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EXPLORING *KAPPAPHYCUS ALVAREZII* (TAMBALANG) AND *EUCHEUMA DENTICULATUM* (GUSO) PROPERTIES AS SOURCES FOR BIOPLASTIC PRODUCTION: ECONOMICAL AND ENVIRONMENTAL BENEFITS FOR THE PEOPLE OF BARMM

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Exploring *Kappaphycus alvarezii* (Tambalang) and *Eucheuma denticulatum* (Guso) Properties as Sources for Bioplastic Production: Economical and Environmental Benefits for the People of BARMM

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ABSTRACT

The production of plastic had brought tremendous changes in fields such as manufacturing and production. While plastics are very useful, they come with negative impacts on the environment. In this regard, scientists have opted for renewable sources to be converted into bioplastics. Bioplastics have been the focus of various researches due to their low-cost production, high affordability, eco-friendliness, and organic decomposition properties. Currently, bioplastic supply around the world is considerably less, and demands for bioplastics have tremendously increased in the last years, making bioplastics one of the most sought-for products. As these demands increase, so is the need to look for other biological renewable sources that could replace synthetic materials, and one of them is seaweed. Bangsamoro, also known as the Bangsamoro Autonomous Region in Muslim Mindanao, or BARMM, is an autonomous region within the southern Philippines known as the country's largest leading seaweed producer, primarily of the species *Kappaphycus alvarezii* (Tambalang) and *Eucheuma denticulatum* (Guso). The researchers aim to (1) propose a sustainable source of livelihood for the people in BARMM by means of converting locally-produced seaweed (*Kappaphycus alvarezii* and *Eucheuma denticulatum*) to bioplastics, (2) initiate a bioplastic industry that would bring local jobs for the people to increase economic growth and engage BARMM towards becoming the country's leading bioplastic provider, and (3) promote environmental sustainability and protection through enriching their aquaculture and maximizing the use of seaweeds. The researchers have found out that producing bioplastics made from locally-produced species of seaweed would be advantageous for the people considering their geographic location and abundance of aquaculture skills and resources. This would produce local jobs that would boost their economy, engaging BARMM towards the bioplastic industry which would open opportunities for maximizing growth potential. It would also help preserve their environment by putting these microalgae into sustainable use. Although seaweed bioplastics are still in the research phase of becoming more durable, seaweed bioplastics still pave the way towards attaining local sustainability and development.

Keywords: Bioplastic, Seaweed, Bangsamoro, BARMM, Aquaculture, Economical Growth, Environmental Sustainability and Development

Introduction

- Plastic as a “staple” in everyday lives
- Plastics and their negative impact on the environment
  - 8 million pieces of plastic pollution in the oceans
- Philippines as the third biggest ocean polluter of plastic in the entire world
- Sustainable alternatives for synthetic materials used in plastic production
- Seaweed as a bioplastic material
- Abundance of seaweeds in BARMM
- Bangsamoro Organic Law or BOL (Republic Act No. 11054)
  - Basilan, Lanao del Sur, Maguindanao, Sulu, and Tawi-Tawi
- Issues on poverty and stunted economic growth

DATA

POVERTY INCIDENCE

(% of total population)

	1991	2006	2009	2012	2015
ARMM	30.5	47.1	47.4	55.8	53.7
Socssksargen	53.3	39.7	38.3	44.7	37.3
Zamboanga Peninsula	40.3	45.0	45.8	40.1	33.9
Philippines, excluding NCR	38.8	29.7	29.6	28.2	25.4
Philippines	34.4	26.6	26.3	25.2	21.6

SOURCE: Philippine Statistics Authority (PSA)

Table 1. Poverty Incidence in ARMM

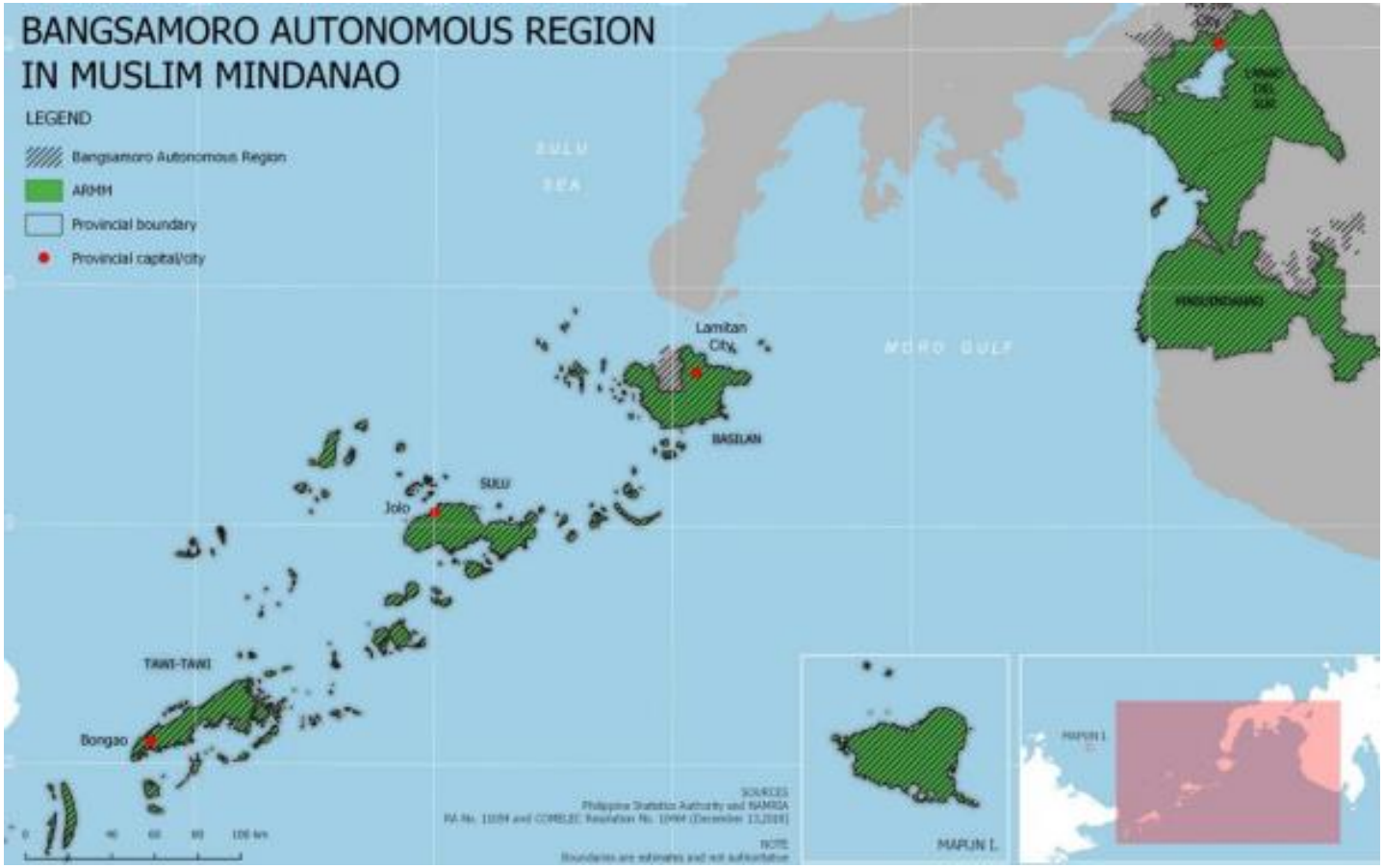

Figure 1. Geographical Map of BARMM

Species	Production (in MT)	
	2017	2018
BRACKISHWATER FISHPOND	**1,447.61**	**1,434.02**
BF - Milkfish	1,272.42	1,272.17
BF - Tilapia	52.87	53.18
BF - Tiger prawn	89.23	74.66
BF - Mudcrab	1.69	1.78
BF - White shrimp	31.40	32.23
FRESHWATER FISHPOND	**23.73**	**26.87**
FF - Tilapia	3.81	5.77
FF - Catfish	19.80	21.10
FRESHWATER PEN	**728.05**	**763.53**
FP - Milkfish	207.97	226.18
FP - Tilapia	520.08	537.35
FRESHWATER CAGE	**73.94**	**75.93**
FC - Milkfish	22.82	24.65
FC - Tilapia	51.61	54.80
MARINE PEN	**..**	**0.28**
MP - Spiny lobster	..	0.06
MP - Others	..	0.22
MARINE CAGE	**..**	**1.64**
MC - Milkfish	..	0.55
MC - Others	..	1.09
SEAWEED	**135,244.32**	**137,648.66**
Total	**137,517.65**	**139,950.92**

Source: Philippine Statistics Authority

Table 2. Volume of Aquaculture Production in ARMM, by Aquafarm and by Species: Q2 2017 – Q2 2018 (in MT)

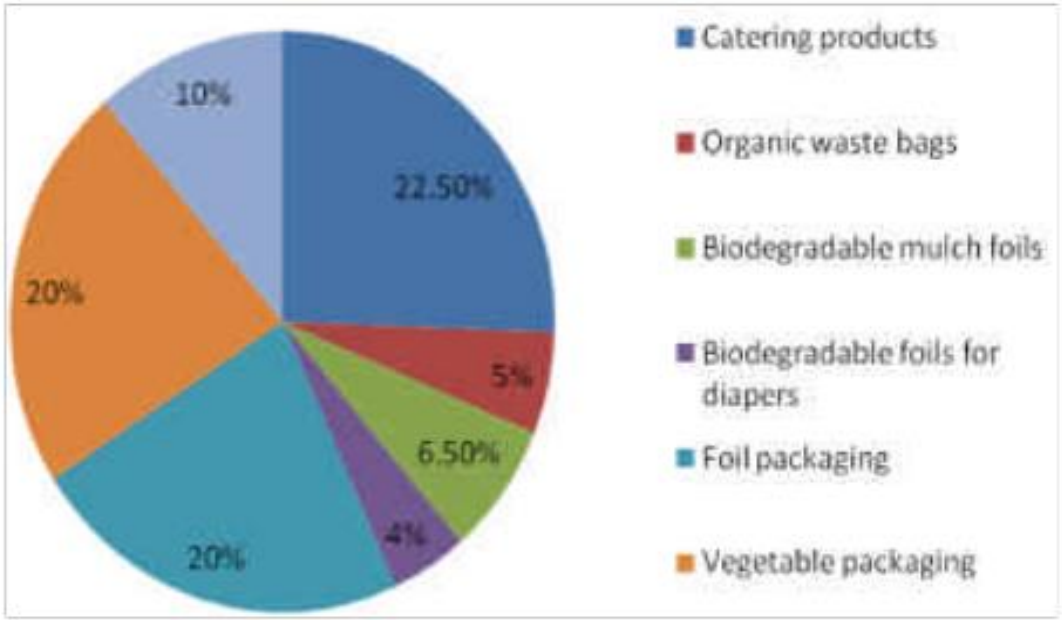

Fig. 2. Proportion of Bioplastics in Different Sectors

Chemical Content	Composition (wt. %)
Moisture	0.89%
Carbohydrate	65.20%
Protein	3.40%
Fat	1.10%
Ash	11.57%

Table 4. Chemical Composition of Kappaphycus alvarezii (Tambalang)

Figure 3. Dried Kappaphycus alvarezii (Tambalang)

Seaweed species	*Hypnea musciformis*	*Sargassum oligocystum*	*Ulva fasciata*	*Eucheuma denticulatum*
Minerals				
Sodium	20.50 ±5.61^{b}	18.79 ± 1.82^{b}	17.42 ± 2.43^{b}	9.88 ± 1.25^{a}
Potassium	2.55 ± 0.18^{c}	0.50 ± 0.03^{a}	2.56 ± 0.10^{c}	1.36 ± 0.25^{b}
Phosphorus	2.21 ± 0.53^{a}	3.35 ± 0.24^{a}	2.36 ± 0.49^{a}	2.43 ± 1.35^{a}
Magnesium	411.56 ± 7.66^{b}	397.12 ± 2.19^{a}	429.88 ± 2.47^{c}	436.97 ± 1.06^{c}
Zinc	1.29 ± 0.23^{a}	1.51 ± 0.22^{a}	4.12 ± 0.30^{b}	4.25 ± 1.85^{b}
Iron	7.34 ± 1.71^{a}	25.82 ± 1.34^{b}	51.39 ± 2.58^{c}	48.80 ± 1.0^{d}
Cadmium	0.17 ± 0.01^{a}	0.18 ± 0.05^{ab}	0.24 ± 0.05^{ab}	0.30 ± 0.10^{b}
Lead	nd	nd	nd	nd

nd = not detected (LOD for lead =0.0692ppm)

Means with different superscript letters in each row are significantly different at $p<0.05$.

Table 4. Chemical Composition of Eucheuma denticulatum (Guso)

Figure 4. Harvesting Eucheuma denticulatum (Guso) in Mindanao

Objectives

- ✓ To propose a sustainable source of livelihood for the people in BARMM by means of converting locally-produced seaweed (*Kappaphycus alvarezii* and *Eucheuma denticulatum*) to bioplastics
- ✓ To initiate a bioplastic industry that would bring local jobs for the people to increase economic growth and engage BARMM towards becoming the country's leading bioplastic provider
- ✓ To promote environmental sustainability and protection through enriching their aquaculture and maximizing the use of seaweeds

Methods

- This study used a descriptive method of research.

- In order to understand the people, the researchers immersed themselves into an observational approach by joining a group on social media where people from BARMM are members.

- The researchers used a secondary data analysis or archival study approach in order to explore the properties of *Kappaphycus alvarezii* and *Eucheuma denticulatum* as potential bioplastic materials.

- Data about the Bangsamoro were gathered through the Open Bangsamoro Data files as well as data from the Philippine Statistics Authority. The researchers also made use of videos, articles, and the latest news on BARMM.

DISCUSSION:
ADVANTAGES AND DISADVANTAGES

ADVANTAGES

- Less dependent on fossil fuels
- Use less energy for production
- Recyclable,
- Dissolves in water
- Balance to mariculture

DISADVANTAGES

- Still in the research phase
- Durability
- May cause pollution on seaweed nurseries or the production areas of seaweeds if not well-maintained

DISCUSSION:
OPPORTUNITIES AND THREATS

OPPORTUNITIES

- Local jobs for the people of BARMM
- A potential emergence of bioplastic industry
- May expand economic growth
- Environmentally sustainable
- May be further developed/enhanced

THREATS

- Bioplastics made of other material (i.e., mango)
- Technological concerns

REFERENCES

Dy, R. (2019). The Poverty Challenge of Bangsamoro. *Inquirer.net*. Retrieved on December 2019 from https://business.inquirer.net/264224/the-poverty-challenge-of-bangsamoro

Jambeck, J. Geyer, R. Wilcox, C. (2015). Plastic Waste Inputs from Land into the Ocean. *Science*, *347*(6223), 768-771. DOI: 10.1126/science.1260352

Gironi, F. & Piemonte, V. (2011). Bioplastics and Petroleum-based Plastics: Strengths and Weaknesses. *Energy Sources Part A: Rec*overy (21):1949-1959. DOI:10.1080/15567030903436830

Global Biodegradable Plastics Market Report 2018-2025 - Market Size is Projected to Reach USD 6.73 Billion. (2018). *GLOBE NEWSWIRE*. Retireved on December 2019 from https://www.globenewswire.com/news-release/2018/11/05/1645081/0/en/Global-Biodegradable-Plastics-Market-Report-2018-2025-Market-Size-is-Projected-to-Reach-USD-6-73-Billion.html

Khalil, A., Tye, Y., Yap, S., et al. (2018). Effects of corn starch and Kappaphycus alvarezii seaweed blend concentration on the optical, mechanical, and water vapor barrier properties of composite films. *Bioresources*, *13*(1):1157-1173. DOI: 10.15376/biores.13.1.1157-1173

Lagdameo, K., Espaltero, C., Ricarte, M., et al. (2015). The Effect of Glycerol to the Biodegradability and Flammability on Kappaphycus Alvarezii (Tambalang) Seaweed Bio-Plastic. Retrieved on December 2019 from http://www.spaconline.org/home/2015/08/04/the-effect-of-glycerol-to-the-biodegradability-and-flammability-onkappaphycus-alvarezii-tambalang-seaweed-bio-plastic/

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REFERENCES

M.D. Guiry (2000 – 2020). The Seaweed Site: information on marine algae. Retrieved on December 2019 from http://www.seaweed.ie/algae/seaweeds.php

Plastics Exposed: How Waste Assessments and Brand Audits are Helping Philippine Cities Fight Plastic Pollution. (n.d.) *Gaia*. Retrieved on December 2019 from https://www.no-burn.org/waba2019/

Plastic Pollution – Facts and Figures. (2020). *Surfers against Sewage*. Retrieved on December 2019 from https://www.sas.org.uk/our-work/plastic-pollution/plastic-pollution-facts-figures/

Rajendran, N., Puppala, S., Raj S., et al. (2012). Seaweeds can be a New Source for Bioplastics. *Journal of Pharmacy Research, 5*(3),1476-1479.

Singh, S., Thakur, R., Singh, M., et al. (2015). ffect of fertilizer level and seaweed sap on productivity and profitability of rice (Oryza sativa). *ResearchGate.Net*. Retrieved on December 2019 from https://www.researchgate.net/publication/291284986_Effect_of_fertilizer_level_and_seaweed_sap_on_productivity_and_profitability_of_rice_Oryza_sativa

Seaweeds Used as a Source of Carrageenan. (n.d.) Retrieved on December 2019 from http://www.fao.org/3/y4765e/y4765e09.htm

Thank you!