million Liters/year)	LOCATION
Chemrez Technologies, Inc.	75	Pasig City
Mt. Holly Coco Industrial Co., Ltd.	50	Lucena City, Quezon
Pure Essence International, Inc.	60	Pasig City
Golden Asian Oil International, Inc.	60	Pasig City
Bioenergy 8 Corporation	30	Davao City
Tantuco Enterprises	30	Tayabas, Quezon
Freyvonne Milling Services	15.6	Davao City
Phil. Biochem Products, Inc.	12	Muntinlupa City
JNJ Oleochemicals, Inc.	60	Lucena City, Quezon
Total:	**392.6**	

BIOETHANOL PROPONENT	CAPACITY (In Million Liters/year)	LOCATION
Leyte Agri Corp.	9.0	Ormoc, Leyte
San Carlos Bioenergy Corp.	40.0	Negros Occidental
Roxol Bioenergy Corp.	30.0	Negros Occidental
Green Future Innovations, Inc.	54.0	Isabela Province
Total:	**133.0**	

2. Objectives of the study

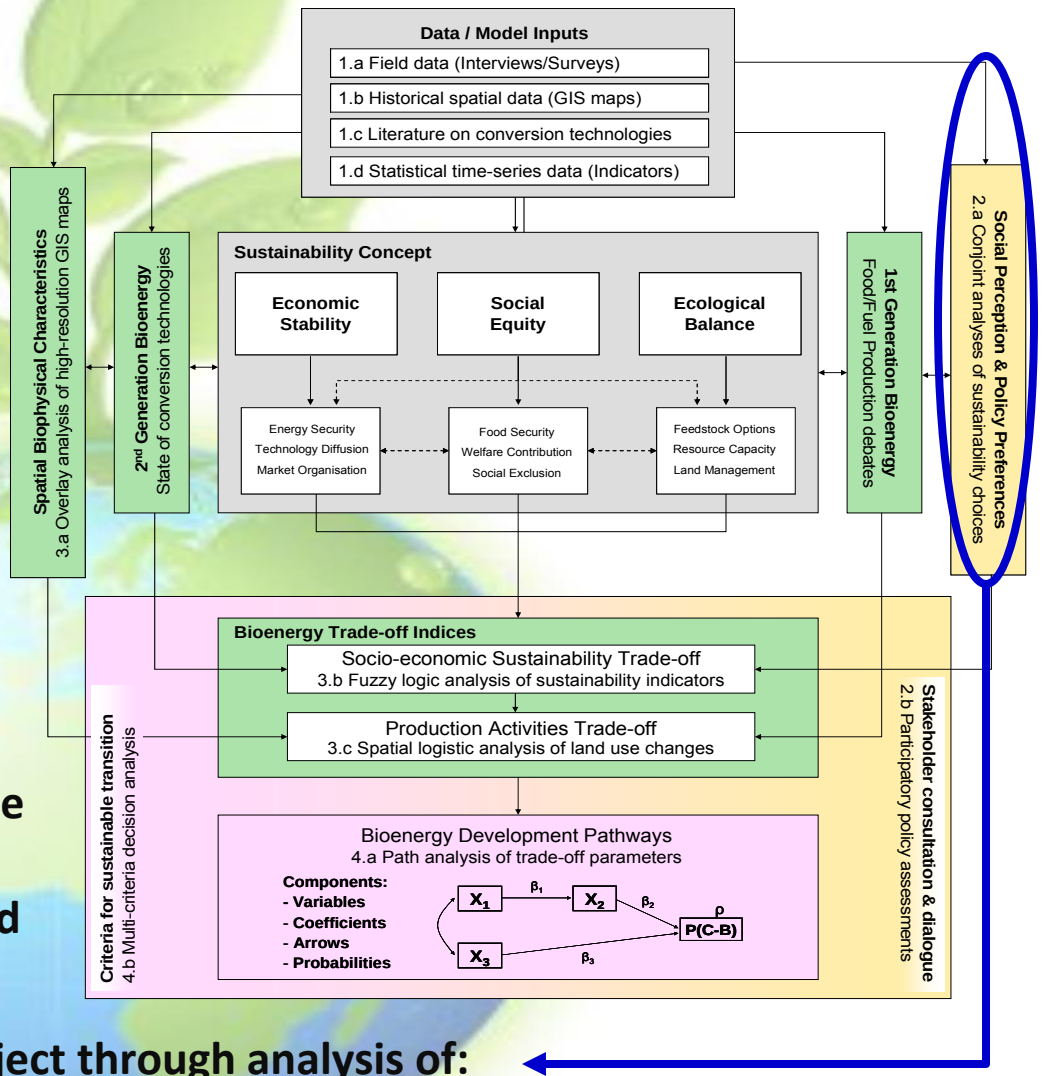
Objectives

Project title:
Integrated sustainability assessment of bioenergy potentials in Asia: An application of a hybrid approach on trade-offs and pathways (PIC-STRAP)

Funding source: APN Low Carbon Initiatives (LCI) Programme

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.

Other project partners: Potsdam Institute for Climate Impact Research in Germany Madras School of Economics in India, and Beijing Normal University in China



This paper contributes to PIC-STRAP Project through analysis of:

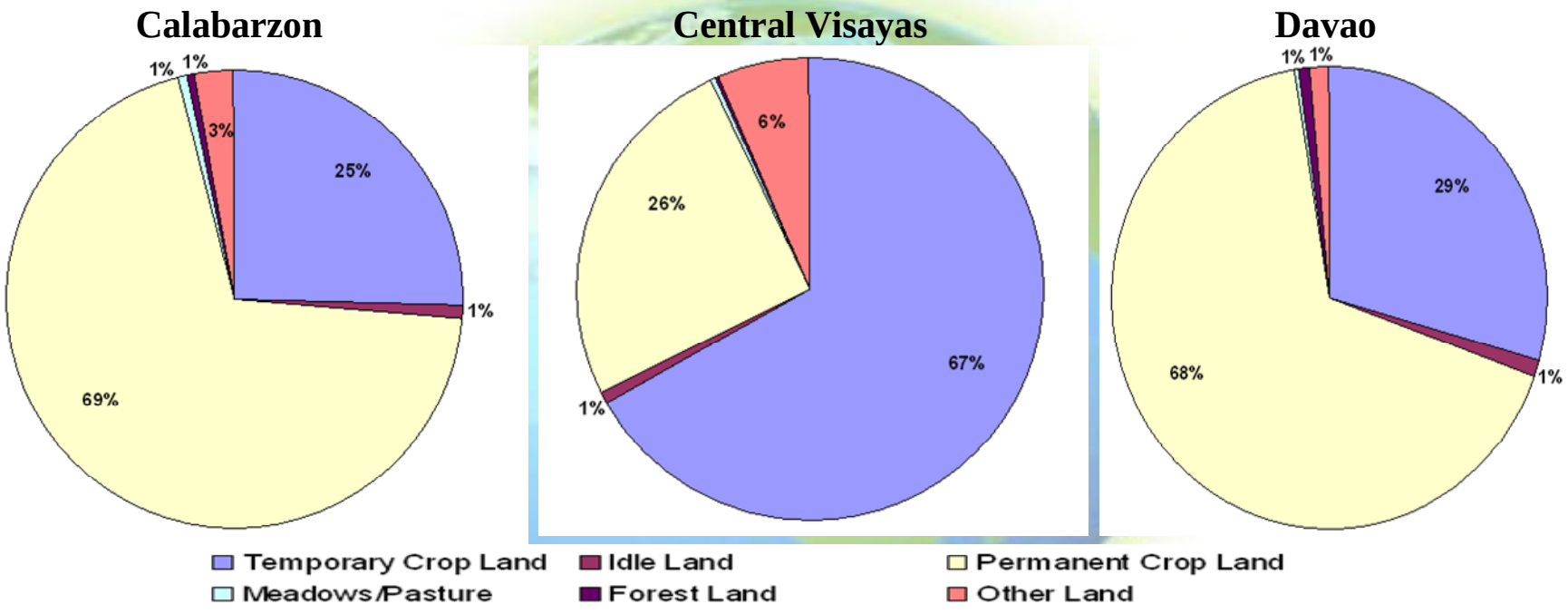
- **Awareness of farmers on bioenergy production and its sustainability**
- **Socio-economic factors affecting their opinions on different bioenergy feedstock**

3. Case study areas: Calabarzon, Central Visayas and Davao

Case study areas

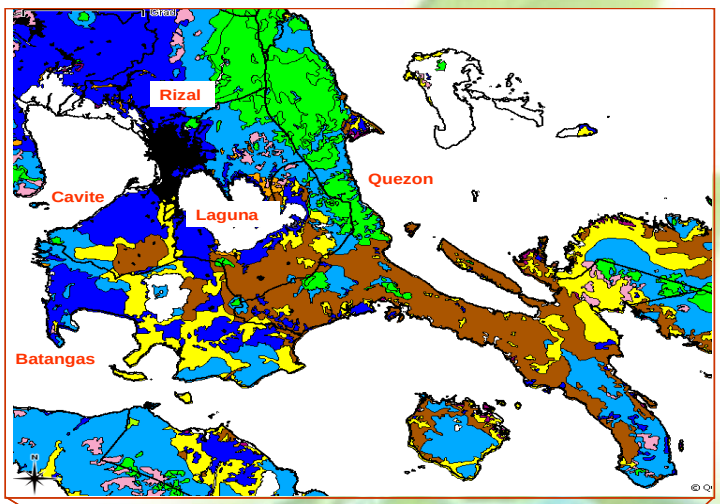
Characteristics	Calabarzon		Central Visayas		Davao	
Population in 2010 (Growth from 2000)	12,609,803	3.07%	6,800,180	1.77%	4.468.563	1.97
GRDP million PhP (Share agric. to GRDP)	1,030,165	6.25%	36,638	7.81%	224.849	18.87%
Agric. land area (Share to total area)	588,516	35.0%	522,433	33.0%	758335	37.0%
Agric. employment (Share to total employment)	742,000	16.0%	905,000	31.0%	746000	41.0%
Daily agric. wage (Poverty incidence)	269.00	10.3%	173,76	30.2%	182.03	25.6%

* GRDP = Gross Regional Domestic Product at constant 2000 prices



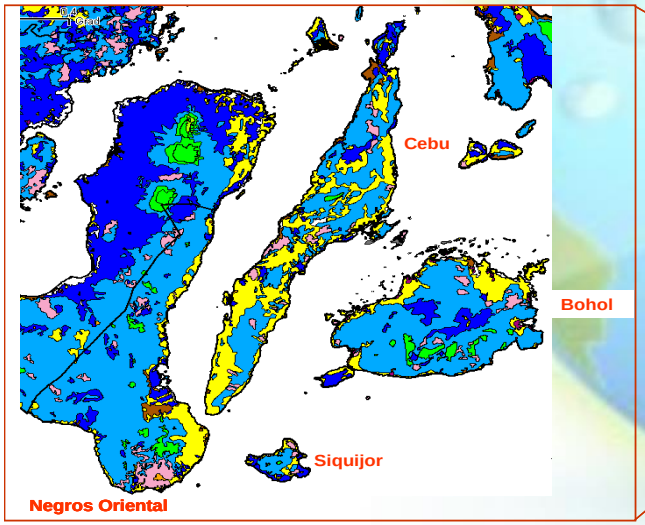
Case study areas

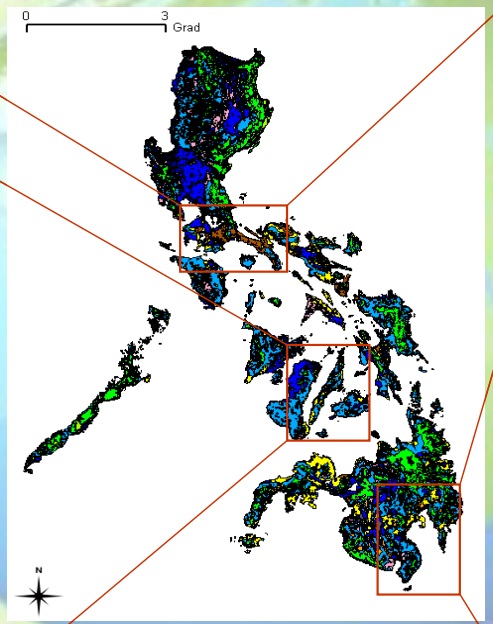
CALABARZON Region



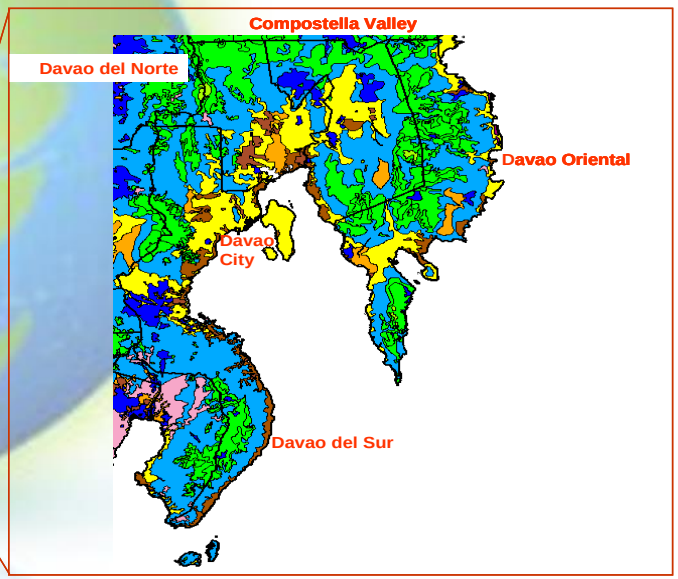
- Arable land, crops mainly cereals and sugar
- Built-up Area
- Closed canopy, mature trees covering > 50 percent
- Coconut plantations
- Crop land mixed with coconut plantation
- Crop land mixed with other plantation
- Cultivated Area mixed with brushland/grassland
- Eroded area
- Grassland, grass covering > 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

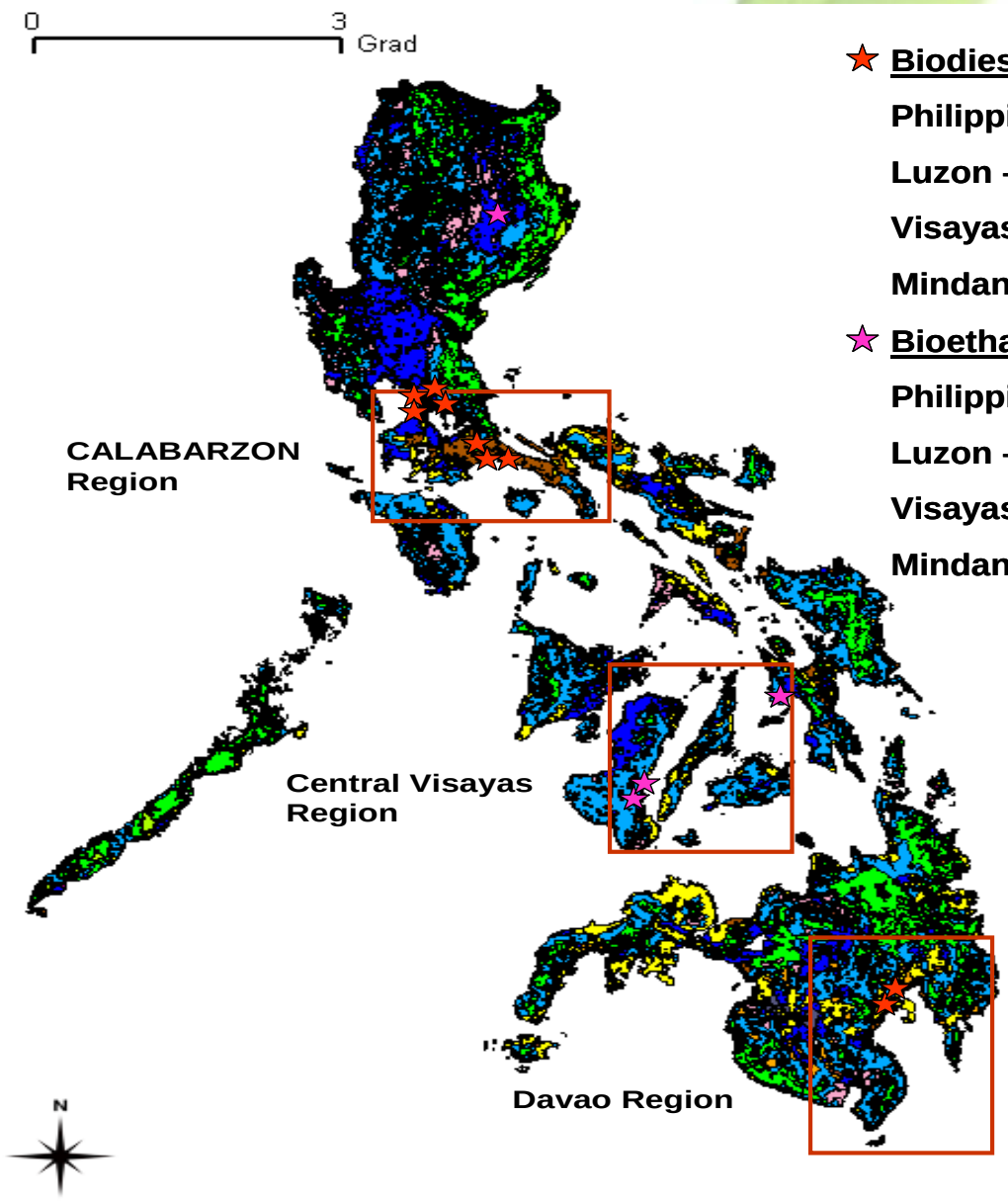




Davao Region



Case study areas



★ **Biodiesel production capacity in liters per year**

Philippines – 392 million (9 companies)

Luzon – 347 million (7 companies)

Visayas – 0

Mindanao – 45.6 million (2 companies)

★ **Bioethanol production capacity in liters per year**

Philippines – 133 million (4 companies)

Luzon – 54 million (1 company)

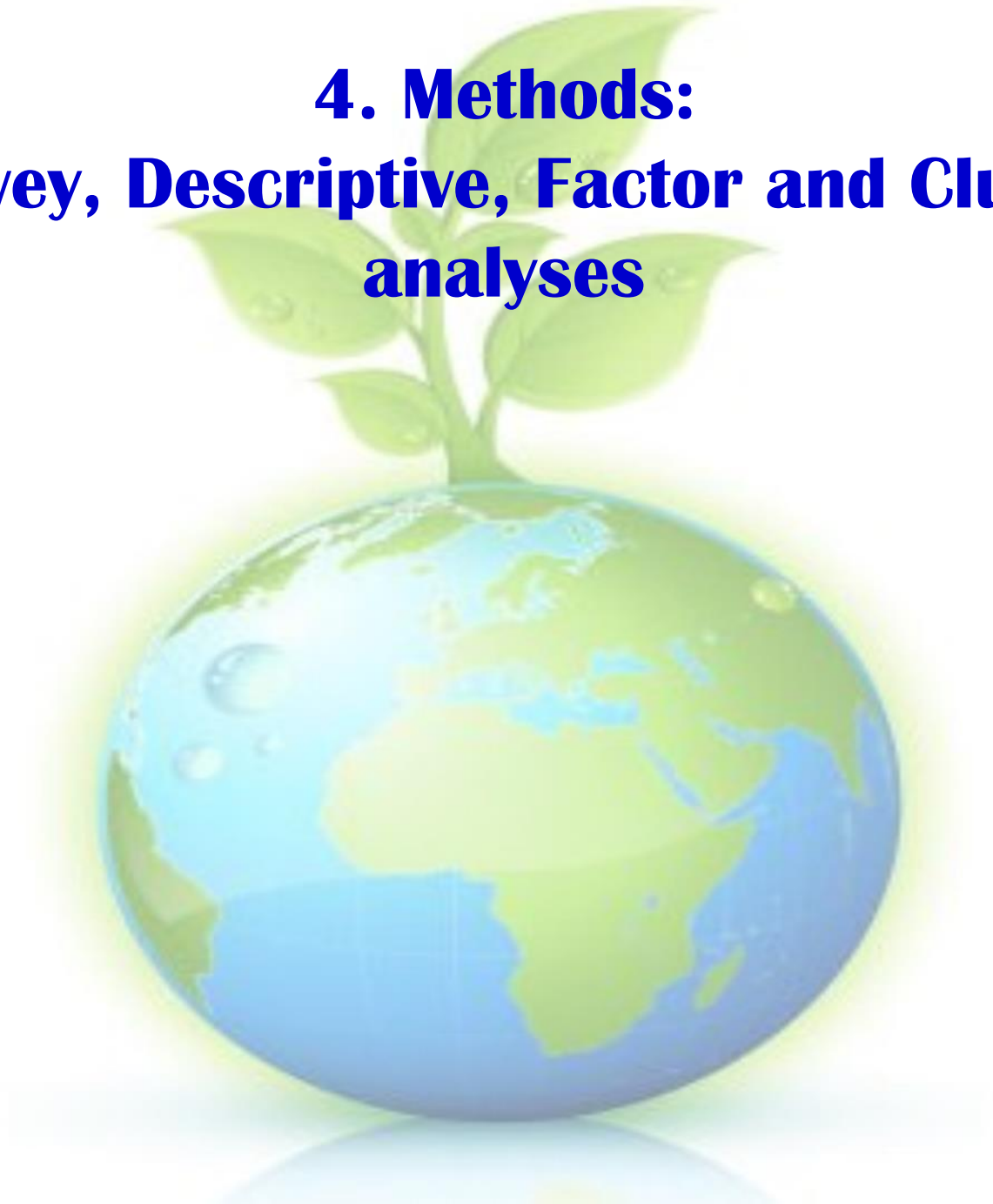
Visayas – 79 million (3 companies)

Mindanao – 0

Rank in production

Region	Coconut	Sugar
Calabarzon	5th rank	4th rank
C. Visayas		3rd rank
Davao	1st rank	

4. Methods:
Survey, Descriptive, Factor and Cluster analyses



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, (2) Sources of information on bioenergy, (3) Knowledge and opinion on bioenergy, and (4) Preferences on bioenergy feedstock. They are referred to here as Factor X1, X2, X3, and X4.**

Survey in Davao

Methods

Descriptive analysis – aimed to compare the different case study regions according to the four factors.

Factor analysis – aimed to identify the most important variables in each factor category, which have the largest contribution to the variance (i.e. difference or spread) in farmers' responses to the survey questions. Only the most important variables will be used as input variables to the cluster analysis.

Cluster analysis – aimed to classify the farmers' into groups so that farmers within a group have common characteristics and farmers in different groups have diverse characteristics. The results of the analysis will be used to develop typology on farmers' awareness on bioenergy

Survey Questions

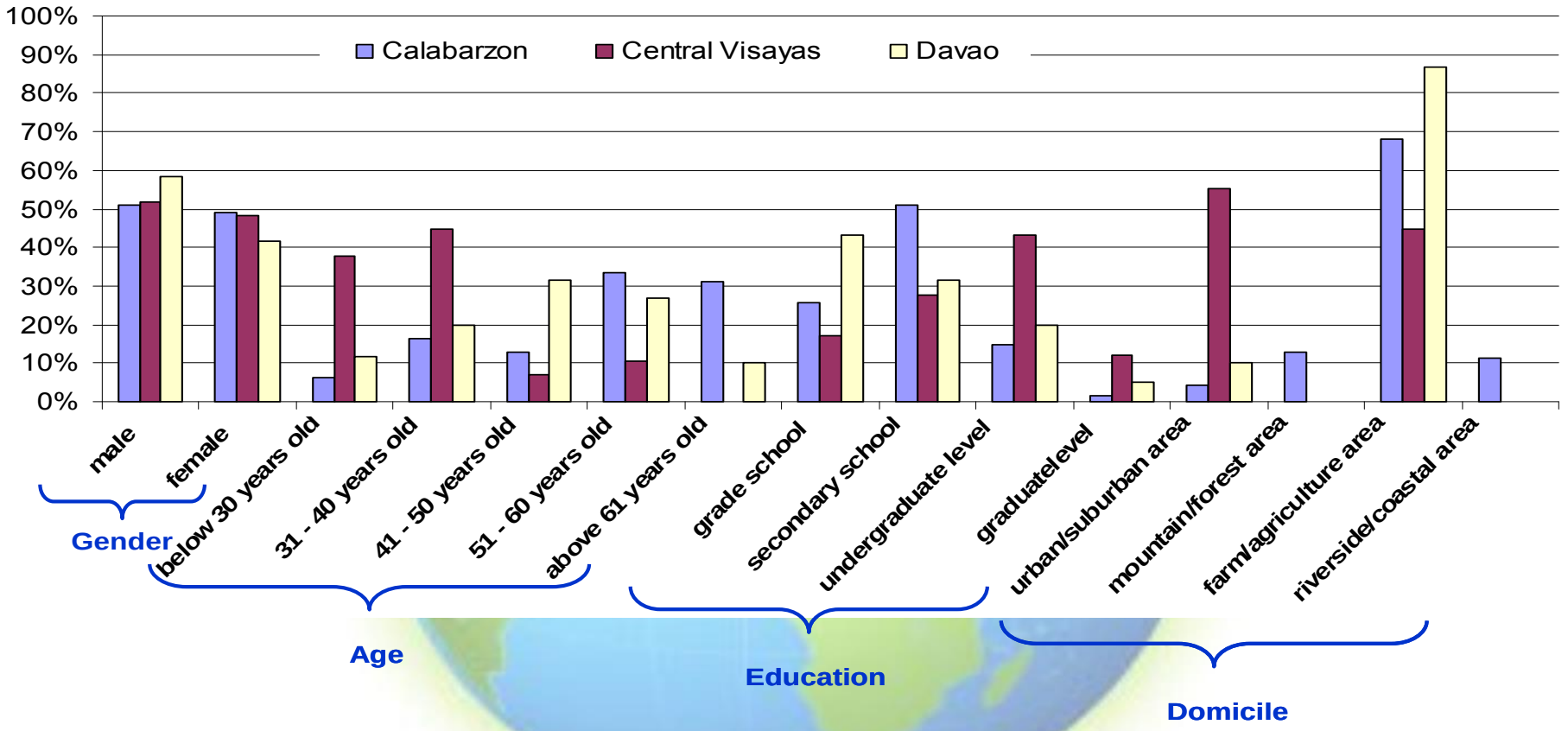
Factor X1 - Socio-Economic Characteristics
(1) Gender, (2) Age, (3) Education, (4) Domicile, (5) Work location
Factor X2 - Sources of information on bioenergy
(1) media (TV, newspaper), (2) internet, (3) family members and friends, (4) work colleagues, (5) neighbours, (6) public officials, (7) academe/science, (8) business partners
Factor X3 - Knowledge and opinion on bioenergy
(1) Familiarity with bioenergy, (2) relation of work to bioenergy, (3) opinion on bioenergy impact on country (good or bad), (4) opinion on effect of using food crops on food security
Factor X4 - Preferences on bioenergy feedstock
Rate potential contribution of (1) sugar-rich crops, (2) starch-rich crops, (3) oil-rich crops, (4) agriculture and forest residues, (5) fast-growing trees, (6) perennial grasses accordingly as very low, low, high, very high, and do not know

5. Results
5.1 Regional comparisons of survey respondents

Descriptive Analysis

Regional comparisons

Socio-Economic Characteristics

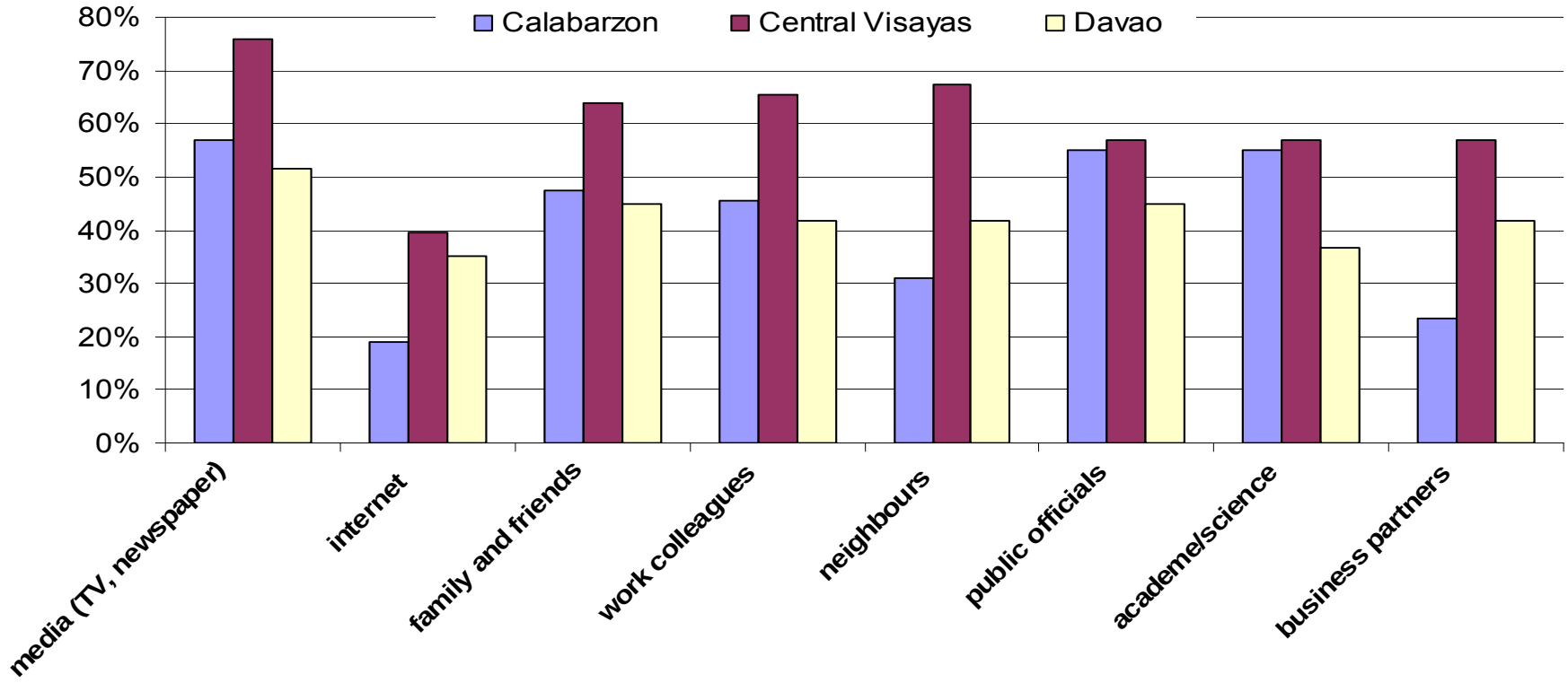


- Gender is almost equally distributed for all three case study areas
- Youngest and highly educated farmers are mostly surveyed in Central Visayas
- Unlike in Central Visayas, farmers in Calabarzon and Davao mostly live in farm

Descriptive Analysis

Regional comparisons

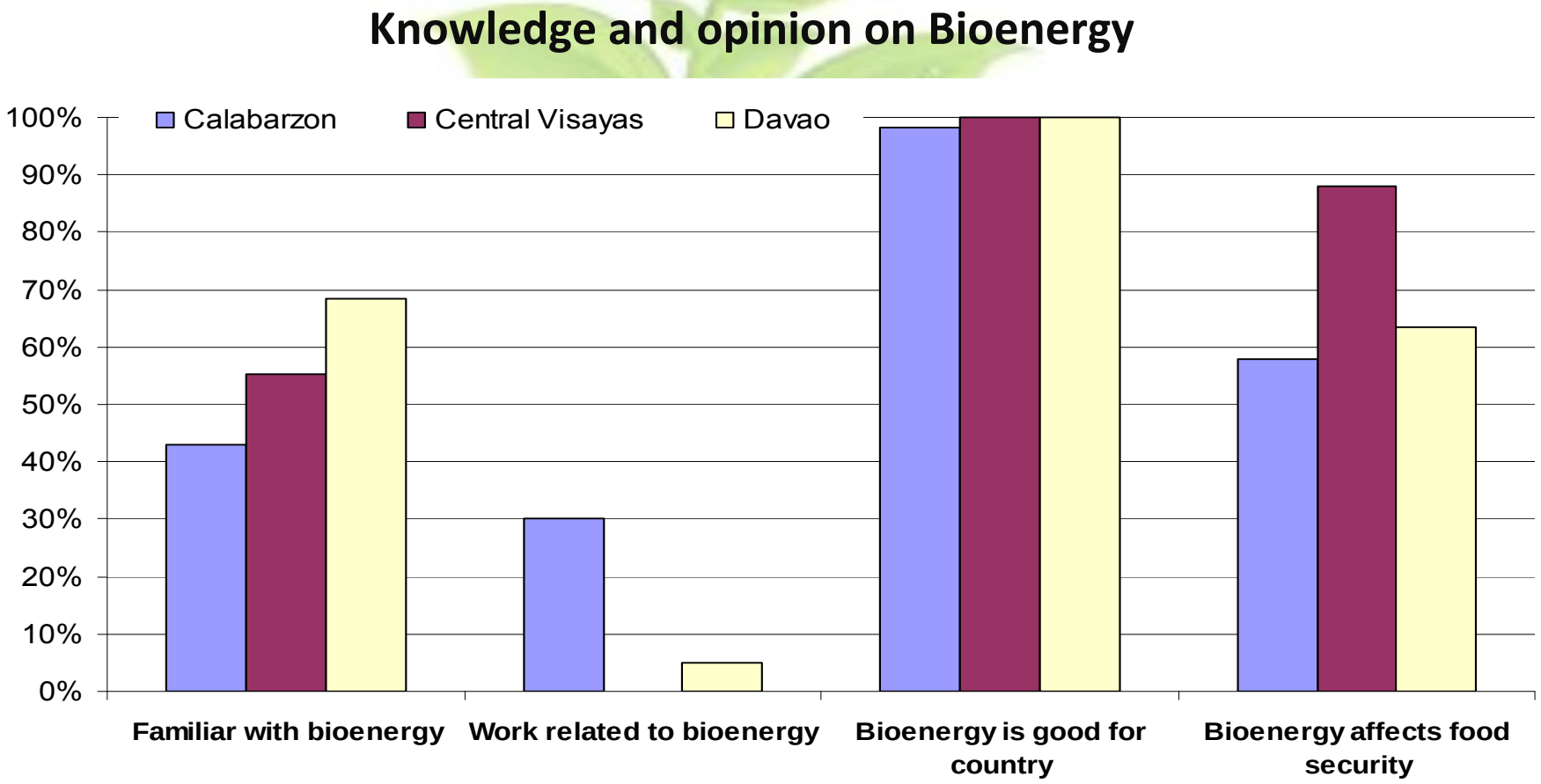
Most important sources of information on bioenergy



- Large number of famers in Central Visayas consider many sources most important
- Like in Central Visayas, only few farmers in Calabarzon and Davao consider internet as useful source of information
- Only media is considered most important by half of surveyed famers in Davao

Descriptive Analysis

Regional comparisons

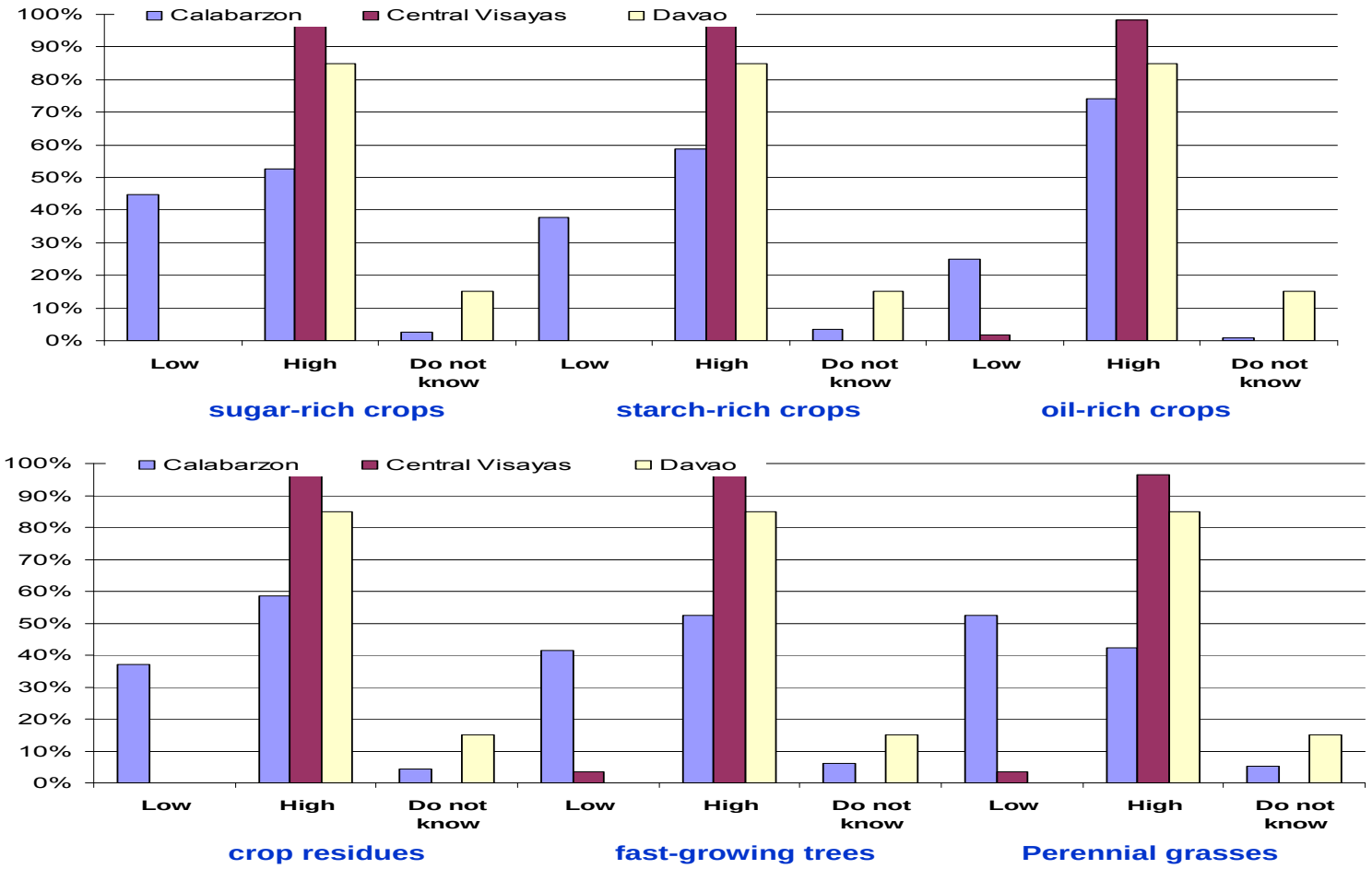


- Familiarity with bioenergy is highest in Central Visayas and lowest in Calabarzon
- None of the farmers in Central Visayas consider their work as related to bioenergy
- All or almost all farmers think that bioenergy is good for the Philippines
- Largest number of farmers who links bioenergy and food security is in C. Visayas

Descriptive Analysis

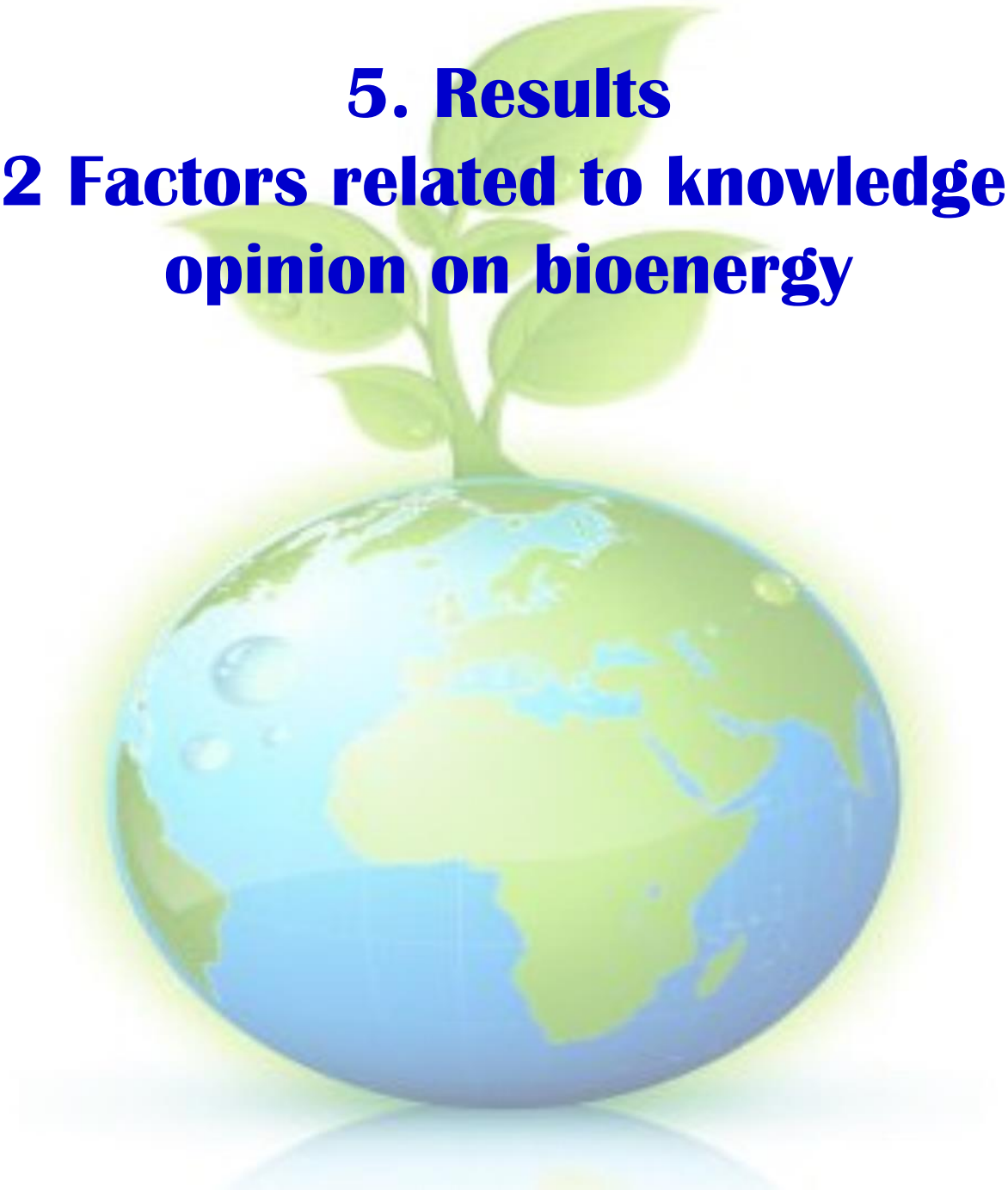
Regional comparisons

Opinion on potential of first and second generation bioenergy



- Opinions on both sources of bioenergy feedstock tend to be similar across all three case study areas, i.e. high potential level

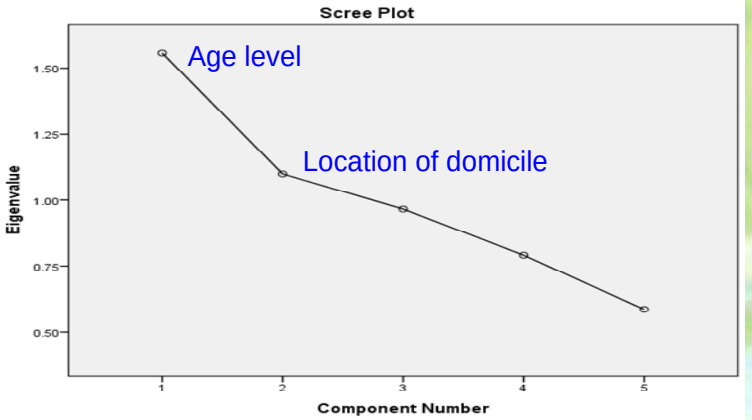
5. Results
5.2 Factors related to knowledge and opinion on bioenergy



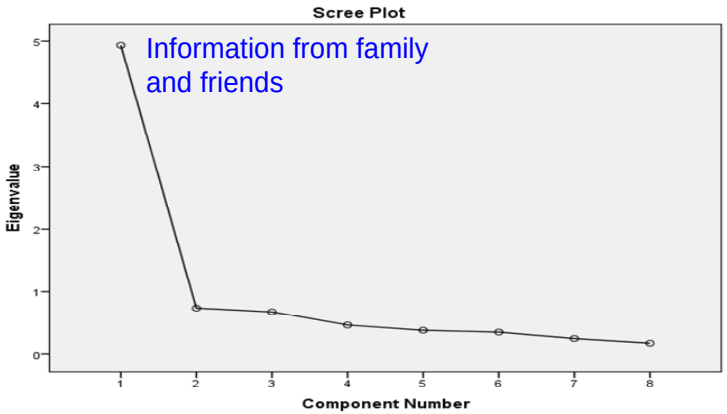
Factor Analysis

Factors related to knowledge and opinion

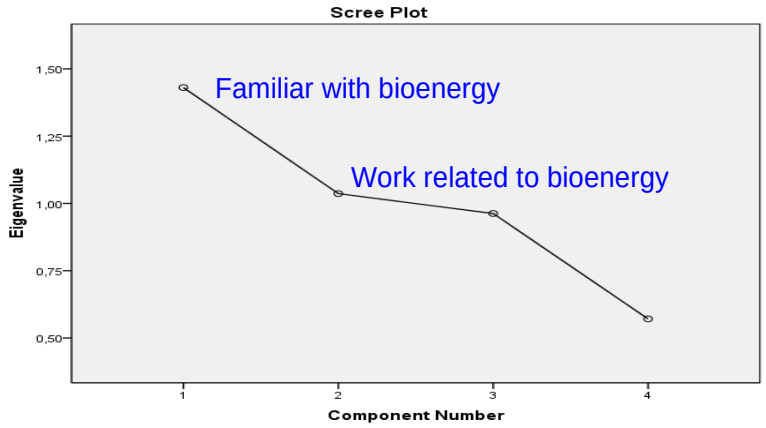
Socio-economic factors (X1)



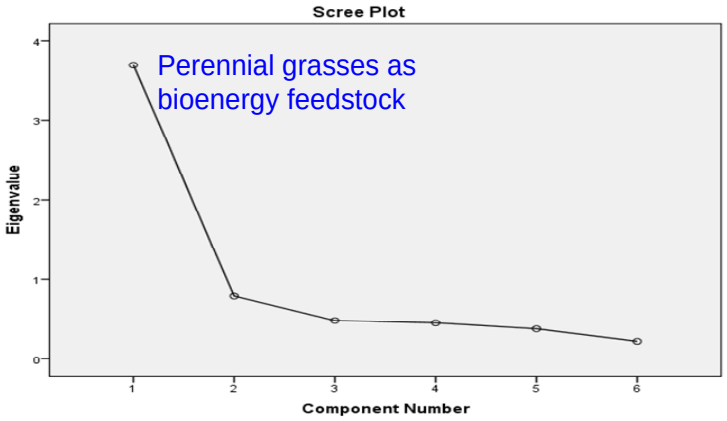
Sources of information (X2)



Knowledge and opinion on bioenergy (X3)



Choices on bioenergy feedstock (X4)



- **The plots show which variables in each Factor group are significantly different from the rest of the variables, i.e. highest Eigenvalue**
- **Two factors appeared important in Factor X1 abd X3, but only one in X2 and X4**

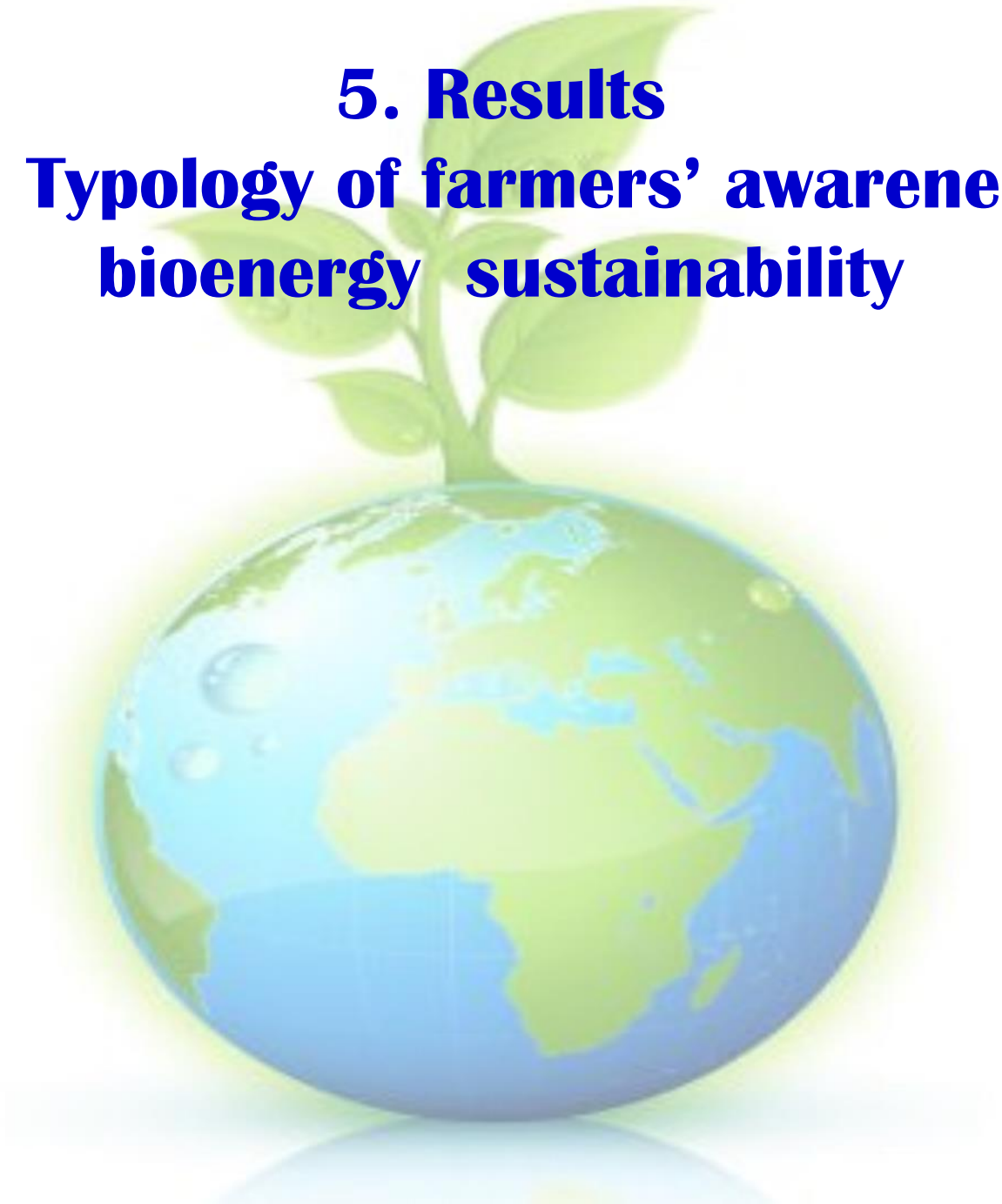
Factor Analysis

Factors related to knowledge and opinion

Factors*	Initial Eigenvalues			Statistical tests		
	Total	% of Variance	Cumula-tive %	KMO	Bartlett test chi-square	Sig.
Factor X1						
a) Age level	1.558	31.152	31.152	0.54	61.21	0.000
b) Location of domicile	1.099	21.983	53.136			
Factor X2						
a) Information from family and friends	4.935	61.693	61.693	0.91	1126.56	0.000
Factor X3						
a) Familiar with bioenergy	1.430	35.758	35.758	0.50	47.381	0.000
b) Work related to bioenergy	1.036	25.909	61.667			
Factor X4						
a) Perennial grasses as bioenergy feedstock	3.697	61.620	61.620	0.84	689.02	0.000

- **Kaiser-Meyer-Olkin Measure (KMO) measures appropriateness of factors in the analysis; only values not below 0.50 are acceptable. The Bartlett tests, which shows that variables in specific factor analysis are correlated and thus belongs together in the factor group, are statistically significant. The four factor analyses are thus all acceptable.**
- **The variable(s) in each factor analysis explain more than 50% (i.e. cumulative) of the variance in all four factor groups. These variables are thus very important.**

5. Results
5.3 Typology of farmers' awareness on bioenergy sustainability



Cluster Analysis

Main characteristics of famers according to cluster groups

Factors	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Age level	50,0% is between 51 and 60 years old	48,8% is 30 years old and below	61,3% is between 31 and 40 years old	**44,6% is between 51 and 60 years old 33,9% is between 61 and 70 years old**
Location of domicile	83,3% in farm or agriculture area	81,4% in suburban area/close to city	86,7% in farm or agriculture area	**75,0% in farm or agriculture area**
Information from family and friends	61,7% is the most important source	74,4% is the most important source	42,7% is the most important source	**48,2% is relatively important source**
Familiar with bioenergy	40,0% answered “Yes“	67,4% answered “Yes“	57,3% answered “Yes“	**48,2% answered “Yes“**
Work related to bioenergy (Yes)	10,0% answered “Yes“	4,7% answered “Yes“	20,0% answered “Yes“	**26,8% answered “Yes“**
Perennial grasses as bioenergy feedstock	**55,0% potential is very high**	**51,2% potential is very high**	**60,0% potential is high**	**44,6% potential is low**

Cluster Analysis

Typology of farmers by cluster

Cluster 1 consists of farmers whose age is close to retirement and live in rural area, who depend on family and friends for information, who are very unfamiliar with bioenergy and do not think that their work are related to bioenergy. They see very good potential for second generation bioenergy. (Typology – unaware)

Cluster 2 consists of famers who are still very young and live in urban area, who largely depend on family and friends for information, who are most familiar with bioenergy even though their work is not related to bioenergy. They see very good high potential for second generation bioenergy. (Typology – informed)

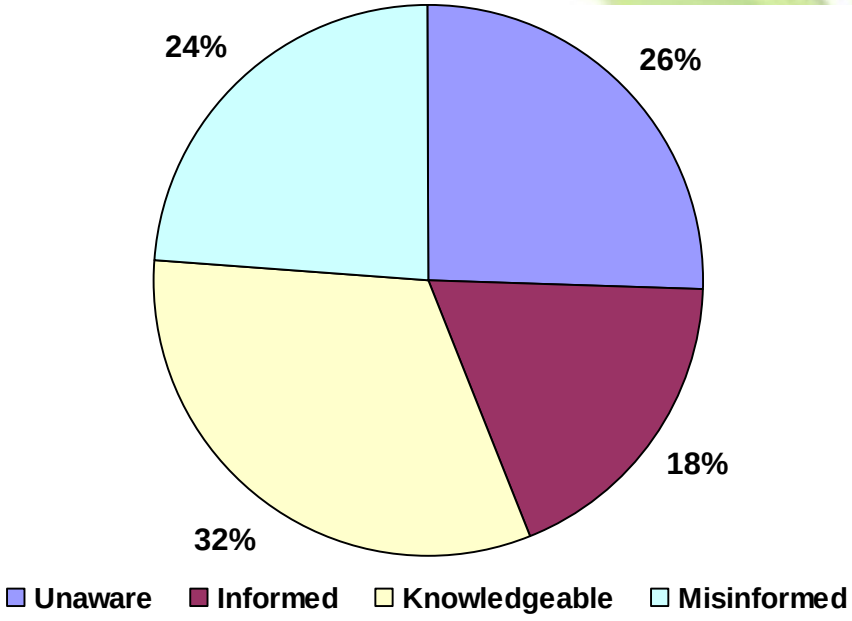
Cluster 3 consists of farmers who are middle aged and live in rural areas, who depend very little on family and friends for information, who are familiar with bioenergy and consider their work as related to bioenergy. They see only good potential for second generation bioenergy. (Typology – knowledgeable)

Cluster 4 consists of farmers who are in retirement and retired age and live in rural area, who depend very little on family and friends for information, who have average familiarity with bioenergy but largely think that their work is related to bioenergy. They do not see good potential for second generation bioenergy. (Typology – misinformed)

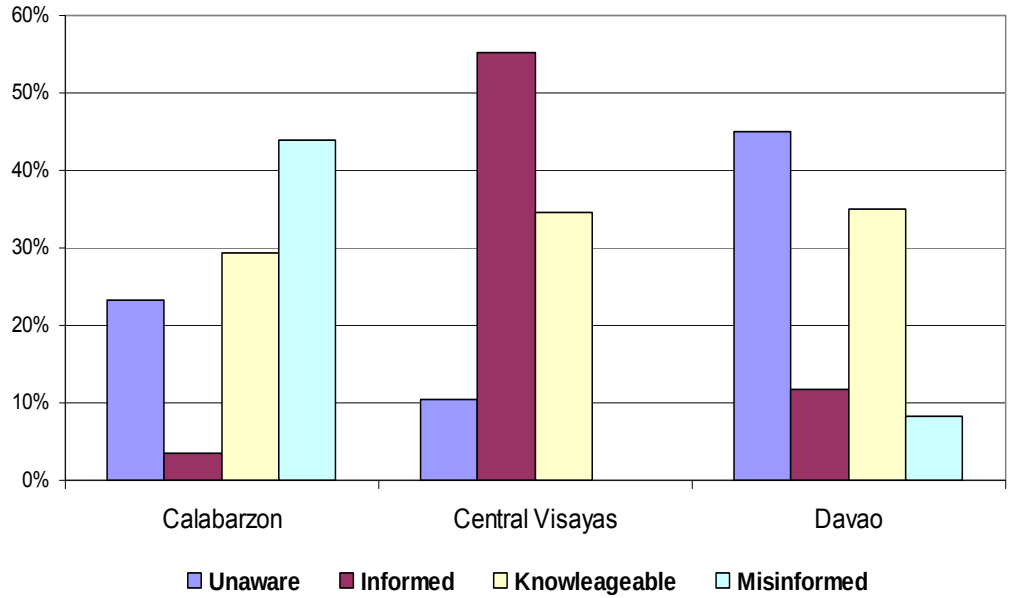
Cluster Analysis

Main characteristics of famers according to cluster groups

Distribution of farmers, by typology



Distribution of farmers, by typology and region



- Farmers in all three regions are well distributed in the four cluster typologies.
- Calabarzon is characterized by large number of uninformed farmers and Davao by unaware farmers. Central Visayas has the largest number of informed farmers. Knowleageable farmers are almost equally represented in all three regions.

Conclusions

✓The largest number of farmers with informed typologies are located in Central Visayas. Even if many famers will support bioenergy production, the region has only limited capacity to produce bioethanol from sugarcane because of the small number (i.e. 3 refineries) and small production capacity (i.e. 79 million liters per year) of these refineries. Bioethanol production can help increase agricultural wage and decrease poverty incidence in this region.

✓Farmers with misinformed typology are mostly located in Calabarzon. This is unfortunate because the potential for bioenergy is largest in this region where refineries have capacity to produce 347 million liters per year of biodiesel and 54 million liters per year of bioethanol.

✓The largest number of farmers with unaware typology is located in Davao. This region ranks 1st in coconut production so it is important to raise awareness on potential for biodiesel production. Moreover, the capacity of refineries to produce biodiesel need to be increased in this region. Refineries in Davao contribute only about 12% of the capacity for biodiesel production despite its important rank in coconut production.

Thanks
for your attention!