



BAR Research and Development DIGEST

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RESTORING THE GLORY OF SEA URCHINS

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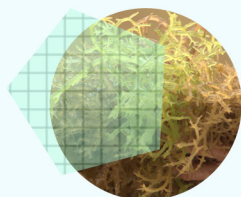
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BAR R&D Digest is the official quarterly publication of the Department of Agriculture-Bureau of Agricultural Research (DA-BAR). A staff bureau of DA, it was established to lead and coordinate the agriculture and fisheries research and development (R&D) in the country. Specifically, BAR is tasked to consolidate, strengthen, and develop the R&D system to improve its effectiveness and efficiency by ensuring customer satisfaction and continuous improvement through work excellence, teamwork and networking, accountability and innovation.

This publication contains articles on the latest technologies, research results, updates, and breakthroughs in agriculture and fisheries R&D based from the studies and researches conducted by the member-institutions of National Research and Development System for Agriculture and Fisheries (NaRDSAF).

BAR R&D Digest welcomes comments and suggestions from readers.

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Harvesting nature's bounty from our seas

by Dr. Nicomedes P. Eleazar, CESO IV

In the history of mankind, civilizations rose mostly along the seacoasts. To this day, some three-fourth of the world's major cities may be found in coastal areas.

That man has situated himself near oceans is understandable as these are where may be found many of earth's valuable natural resources. The seas and oceans have always been an important and reliable source of food in the form of fish and other items.

is primarily about fish and shellfish. However, edible sea plants, such as some species seaweeds and microalgae, are also widely-eaten as seafood around the world with Asia registering the highest per capita consumption.

More than 3.5 billion people depend on the ocean as their primary food source. Seafood is the world's prime source of high-quality protein as it accounts for 14-16 percent of the animal protein consumed worldwide.

Ironically, according to the Bureau of Fisheries and Aquatic Resources (BFAR) consumption of seafood in the country is declining. This adds urgency for government to increase its support to families and communities in the coastal areas, the very places where the most impoverished and most vulnerable live, in the form of improved food production and expanded opportunities for livelihoods and employment. To this end, the Bureau of Agricultural Research (BAR), BFAR, and other concerned agencies of the Department of Agriculture have been busy in their efforts to improve efficiency in the use of coastal resources, thereby promoting conservation, and increase productivity and incomes. Attention is also being given to empower stakeholders towards greater food security, and reducing postharvest losses and waste.

This issue of the *BAR R&D Digest* focuses on some of the research initiatives on the commodities from the deep sea to shore waters supported by the bureau and implemented by partners in the agriculture and fisheries R&D system - from two finfishes to a crustacean to several soft bodied animals and on to seaweeds. With these, we hope to translate to reality the promise of the seas as a source of much needed sustenance for consumers and producers alike. ###

“More than 3.5 billion people depend on the ocean as their primary food source. Seafood is the world's prime source of high-quality protein as it accounts for 14-16 percent of the animal protein consumed worldwide.”

In recent times, the popularity of seafood has increased because of better regard for the ocean as a source of health-promoting food. According to the Food and Agriculture Organization, worldwide, people consume an average of 19 kilograms of fish yearly.

To us humans, seafood is any sea life that can be used as food. It

This has made capture fisheries enormously important to many economies and to man's wellbeing.

In 20 years, seafood consumers could double to seven billion and this is raising deep concerns about the sustainability of seafood supply from capture fisheries. Increasingly, aquaculture will be called on to fill future insufficiency.

Restoring the glory of sea urchins

by Aldrin N. Taoatao, BFAR I

Even if seen for the first time, one is bound to be captivated by the exquisiteness of these colourful balls of spines.

Sea urchins are slow-moving creatures living in the shallow bottom of the ocean. They belong to the *Phylum Echinodermata*, same as that of brittle sea stars, sea cucumber, sand dollars and starfish. Mainly, they feed on macroalgae or seaweeds for their nutrition.

Distributed all throughout the world, sea urchins pose a threat to biodiversity. Their rapid reproduction can obliterate the marine flora leading to “urchin barren” – these are places where the abundance of sea urchin increases dramatically because the urchin devours everything in its path, leaving all else barren. This affects the ecological balance in the area that may lead to exhaustion of resources and even extinction.

Although the occurrence of urchin barren in the Philippines is still far at sight, the populations of sea urchins are being threatened.

Tripneustes gratilla is the most exploited species in the country. These echinoids are recruited heavily due to their high export demand. They are considered a culinary delicacy in many places around the world particularly in Japan, Taiwan, Hong Kong, and Korea. Urchin eggs or roe are especially sought-after due to its great taste akin to lobster and are believed to be a powerful aphrodisiac. In the 1970s, export of this commodity gave a lucrative livelihood to many fisher-families in Bolinao, Pangasinan. This fishery industry in Bolinao generated multi-million peso earnings annually. However, this livelihood has rapidly depleted the sea urchins in the area, leading to its eventual collapse. Even the rapid reproduction of these sea creatures cannot cope with the fishing pressures in the community.

Several interventions were undertaken to replenish the population of *T. gratilla* in Bolinao, Pangasinan. In 1989, the municipal government imposed an annual two-month closed fishing season. However, this fishing regulation made no significant impact on

the status of the declining wild population. In January 1993, a moratorium on commercial harvesting in the municipality was implemented but still recruitment was low. This may be due to the small-size of the remaining wild stocks. Eventually, the University of the Philippines-Marine Science Institute came up with the idea of mass producing sea urchins in the laboratory to provide seedstocks for the community's aquaculture that will serve as mini- reproductive reserves. This strategy to a certain degree revived the livelihood of some families in the locale.

Start of sea urchin culture

The eventual success of the sea urchin culture in Bolinao gave way to its promotion in the region. In 1988, the initial grow-out culture of sea urchins was conducted in sea pens at Brgy. Nalvo, Santa Maria, Ilocos Sur. In the same year, a community- based grow-out culture of sea urchins was introduced in Bolinao, Pangasinan. There were also several verification trials conducted in suitable areas of Ilocos Norte and La Union.

The Department of Agriculture-Bureau of Fisheries and Aquatic Resources (DA-BFAR) improved the technology of the culture method of this commodity until the most feasible one was generated. A technology commercialization project that was funded by the Bureau of Agricultural Research (BAR) was implemented in Paraoir, Balaoan, La Union. Until now, this technology benefits the community's fishers and the sea urchin has become the "One Town, One Product" in the area.

Improved culture technology

The technology modified by DA-BFAR I uses a modular system. In this approach, there are seven

cages in each module. The first design of the cage was a rectangular prism-shaped which measures 2.4 x 1.2 x 0.6 m. Later on, the shape of the cage was modified into triangular-prism to effectively lessen the impact of strong waves.

The first cage is initially stocked with about 2, 000 pieces of sea urchins (*T. gratilla*) measuring from 1-2 cm in test diameter. After two months the initial stocks would be divided into two, i.e., 1,000 pieces of juveniles would be transferred to one cage of the same dimensions and the other 1,000 pieces would be transferred to another cage. After another two months, the stocks would be divided again into two and would be transferred to another two cages. After two months, stocks would again be equally divided and would be transferred to next two cages.

For newly-established venture, all cages would be initially stocked with sea urchins of

different sizes to maximize the use of the cages. An *ad libitum* feeding is being done with fresh Sargassum. After two months when the test diameter reached 7-8 cm, the sea urchins are ready for harvesting and re-stocking for the next cycle. This means that stocking, stock transfer and harvesting would be done every two months.

Since the developed culture technology was introduced and promoted for adoption, several municipalities in the region started to implement this culture. These municipalities include: Bacnotan and San Fernando City in La Union; Santa Maria, San Esteban, Santiago, Narvacan, Cabugao, Sinit, and San Juan in Ilocos Sur; Currimaog, Badoc, Burgos, and Pagudpud in Ilocos Norte; and Anda, Dasol, and Infanta in Pangasinan. Other regions in the country have also





adopted the technology. These include: Region 2 (Cagayan), Region 4A (Calatagan, Batangas), Region 5 (Panganiban, Camarines Norte), and Region 6 (Aklan).

Problems in culturing sea urchins

Certain considerations must be observed in venturing in sea urchin culture. One is the limit in using *Sargassum* as feed, and the other one, is in the event of typhoons or storm surges.

There are some limitations as to the use of *Sargassum* as feeds for sea urchin. The restriction for the utilization of *Sargassum* as

feed is stipulated in the Fisheries Administrative Order (FAO) No. 250. Sea urchin raisers can use these seaweeds provided that the collected or gathered *Sargassum* is intended only for sea urchin feeds. The seaweeds must be those found floating on the water (not uprooted). FAO 250 is still in force but is in the process of amendment.

The present design of the cage is effective for use during typhoons and storm surges. However, in case of strong typhoons, cages must be pulled out from the site and placed in safe places to avoid its destruction.

Towards a sustainable and maximum utilization of resources

DA-BFAR I further improved the culture technology to maximize the utilization of the water column and to at least increase income of the raisers.

In 2013, the “Technology Demonstration on the Co-culture of Seaweeds and Sea Urchin” was introduced and piloted. This project which was implemented in the four provinces of the region sought to test the economic viability on the co-culture of sea urchin and seaweeds, to maximize the productivity of a certain area with the culture of two



commodities at the same time, and to showcase the technology on the co-culture of sea urchin and seaweeds to the fishing community.

This project, also known as “Sea Garden” employed two culture methods. The single long line culture method was used for seaweeds. There were a total of 51 lines at 50 meters/line installed in areas measuring 2,500 m². These lines were set up at the water column at one meter below the water surface during lowest low tide. Under these lines was one module sea urchin culture in cages.

This co-culture system follows the principle of Integrated Multi-Trophic Aquaculture (IMTA). IMTA is based on the concept of recycling in which the waste product of one organism becomes the food of the other organism. In an IMTA system, seaweeds extract the dissolved inorganic nutrients (particularly carbon, nitrogen, and phosphorus) and produce oxygen to the water while the sea urchin uses the oxygen and releases nutrients

“This project which was implemented in the four provinces of the region sought to test the economic viability on the co-culture of sea urchin and seaweeds...”

from the digested Sargassum. IMTA is different from polyculture in that the former requires the cultivation of species from different levels of the food chain while the latter can include the co-culture of any species.

Socio-economic benefit and success stories

The approach of integrating cultivation of seaweeds and sea

urchins under a single water column helps elevate the socio-economic status of the cooperators while reducing fishing pressure in the marine resources.

Beneficiaries of the project are registered fisherfolk and/or fisherfolk under TARGET (Targeted Actions to Reduce Poverty and Generate Economic Transformation). The project serves as an additional





source of livelihood and at the same time strengthens the families' or communities' social collaboration. The cultivation is attended by the head of the family while some family members gather and sell them.

Seaweeds can be sold fresh or processed/value-added. Dried or bleached seaweeds are sold at higher prices and can be stored for a longer time. Bleached seaweeds can be further processed into candies or pickles. Likewise, live sea urchins of marketable sizes (7-8 cm in test diameter) can be sold at Php50 per kilo to the village buyers and Php80 per kilo to commercial buyers.

Through the income generated from the culture, several families were able to renovate their houses and send their children to school (everyday support of "baon" or daily allowance).

One of the beneficiaries, Mr. Renante Prado, a 41-year old resident of Paraoir, Balaoan in La Union, shared his success story. He started the cultivation of sea urchin

in 2005 when he became one of the project recipients. For many years, selling sea urchin is the only source of his family's income, but with dedication he is able to support their everyday living. Now, Prado incorporates cultivating seaweeds. "Because of sea urchins and seaweeds, I can afford to send my three children to school and can feed my family," Prado said. His children are now in Grade 11, Grade 7, kinder, and the youngest is just a two-year old kid. His wife is the one responsible for taking care of the children while he is taking care of the sea urchins and seaweeds.

At the end of the day, it is important to note that, it is not just the technology that measures true success but more importantly, it is the dedication of the receivers that created for their own achievement.

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Leading the way for better, safer seaweed and fish products

by Victoriano B. Guiam

During the 7th Agriculture and Fisheries Technology Forum and Product Exhibition organized by the Bureau of Agricultural Research (BAR) in August 2011 at the SM MegaMall in Mandaluyong City, a curious crowd had gathered to watch a cooking demonstration. The two dishes being prepared were spaghetti and *leche flan*. Now, this may not have looked like anything out of the ordinary save for one thing – the spaghetti and *leche flan* were made with seaweed! They looked like the real thing. Those who got to taste the dishes said they were good.

Preparing the dishes then were Bureau of Fisheries and Aquatic Resources 5-Regional Fisheries R&D

Center (BFAR 5-RFRDC) Manager Aida Andayog and her staff who are based in Sorsogon where the center's researches on seaweed and seaweed products are conducted. Already, the center has demonstrated that local edible seaweeds can be used to make a variety of food. To date, they have come up with some 20 value-added products from seaweed.

But why use seaweed for everyday food?

To the researchers, the edible seaweeds can substitute for many of our daily dishes. According to Andayog, "Seaweeds are nutritious. They can help build and sustain the broad nutritional requirements and balance of vitamins, minerals and vital nutrients". Her team has used

them for making pansit/noodles, pickles, *morcon*, *lumpia*, chocolate, jam/marmalade and *nata de seaweed*. Their food potentials continue as they can be used as stabilizer, emulsifier, binder, thickening agent and jelly. They also have applications in medicine and in industry owing to their unique characteristics. They also find use in wastewater treatment, and as animal feed and fertilizer.

Much of man's civilization developed along the seacoasts and seaweeds have been part of his diet. In Asia, where the use of these plants as food is most developed, particularly Japan, Korea, and China, seaweed cultivation is a major industry. It is eaten as a vegetable



in raw or processed form, as a food wrapper, as a cooked rice and dish enhancer, and many others. Presently, in the coastal areas of the Bicol region's provinces (Camarines Norte, Camarines Sur, Albay, Sorsogon, Catanduanes, and Masbate) where seaweed can grow, many of the communities are engaged in seaweed farming. The Bicol region, particularly the Province of Sorsogon, commercially-important seaweeds grow abundantly including *Eucheuma*, *Gracilaria*, *Caulerpa*, *Gelidium*, and *Kappapichus*.

Bicol is also rich in marine fish and the region has been processing tuna, snapper, sardines, croakers, siganids, and others for food through traditional sun-drying, smoking ("inagunan"), and fermentation methods. Some are unique to Bicol and the rest of the country is yet to be acquainted with them.

To the residents, these are not just food but they provide much needed extra income. These products have high demand from both local and foreign tourists. The

possibility of opening up more livelihood opportunities for fishermen and other workers is a compelling reason for BFAR Region 5 to improve on and expand these cottage industries.

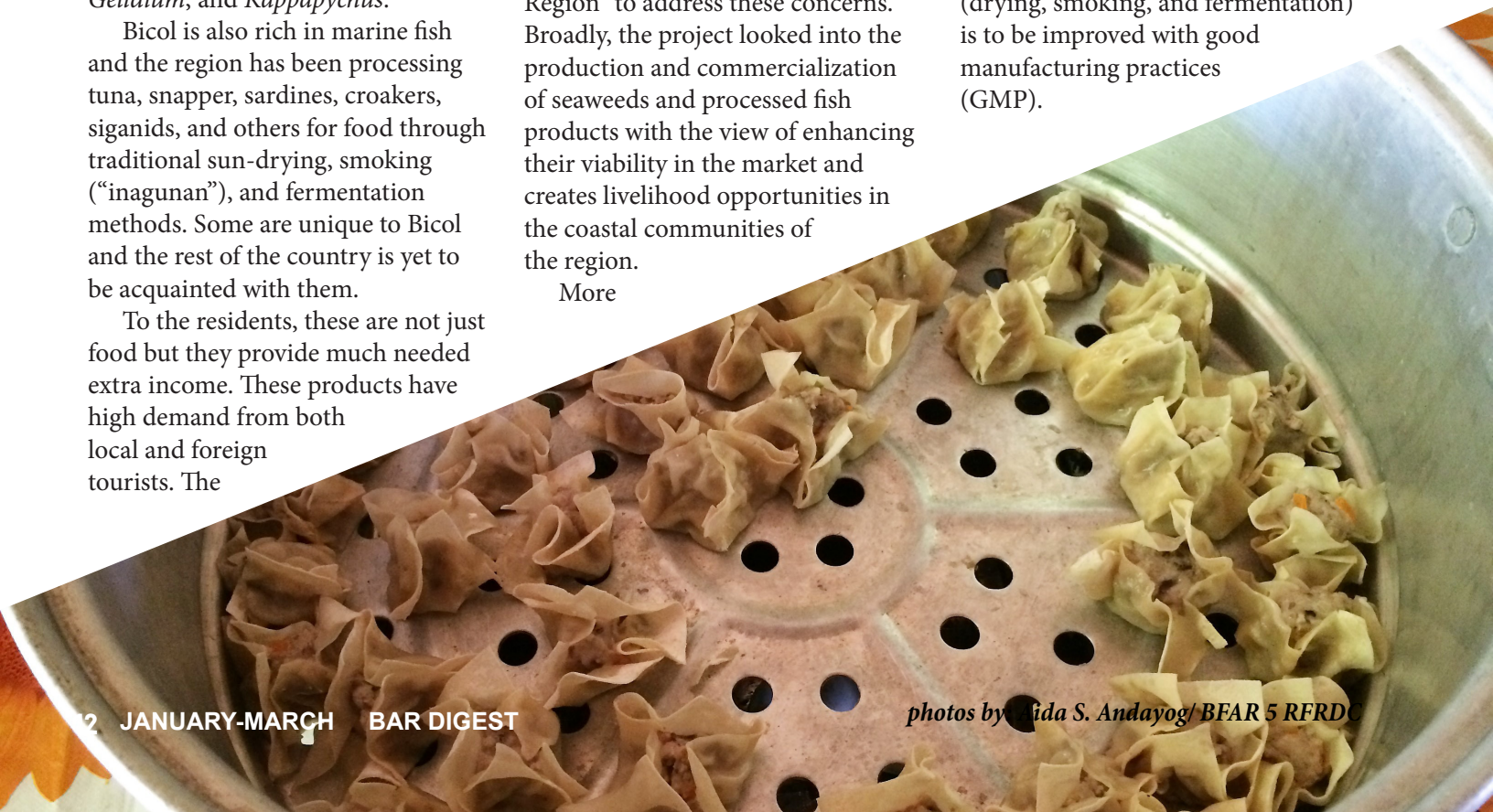
However, for the seaweed and marine food products produced by the coastal communities of Bicol to penetrate a wider market, these need to undergo further product improvement and pass the hurdle of regulations and protocols governing food preparations for safety reasons. Product acceptability among would-be entrepreneurs and the business and marketing side of production also have to be explored.


In 2017, BFAR 5 submitted a project proposal to BAR titled, "Technology Enhancement and Utilization of Seaweeds Value-Added and Fishery Products in Bicol Region" to address these concerns. Broadly, the project looked into the production and commercialization of seaweeds and processed fish products with the view of enhancing their viability in the market and creates livelihood opportunities in the coastal communities of the region.

More

specifically, it intends to enhance the quality and packaging of processed fish and the production of seaweeds products; test for the nutritional and microbiological contents of the products; and acquire an understanding of their acceptability and the preferences of consumers through market studies in order to make the commercialization of local seaweed and fish products industries viable. To promote livelihood opportunities, the project provided technical assistance and input support to identified groups through demonstrations and trainings on value-added seaweed and fish products.

On the improvement of seaweed value-added products, the project implementers plan to enhance their sensory characteristics (e.g., look, smell, taste, texture) and the quality of packaging and labeling. As for fish products, their processing (drying, smoking, and fermentation) is to be improved with good manufacturing practices (GMP).





The project implementers believe that food safety is a basic consideration. Food coming from the sea has its own hazards. Contaminated and adulterated food can result to illness or worse. For both kinds of products, the application of Sanitation Standard Operating Procedures (SSOP) and Hazard Analysis and Critical Control Points (HACCP), in addition to GMP, was to be conducted to promote food safety and food quality in compliance with the standards set by the Philippine Food and Drug Administration (FDA).

By the end of the project, the implementers accomplished the following: improvements in at least four products - spicy noodles, seaweed sauce, seaweed cookies and marshmallows – in terms of their sensory characteristics, labeling and packaging; the nutritional and microbiological contents of the seaweed and fish products determined; demonstrations on the technologies updated/developed that promote livelihood opportunities for local organizations, out-of-school youth and fisherfolk in at least one site per province in the region conducted; and identified peoples organizations (PO) assisted in linking with LGUs and other appropriate agencies, given trainings on production, and provided with technical assistance on product safety, packaging, promotion, marketing, and related support.

An early participant in BFAR 5's promotion of seaweed value-added products is the Tabaco Faith International Church – Ladies Association in Tabaco, Albay. Now known as the Tabaco Christian Producer Cooperative (TCPC), the organization has been commercially producing seaweed-fortified *pansit* and other value-added products, such as seaweed pickles and nata de seaweed, using the technologies developed by BFAR 5-RFRDC. Its seaweed pansit has reached the cities of Manila and Cebu, and, surprisingly, South Korea. In year 2012 alone, the TCPC produced 1,200 kg of the product and this has been increasing annually. The TCPC is assisted by BFAR5-RFCDC in the improvement of its processing methods and in the conduct of market studies in order to expand the business.

Other organizations in Bicol have begun to adopt the technologies on seaweed value-added products as well. Some of the members of a PO in Sorsogon could not wait and have gone ahead and are already doing home-based businesses in making seaweed jelly flan, pickles, juice, and ice candy. ###

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Seaweeds are not just for food

by Leoveliza C. Fontanil

The importance of seaweeds as an essential component of the coastal ecosystems has long been acknowledged. However, their economic significance, other than in areas of the world where they provide food, has only been emphasized recently. This realization is largely due to the rapid expanding of seaweeds' industrial uses particularly in the areas of pharmaceutical, cosmetic, and processed food.

Economic products obtained from algae are often associated to

species of seaweeds that can only be utilized as food. Researchers claim that algae are not only important for food but also as a source of industrial products.

Seaweeds are important source of antioxidants for medicinal supplements and other nutraceutical products which are of significant benefits to human health. "Various biologically-active compounds such as nutritive chemicals can be found in seaweed plants, these chemicals have some powerful little

molecules that have huge impact to our health in amazing and surprising ways," said Dr. Andres Y. Tungpalan of the College of Aquatic Sciences and Applied Technology-Mariano Marcos State University (CSAT-MMSU). "Because of this, the initiative of extracting and characterizing new natural chemical source, with biological activity such as antioxidant, antihypertensive, antibacterial property of seaweeds that can contribute to consumer's well-being as part of new functional



purposes has become a major focus on our research,” Dr. Tungpalan added.

Dr. Tungpalan, together with her colleague, Ms. Joyce R. Tolentino embarked on a project that aimed to study, assess, and identify selected economically-important species of seaweeds. This is to specifically conduct the preliminary phytochemical screening in determining the other biologically-active compounds of algae for its other potential uses. The research initiative was funded and supported by the Bureau of Agricultural Research.

“Part of our research is to evaluate and investigate the particular role or purpose of the different species of seaweeds. Screening of novel sources from other sources of marine algae is being done. The results of our research will serve as the baseline for the different development and maximum utilization of seaweeds and can be used by researchers, applied technologies and businessmen” Dr. Tungpalan explained.

Under the project, selected species of seaweeds samples were collected at 14 sampling sites along the coastline of Ilocos where there were abundant marine algae resources during the vegetation season. The selected species found at the Ilocos Region were extracted using the standard qualitative procedures. They were analyzed and subjected to various chemical tests in the laboratory to screen the presence of biomolecules, its phytochemical constituents and in-vitro antioxidant activity.

Preliminary findings showed, for the three species of *Halimeda*, the *H. macroloba*, *H. bikenensis*, and *H. gracillis* contain phytochemical substances such as flavonoids, tannins, alkaloids, saponins, and anthraquinones which are active component. Microbial bioassay

of its crude extract was evaluated on two pathogenic species of bacteria, namely: *Escherichia coli* and *Staphylococcus aureus*; and two species of fungi; *Candida albicans* and *Trichophyton mentagrophytes*. Furthermore, the test on the hemolytic activity of *Halimeda spp.*, both in inhibition zone and activity indices of the different treatments against *E. coli* and *S. aureus*, showed that it has antibacterial effect comparable to the commercial antibiotic ampicillin. This indicates that the three varieties of *Halimeda* are potential sources of anti-bacterial drugs. While *H. macroloba*, was also found to have effects comparable to the commercial antifungal agent, Canesten, which means it could also possess antifungal property against *T. mentagrophytes*. Similarly, a pure concentration of *Halimeda* can hemolyze red blood cells of the treated human blood culture when evaluated through *in vitro* test. Results found that it is used to be the most effective against above mentioned species of bacteria and fungi.

“Since the project is still ongoing, the Pharmacy Department of MMSU is still on the pharmaceutical preparation and test trials to evaluate the other factors of some collected

species of seaweeds. The presence of metabolites such as alkaloids, flavonoids, phenols, glycosides, among others will be further tested. Observed results obtain with this, considering the high value metabolites will be verified for specificity to ascertain their potentials for various other biological application and other therapeutic cases,” Dr. Tungpalan said.

With the expected information and technology that will be gained from the project, it will be useful for medical practitioners in search for more related medicinal properties of seaweeds for future application including in pharmaceutical preparations. For the seaweed farmers and entrepreneurs, the data to be established from this study will give them a better understanding of the economically-important seaweeds for home consumption, commercial propagation, and industrial purposes. ###

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TINAPANG BANGUS

Milkfish (*Chanos chanos*) or *bangus* is one of the staples in the Filipino diet. Notorious for its delectable meat full of bones, it is usually preferred by consumers when it is processed into boneless or soft-boned. *Bangus* products such as *tinapang bangus* and *daing na bangus* are amongst the breakfast staples of Pinoys.

Smoking is one of the oldest forms of food preservation according to studies. Smoking not only preserves the meat but also adds the appealing smoke flavor. In the Philippines, smoked fish products, commonly referred to as *tinapa*, are usually made from *bangus* or round scad (*galunggong*).

With the tight competition in the market and the growing awareness of the consumers, innovating products can provide a better chance at being

successful. *Tinapang bangus* are all-over the market, you can find it most *talipapa* and *palengke*. Thus, it is quite a challenge to innovate this product.

SLSU's herb-enhanced smoked soft-boned bangus

Prompted with the persistent demand for the supply of *bangus* in the local market, the Southern Luzon State University-Judge Guillermo Eleazar (SLSU-JGE), in collaboration with Lamon Bay School of Fisheries, conducted a study that explored the product enhancement of smoked soft-boned *bangus*. Funded by the Bureau of Agricultural Research, through its National Technology Commercialization Program, the study aimed to: improve the existing processing facilities as well as the smoking process, identify the most

acceptable herb enhancer in terms of taste and odor, enhance the market appeal and storage condition through proper packaging and labeling of the product, and commercialize the technology on enhanced smoked soft-boned *bangus*.

The study tested three herbs separately (i.e. tarragon, rosemary, and Italian oregano) to enhance the flavor and appearance of the smoked soft-boned *bangus*. These herbs were incorporated during the brining, pressure cooking, and smoking stages. Among these herbs, tarragon proved to be the most acceptable in terms of taste and appearance after a series of acceptability test.

Commercializing herb-enhanced smoked soft-boned bangus

“The capability of the product to offer income to the adopters play a



WITH A TWIST

by Rena S. Hermoso

crucial role in the commercialization of technology,” said Mr. Cesar Nazareno, project proponent. Thus, the study also presented the cost and return analysis of tarragon-enhanced smoked soft-boned *bangus*.

The tarragon-enhanced smoked soft-boned *bangus* has higher return on investment (ROI) rate at 52 percent compared to the 29 percent ROI of plain smoked bangus according to the study. In the duration of the study, eight individuals adopted the technology on the tarragon-enhanced smoked soft-boned *bangus*. In their initial performance, two of them were able to generate an ROI of more than 60 percent.

Mr. Nazareno said, “[t]he technology on herb-enhanced smoked soft-boned *bangus* is found

profitable owing to the initial results of ROI and increasing market demands. Increased income is attributed to value-adding in terms of herbs, proper packaging and labeling, and longer shelf life.”

As part of the study, the technology on herb-enhanced smoked soft-boned *bangus* was promoted through distributing information, education and communication materials (i.e. flyers and technoguides); conducting series of demonstrations and training for the prospective adopters and selected target market; and, exhibiting the product in forums, product exhibit, and trade exhibit.

Moving forward with the technology

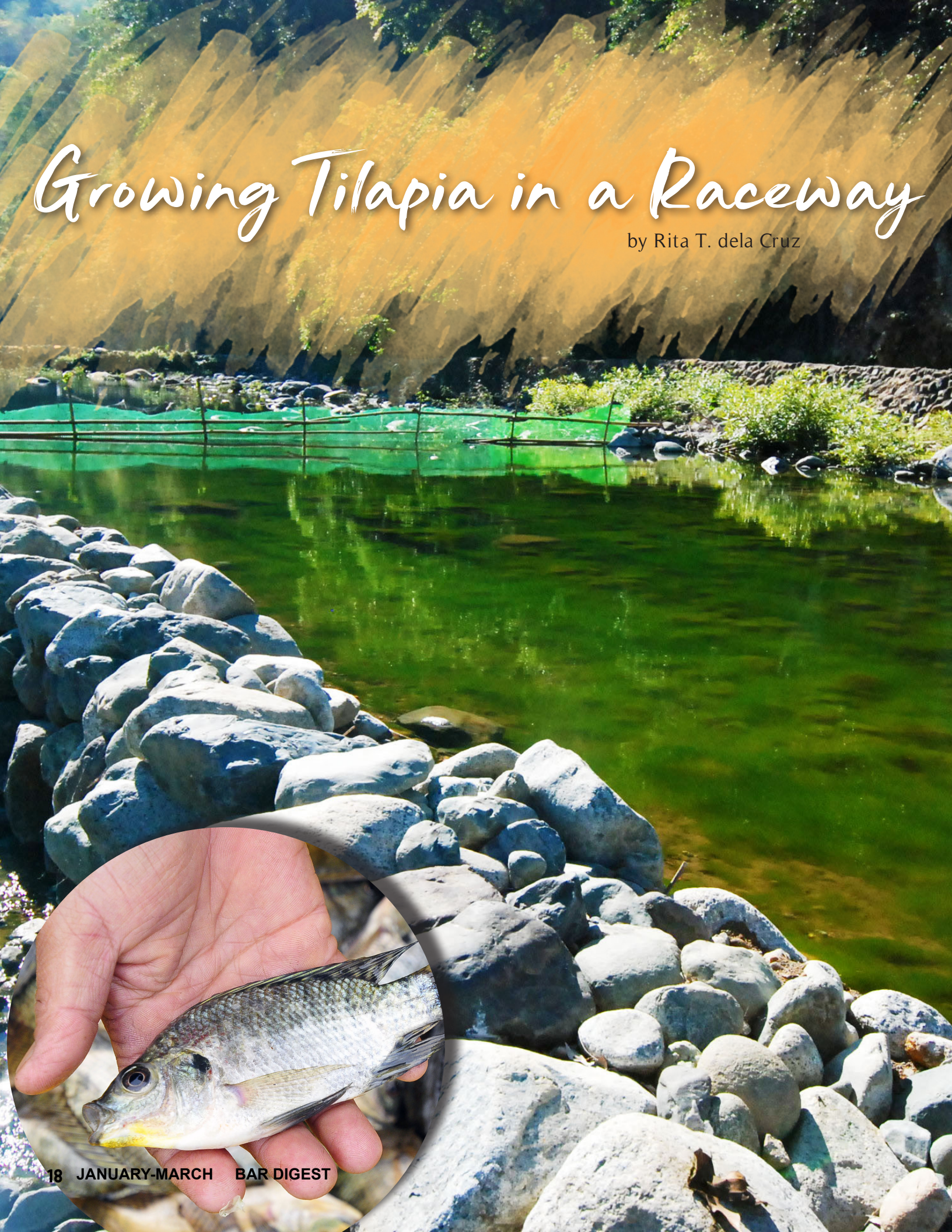
According to Nazareno, once

the technology is embraced by fish smoking processors and penetrated the market, maximum utilization of the whole bangus is now feasible with the added nutritive value in terms of edible spines and herbs. More so, this new technology offers “many advantages to the resource fisherfolk who could raise the technology for his family and to the entrepreneur who could produce the product for profit,” said Dr. Victoria M. Noble, project leader. ###

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Growing Tilapia in a Raceway

by Rita T. dela Cruz



Raceway or flow-through system is one of the earliest methods used to culture freshwater species. It usually consists of rectangular basins or canals with an inlet and outlet wherein continuous water flow in and out of providing the required level of water quality.

In today's modern times, this traditional method of growing aquaculture species is still very much alive and thriving among the Maeng Tribe in Tubo, Abra, a distant area in the North Philippines, which is home to around 6,000 people who are bound by their instinctive desire and love to conserve and protect their natural resources. Surrounded by endless mountains and rivers, the Maeng Tribe has kept their culture and traditions intact, and their people peace-loving and united.

One indigenous practice that has survived through time is the *lapat* system. *Lapat*, which literally means "to prohibit" or "to regulate", is a century old system of regulating the use of natural resources and its biodiversity. The system has three underlying principles: 1) stewardship, 2) communal ownership and collective responsibility, and 3) sustainability. The system is enforced by the *Dap-ay*, a system of governance of the Maeng Tribe for managing and directing the socio-economic, cultural, political and spiritual life of the people of the community. They are mainly consisted of elders in the community.

Harmonizing CPAR with *Lapat* System

Merging indigenous practice with a relatively new concept is never an "either-or" issue. Previous experience shows that harmonizing traditional and modern technologies can bring forth better chance of success in terms of better productivity and profitability for the farmers.

Indigenous knowledge and practices, when given due consideration in introducing new technology or intervention, have a higher chance of producing successful generation and adoption at the farm level.

This was particularly proven true with the project, "Community-based Participatory Action Research (CPAR) on Tilapia Production in Fishponds" funded by the Bureau of Agricultural Research (BAR) and implemented by the Bureau of Fisheries and Aquatic Resources-Cordillera Administrative Region (BFAR-CAR). CPAR, a flagship program of BAR, is a location-specific research cum extension activity that aims to improve the productivity and profitability of farmer-beneficiaries by applying effective total farm productivity within the context of a sustainable production and farming system approach.

Initially, the project was implemented in two barangays of Tubo, Abra, namely: Tubtuba and Dilong with 70 fish farmers as project cooperators.

"We introduced the concept of CPAR in Tubo, Abra with the aim of improving their existing culture of tilapia following a semi-intensive culture system. We would like to introduce an intervention that will not contradict their indigenous practice, which in this case, it's the *lapat* system," explained Lois June B. Fermin, assistant regional director of BFAR-CAR and CPAR project leader. She added that, since CPAR is a research activity, the project aimed to institutionalize participatory approaches in the conduct of research and extension, and encourage and enhance the development of enterprises and agribusiness ventures through enhanced tilapia production in the area.

In Tubo, Abra, aquaculture is

a promising industry, and tilapia (along with carp, eel, gobi, etc.) is commonly being cultured.

Given the difficulty of buying fish, due to the area's remoteness and the land barriers surrounding the community, people are learning to culture commercially demanded fishes like tilapia. They grow tilapia both as a source of food and as a livelihood, making aquaculture an important sector in the municipality.

As part of the environmental practice of the *lapat* system, fish farmers in Tubo, Abra grow tilapia through the raceway system. The raceway system is implemented along the riverbanks. It divides a portion of the river where commercial tilapia are raised but not fed with commercial feeds, relying only on the available natural food. The fisherfolk pile stones to divide the river into terraces which act as barriers to prevent the escape of the fishes. This type of operation can be done by individuals, household or a group of farm fishers, stocking fish in the raceway that feed on existing food in the environment such as *bagiw* or *lumot* (algae) and phytoplankton.

As part of sustainable fishing, the *lapat* system prohibits and discourages the use of destructive fishing gears, chemical spraying near water bodies, and catching the young of fish species, and promotes the observation of close season or no fishing on specific periods of time. This kind of system enables the continuous reproduction of fish species, addresses resource degradation, and enhances the adaptive capacity of the ecosystem.

Part of the intervention of the CPAR project is the introduction of the fishpond culture technology. "The fingerlings are stocked in the *lapat* raceway in the river in November or December. These are harvested before the rainy season to prevent the fish from being carried

away by strong rains,” explained Fermin. She added that because most of the fishponds are small, the fishes get crowded when they grow thus they are returned to the raceway after the rainy season. “In April or May, they are transferred again to the fish pond until they reach their marketable size,” she furthered.

Another intervention in the CPAR project according to Fermin is the introduction of good quality fingerlings. She said, “isang intervention natin ay iyong paggamit ng strain ng tilapia na hindi inbred. Kasi yong old practice nila ay

ibinabalik lang yung anak ng dati na nilang inaalagaang tilapia so mahirap lumaki. The very reason we supported them with hatcheries was to maintain the quality of fingerlings or stocks.”

Through the project, BFAR provided a micro-hatchery in Tubtuba which became the source of tilapia fingerlings for the CPAR sites in Tubtuba and Dilong, Tubo, Abra.

Lapat-CPAR practitioners

The CPAR project was initiated in 2012 and until now, many of the cooperators have continued on with

adopting the interventions introduced to them through the BAR-BFAR project. Two of them were Paulo Pacdiw and Eliseo Manggalis of Brgy. Dilong, Tuba, Abra.

Paulo Pacdiw, 58, was one of the

original CPAR farmer-cooperators when the project was initiated in 2012. He mentioned that, after six years, many farmers have adopted the CPAR technology. “Ginagaya nila kase nakita nila maganda pala ang mag-alaga ng tilapia kase may naibebenta ka so ang gusto nila mag-alaga na din sila para pagkailangan nila bilang pagkain di na sila bumibili.” Aside from tilapia being a source of protein, Pacdiw mentioned another advantage of having his own tilapia pond, “in terms of income, kapag kailangan ng matrikula ng mga anak ko, merong agad mapagkukunan,” he said. Pacdiw also sells fingerlings, Php 200-250 a kilo, to his fellow fishers who need it.

Meanwhile, Eliseo Manggalis, 60, is part of the second batch of 20 fishers who got into CPAR in 2015. He recalled that he adopted the CPAR technology upon the encouragement of their municipal agriculturist.

“Ang ugali kase dito, pagsumali na ang isa, tapos nakita na nila yung ginagawa mo maganda pala, sasali din yung iba. Gaya-gaya system,” explained Manggalis.



He added that before the CPAR project, they buy their fingerlings from Pangasinan but when BFAR provided the fingerlings, through the CPAR project, they maintain their own hatchery and use that for their tilapia production. “Nagbebenta din ako ng fingerlings dun sa may kailangan, isang sako ay Php2,000,” he said. Manggalis mentioned that most of his harvest is for family consumption. “Masaya kase kung gusto mong kumain ng tilapia, kukuha ka lang di mo bibilhin. Hindi kailangang pumunta sa market,” he said. ###

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SURVIVAL OF THE FISHES:
the Pijanga Conservation Mission

by Daryl Lou A. Battad

White goby (*Glossogobius giuris*) or “Pijanga” to the locals of Surigao and Agusan in the Northeastern part of Mindanao, is one of the native endemic fish species found in Lake Mainit. Its abundance in the Lake made it an essential, and of high-value commodity in the province, providing steady livelihood to many fishing communities.

With the increasing threats posed by different natural and man-made influences, however, *Pijanga* is said to be on a decline for the past years in terms of quality and quantity. According to some local lake fishers, the decreasing size of *Pijanga* as well as its declining catch in the recent

years is causing an alarm, which can be an indication of a possible extinction if not favorably addressed.

Compelled by this predicament, the research project, “Environmental and Anthropogenic Stressors affecting the Biology, Ecology, and Fishery Potential of *Glossogobius giuris* in Lake Mainit, Northeastern Mindanao, Philippines” was set in motion by the Mindanao State University – Naawan in partnership with the Bureau of Agricultural Research. Led by Dr. Sonnie A. Vedra, the project undertook a sound scientific inquiry to understand and address the issues concerning the abundance and distribution of *Pijanga*.

To do this, the project targets to determine the biological and

ecological aspects of *Pijanga* in Lake Mainit; measure and monitor the basic water quality parameters and climate profiles of Lake Mainit areas; and describe the socio-demographic and economic profiles of the fishing communities affecting water quality characteristics, biology, and ecology of the *Pijanga*. Ultimately, the project aims to come up with recommendations and policy measures for the conservation and management of *Pijanga*.

Environmental and biological influences

A good balance in the ecosystem determines the efficiency and productivity of all life forms in it. In the same way, an imbalance results to socio-ecological crisis. Given



the decline in the catch, the project determined various environmental and biological factors that are affecting *Pijanga* fishery.

Lake Mainit is the fourth largest freshwater lake in the country and the second largest lake in the Mindanao region. It traverses Agusan and Surigao del Norte provinces, with an approximate area of 17, 340 hectares and a recorded depth of about 168 meters, and supports an important fishery in the region. However, a recent study based on a geographic information system (GIS)-mapped normalized difference vegetation index (NDVI) images showed that the watershed vegetation cover of Lake Mainit has been decreasing for over 38 years due to continuous utilization since the 1970s (Padilla et al., 2015). These include land conversions, increasing inhabitants and settlements within the lake plains, and various degradation activities. If left unmanaged, these could result to uncontrolled risks, thus economic collapse.

To assess the *Pijanga's* current habitat, Lake Mainit was subjected to basic water quality and climate profiling. Water samples were collected on a monthly basis from November 2016 to June 2017 to evaluate physico-chemical properties such as heavy metals, sediment flux, plankton population, and water quality profile which include temperature, dissolved oxygen, pH levels, light penetration, and essential

nutrients.

Biologically speaking, the *Pijanga's* morphometric characters – or the measurable characteristics common to all fishes – were carefully used to describe its physical and reproductive dimensions that are seen to be affected by human and environmental activities. By determining these attributes, influences on the *Pijanga's* food sources and quality of habitat were considered.

To maintain a holistic research observation and results, the project consulted the community regarding the possible changes observed in the Lake. Some of the significant changes mentioned include a decrease in the diversity of fishes and other species; an increase in the number of fishermen; and an apparent conversion of large fishing areas. Elaborating on the possible causes of these changes, the community members said that soil erosion from mining, pollution, illegal fishing, improper waste disposal, and an increase in the number of fishermen contributed largely to this rather negative transformation of the Lake and its surrounding tributaries.

Lake Mainit still a favorable habitat

Having satisfied a year of study, project results indicated that Lake Mainit is still in a comparably good condition providing a favorable habitat for the *Pijanga* and other aquatic organisms. The conditions of

the lake are justified by the optimum and good water condition. In fact, Lake Mainit is classified as Class A (Public Water Supply Class II) based on the Department of Environment and Natural Resources' (DENR) water classification system. This means that the water is intended as a suitable source of water supply, requiring conventional treatment to meet the country's National Standards for Drinking Water (NSDW).

Variations in the temperature, dissolved oxygen, pH levels, and light penetration do not thoroughly affect the biology and ecology of the *Pijanga*. Although the increase of surface and vertical temperatures in the Lake over the past decade manifested an alarming state of global warming, still other physical and chemical parameters passed the requirements for fish growth and propagation. This is evident through the fish's well-proportioned body structure, year-round spawning pattern, and the absence of sexual dimorphism.

Conserving the *Pijanga*

Despite favorable results, the *Pijanga*, often referred to as the 'lifeblood' of Lake fishers in the provinces of Surigao and Agusan del Norte, still needs careful attention since the relatively big-sized *Pijanga* which are presumed to be spawners, are no longer available in large quantities. Therefore, it is thought that the next maturing population of



photo by: Dr. Sonnie A. Vedra/MSU

“The level of awareness raised among the respondents from different fishing communities in the region can be a good start in the conservation measures set by the findings in this research. As a matter of fact, they were already well-informed about their vulnerability and the courses of actions they can take to conserve this important resource.”

Pijanga may be forced to spawn to replenish their declining population.

In the case of the supposed smaller-sized *Pijanga* as observed in this study, this may be attributed to the unregulated manmade activities affecting the *Pijanga* fishery, its food, and natural habitat. These include destructive fishing methods and overfishing. According to Dr. Vedra, it is recommended that both regulatory and non-regulatory measures must be undertaken to conserve the *Pijanga*, more so the livelihood of the community. These can be carried out through

the enactment of resolutions and ordinances, as well as the conduct of different awareness activities for all stakeholders.

Further, a more in-depth scientific venture is needed, such as the establishment of aquaculture and seeding programs to enhance the natural stock of the *Pijanga*.

The level of awareness raised among the respondents from different fishing communities in the region can be a good start in the conservation measures set by the findings in this research. As a matter of fact, they were already well-informed about their vulnerability and the courses of actions they can take to conserve this important resource. Possible solutions provided by the community members and respondents include alternative livelihood, continuous monitoring of the Lake, strict implementation of related laws and regulations especially on mining and illegal fishing, proper waste management, fingerling dispersal, and government interventions.

With this information generated backed up by science and thorough research, Dr. Vedra and his team remain positive that this would serve as one of the tools in sustaining the delivery and benefits of *Pijanga*, Lake Mainit’s famous, “legitimate symbol.” ###

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photo by: Ellie Balangue (chasingculprit.blogspot.com)

Improving potential of seaweeds through squid pot fishing

by Ephraim John J. Gestupa



The oceans need rebuilding. Climate change is no longer just the only threat being faced by the fisheries sector. The constant overexploitation of aquatic resources in our local seas has posed serious consequences to biodiversity. There is a need for agriculture and fishery sector to develop sustainable practices that consider the limits of what the ecosystems can provide.

To address overfishing, the Bureau of Fisheries and Aquatic Resources (BFAR) schedules fishing bans that would prohibit the catching of fish for a short period of time. Another intervention is introducing sustainable aquaculture. BFAR, along with the local government units, continuously encourage coastal communities to integrate aquaculture by presenting it as a source of additional income to household.

The National Oceanic and Atmospheric Administration of the United States define aquaculture as “—the breeding, rearing, and harvesting of animals and plants in all types of water environments— [it] is one of the most resource-efficient ways to produce protein and has helped improve nutrition and food security in many parts of the world.”

In the Philippines, widespread practice of aquaculture has made the seaweed the second most exported fishery resource, with almost 40,000 metric tons of seaweed exported in 2016.

The introduction of aquaculture practices like seaweed farming has been a key factor in lessening

the cases of illegal and destructive fishing activities such as the use of dynamite and cyanide, done in coastal communities. By opting to farm seaweeds, marine life flourishes as the seaweeds become the breeding ground for marine life.

According to a study conducted by the International Center for Marine Resource Development at the University of Rhode Island, seaweed farming is a good option for fisherfolk thinking of shifting from fishing to aquaculture. Seaweed is easy to cultivate, requires low initial capital investment, and provides a rapid and high return on investment.

Despite the profitability of seaweed farming, most fishing households in the Philippines do not rely on mainly on the practice. This is mainly because seaweed profitability is largely dependent on market prices. The price of seaweeds ranges from 25-60 pesos per kilo depending on the quality and the time of the year it was harvested. The price of seaweeds begins to increase from August to December as the volume of production decreases because of stronger winds hitting coastal communities brought about by the northeast monsoon.

Seeing that seaweed farming is only a supplemental source of income in fishing households, the Bicol University Tabaco Campus proposed a research project implemented in one of the small island municipalities of Southern Luzon. The research titled, “Development and

Promotion of Squid Pot-Seaweed Farming Integration: An Income Diversification Option in Small Island Community,” sought to integrate another aquaculture practice that can augment the income earned by seaweed farmers through squid pot fishing.

A squid pot is a container device usually cylindrical in shape, designed to catch squid in coastal waters. The device is hung on a bamboo buoy and submerged halfway to the bottom of the surface where squid can be baited with a coconut branch or a fruit stalk wherein squid can lay their eggs.

Ideally, squid pot is installed in areas with dense concentrations of sea grass. For the project, squid pots are placed beneath the cultivation lines of seaweeds. Once a day, the squid pots are pulled above the surface where the squid is harvested except for its eggs which are yet to hatch underwater. Fisherfolk can harvest around 2.5-45 kilograms of squid daily sold at around 150 pesos a kilogram.

The project, which was funded by the Bureau of Agricultural Research, generated the data from two coastal communities in the island of Batan, Rapu-Rapu, Albay, around 200 miles southeast of Metro Manila. Income was compared between fishing households who do seaweed farming only, squid pot fishing only, and those who integrate both practices as their source of livelihood.

According to Dr. Plutomeo M. Nieves, project proponent, by



integrating squid pot fishing to seaweed farming practices, coastal communities can augment their income as well as develop resiliency when typhoons get blown over to their area, which is very common to the coastlines of the Bicol region.

Based on the data gathered, it was observed that when both seaweed farming and squid pot fishing is practiced, household income increases to at least 19 percent. Upon three months of upgrading from a single practice of aquaculture to the introduced integrated system, fishing households can earn almost 10,000 pesos. That's 4,000 pesos more than what they can earn from just

practicing seaweed farming. Bicol University is now looking into how to better improve the willingness of the coastal communities to use the technology.

Aside from its profitability, squid pot fishing utilizes passive gear that's non-destructive to the aquatic ecosystem. The catching device not only catches squid but also houses squid eggs which can be left alone to hatch even after the device is brought to the surface.

Research staff from Bicol University discovered that the squid pot device also became catching devices for other marine life such as groupers, lobsters, siganid, snapper,

and Caesio species. This observation is further proof that the integrated system helps rebuild biodiversity within the aquatic ecosystem. Bicol University Tabaco Campus is currently redesigning the squid pot so that it may serve as a multi-species trap made up of indigenous materials, the design of which should be in accordance with the fishing ground and seaweed farm location.

Among the 16 regions of the Philippines, Bicol is one that is constantly hit by typhoons. While the effects of climate change may be very apparent in this region, aquaculture is paving a path towards resiliency and sustainability. ###

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“According to Dr. Plutomeo M. Nieves, project proponent, by integrating squid pot fishing to seaweed farming practices, coastal communities can augment their income as well as develop resiliency when typhoons get blown over to their area, which is very common to the coastlines of the Bicol region.”

Seafood is one of the top traded food commodities. The recent increase in seafood trading activities, however, raised concerns on the sustainability of fisheries and the distribution of benefits among the stakeholders of that fisheries resource.

In the Philippines, sardine belongs to the top 10 important fisheries and is one of the most traded seafood commodities. Sardines are generally found throughout the Philippine waters. Two species, *Sardinella lemuru* and *Sardinella gibbosa* are primarily

concentrated in the water bodies of central Visayas; southeastern coasts of Luzon; and islands in the Autonomous Region of Muslim Mindanao and Palawan. In terms of contribution to the total sardine production, fimbriated sardines (*Sardinella fimbriata*), locally known as *tunsoy* and Bali sardines (*Sardinella lemuru*), also known as *tamban*, are among the top catch.

The top three sardine-producing regions are Zamboanga Peninsula, Bicol region, and Western Visayas making up to 70 percent of the total sardine production in

the country. Among the three, the Zamboanga Peninsula ranked the highest.

Regardless of food preparation, sardines will stay as a favorite food delicacy and the sardine fisheries has been constantly providing income to fisherfolk in coastal communities, as well as livelihood opportunities among small and medium scale sardine-based industries.

Just like any other seafood commodities, the economic opportunities derived from the sardine industry are highly dependent on the state of the

Management strategy for sardines through value chain analysis

by Patrick Raymund A. Lesaca



resource. Similar to any fisheries resource, the risk of overharvesting or overexploitation is high and this is mainly attributed to the complexity of the aquatic environment.

Through value chain analysis (VCA), the management strategies for the sardine industry and the regulatory mechanism that is needed for the proper distribution of benefits through the production, processing, distribution, and marketing in the sardine industry can all be mapped out.

A group of researchers, found the need to study further the complexity of aquatic environment along the food value chain and thus, put forward their observations and measures were undertaken through the project, “Value Chain Analysis

(VCA) of Sardine Fisheries in the Philippines for Improved Industry Performance”.

Funded by the Bureau of Agricultural Research, the College of Fisheries and Ocean Sciences of the University of the Philippines Visayas implemented the project. Dr. Encarnacion Emilia S. Yap, project leader, noted the pressing need for a value chain analysis of sardines to come up with recommended management interventions that can influence the distribution of benefits through the different nodes in the value chain of the sardine industry

Dr. Yap further noted that a number of sardine processing companies are found in the southern part of the country where sardines are produced in great quantity.

However, there is insufficient information as to whether support facilities and services like financial packages and processing plants in the sardine industry have created leverage for the key players to thrive well in a competitive market environment.

According to her, the overall goals of the research project are to: 1) identify the inefficiencies along the sardine supply chain, and/or the economic inequalities that emerge between stakeholders, such as fishers and middlemen, as a result of trade relations; and 2) come up with appropriate interventions that can help improve the industry performance of the sardine fisheries in the Philippines.

The project also intends to:





1) evaluate the performance of the sardine fishery industry in terms of its contribution to food security, employment and economic development; 2) determine the linkages between stakeholders and examine how benefits are distributed along the chain; and 3) identify and/or design interventions to improve technologies and effect institutional and policy reforms.

The project, once completed, is expected to produce specific data and information on the value chain of sardine fisheries in the Philippines from the fishers to the consumers; derived cost at the different stages in the chain; list of practices and the appropriate intervention measures in improving (or enhancing) such practices in each of the stages in the chain; and policy recommendations on how to improve industry performance of the sardine fisheries in the country. More importantly, the project is expected to identify the research gaps that can help the sardine fisheries of the Philippines.

This information is of paramount importance to both research institutions.

The project, which is located in Miagao, Iloilo identified different sites for its field activities. The site selections are based on established and locally-significant sardine fisheries, highest producers of sardines; major processing and distribution centers, and site accessibility.

To date, field activities have already been conducted in the following sites: Zamboanga Peninsula (Dipolog City, Zamboanga City, and nearby municipalities); Naic and Rosario in Cavite; the Navotas Fish Port Complex in Navotas, Metro Manila; Quezon province, Roxas City in Capiz; and the municipalities of Estancia, Concepcion, and Ajuy in Iloilo.

Field activities are scheduled in other sites such as the provinces of Sorsogon, Camarines Norte, Pangasinan, Palawan, and Misamis Oriental in Mindanao, as well as

in Tondo in Metro Manila as the identified main trading area for dried sardines. Initial findings indicate a wide variety of fishing and post harvest processing practices that vary in the different sites. Several researchable areas that can help the industry were also identified.

With the VCA approach, the fishing industry in general can benefit from this research study. In particular, consumers who are loyal to sardines, the national and local governments, fishers and traders, and the canned and dried sardine processors and distributors will have a share of these benefits. ###

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Abalone, locally known as *sobra-sobra* is considered a rarity in the agri-fishery industry. The sea creatures don't just grow under any coastal circumstances as it requires certain saltwater salinity with clear and flowing water at all times. Due to its nutritional value and the laborious process of harvesting abalone, it commands a premium price. To preserve the populations of wild abalone, the Western Palawan University (WPU), in partnership with the Bureau of Agricultural Research (BAR), embarked on a project, "Utilization of Indigenous Materials for the Mass Production and Community Farming System of Abalone (*Haliotis asinina*) in Palawan." The project aimed to introduce an alternative agri-fishery system that will provide enough harvestable abalone for a fisherfolk family's daily provisions as well as lessen the collection of the threatened wild abalone. (Photo by: LAEspiritu)



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