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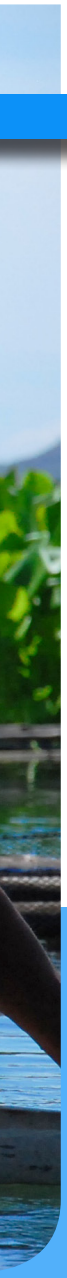
R&D NOTES

Progressive agriculture and growth in fisheries are the conditions that will set the stage from which the country can graduate from its food and poverty problems. As we work our way towards these ends, much needed answers to the problems of low farm productivity, economic stagnation, unemployment and political instability can be realized.

Key to these is the state of the country's production base for agriculture and fisheries. Two complementary and necessary interventions must be undertaken to accelerate the development of the countryside where our farmers and fisherfolks are.

One is the intensification of agricultural production by providing agriculture's stakeholders with the necessary logistics and support mechanisms needed to boost productivity. Making agricultural land productive and the maximization of its potentials are by far the most effective ways to achieve this end goal. For instance, the provision of high yielding seeds, farm to market roads and other forms of infrastructure; efficient irrigation and other water systems; human and capital resources; postharvest facilities; as well as



A performing FISHERIES & AQUACULTURE industry is imperative to DEVELOPMENT

by DR. NICOMEDES P. ELEAZAR, *CESO IV*

research and development (R&D) have proved their worth and should all be integrated in the whole process of agricultural production.

The second intervention or measure is increasing and sustaining the growth of the fisheries sector. As a maritime country, the Philippines still has rich fishing grounds. In order to make full use of this advantage, particularly in the attainment of food security, there is need to assure its productivity while at the same time conserve and enhance the country's remaining aquatic resources. The Bureau of Fisheries and Aquatic Resources (BFAR) is the government agency entrusted with this task to be carried out, not only in the short term, but also over the long run.

Official data released by the Bureau of Agricultural Statistics in 2012 indicate that the country's Gross National Income (GNI) increased by 3.20 percent in 2011 while its Gross National Product (GNP) registered a 3.91 percent growth. A similar trend is in agriculture and fisheries' share in the Gross Value Added (GVA) which expanded by 2.46 percent. If this upward trend is sustained, the agriculture and fisheries sectors will very well shape the future social and economic landscape of this country. Putting premiums on these two measures in terms of direct government interventions will strengthen the sector. As imperatives, it is thus the state's responsibility to see to it that these are recognized and well addressed.

Collective endeavors on the part of the government, while still lagging behind against our more advanced neighbors, are already on the right track. Now is the right moment to cascade this growth in a more aggressive manner to achieve the benefits due to the farmers, fisherfolk, and the urban and rural populace in the least possible time.

With the aim of sustaining positive gains, one component that has to be given utmost importance is research and development (R&D). R&D in the context of agri-fishery development deserves a commensurate increase in government support given its important role. A more proper R&D budget allocation is long overdue particularly for the fisheries sector.

For this issue of the BAR R&D Digest, is featuring the fisheries and aquaculture industry in recognition to its great contribution to the country's agriculture sector. Among the lined-up topics are industry situationers to give the readers a wide-eyed view of the industry, particularly its production last year. Also highlighted in this issue are major R&D initiatives mostly, out of the CPAR fisheries projects funded by the bureau. ■

Declining productivity, resource depletion of capture fisheries, and lack of alternative livelihood among fishers remain unresolved and continuous to be among the long-term issues in the Philippine fisheries sector.

Way back in 1945, fish production in the Philippines, specifically capture fisheries, boomed until the 1960s. In the 1970s, smallscale fisheries production grew positively but at a slower rate. Unfortunately, the fish production dropped significantly in the early 1980s and eventually leveled off to an average of 2.1 percent in the 1990s due to depletion of stocks, overfishing of near-shore areas and degradation of critical coastal habitats associated with most fishing grounds.

Changes in catch composition showed a general decline in production of smallscale fishery sector due to the depletion of resources in near-shore areas.

According to the Bureau of Agricultural Statistics data, the volume of fisheries production from 2009 to 2010 increased by 1.56 percent with 5, 079.90 metric tons and 5, 159.50 metric tons, respectively. However, by 2011, production dropped by 3.6 percent with 4, 973.50 metric tons and again decreased the following year by 2.32 percent with 4, 858,097 metric tons.

Given the past and present situation of the Philippine fisheries sector in the coastal areas, the government is continuously pushing for an effective strategy to make fishing a sustainable livelihood in the coastal areas through aggressive promotion of fishing technologies particularly mariculture practices for increased fish production.

What is Mariculture?

Mariculture is a specialized branch of aquaculture involving the cultivation of marine organisms for food and other products in the open ocean, an enclosed section of the ocean, or in tanks, ponds or raceways which are filled with seawater. An example of the latter is the farming of marine fish, including finfish, crustaceans, shellfish that includes prawns, oysters, and seaweeds in saltwater ponds. Non-food products produced by mariculture include: fish meal, agar, jewelry (e.g., cultured pearls), and nutraceuticals such as drugs and cosmetics.

A Mariculture Park (MP) is an area (500 ha or more) encompassing coastal waters within 15 km distance from the shoreline. The MPs are selected based on the technical, social, economic viability and environmental stability of the area. The parks are managed by an Executive Management Council (EMC), headed by the Local Government Unit (LGU) Executive or Municipal City Mayor and assisted by the Department of Agriculture-Bureau of Fisheries and Aquatic Resources (DA-BFAR) Regional Director. The EMC is therefore a joint collaboration of the LGU, DA-BFAR, Department of Environment and Natural Resources Office (DENRO), barangay chairpersons from communities near the MP and representatives from the locators' association. The special group performs specific functions such as planning, directing, implementing, evaluating, monitoring, and approving the decisions for execution of the Project Management Unit which is the overall in-charge of the full implementation of policies, operational procedures and daily operations of the project.

Government Initiatives

The DA-BFAR is promoting

Sustaining fisheries production through mariculture

by LIZA ANGELICA D. BARRAL

mariculture in response to the current issues in Philippine fisheries as an alternative source of income and sustainable livelihood among fishers in the coastal communities which makes use of aquaculture technologies like fish cage farming and sea ranching.

In an effort to effectively promote mariculture as a nationwide project, BFAR launched the Mariculture Park (MP) Development Program which aims to: hasten socio-economic growth and food security; provide appropriate structures, equipment, and support services; develop skilled and technically capable fisherfolk; and stimulate a favorable investment climate. BFAR also visualizes that MPs will promote livelihood diversification along with other economic and ecological systems within the community where these are located.

Furthermore, MPs are also considered as community-based projects wherein the fishermen in the community actively participate in the activities for the successful implementation of the project. BFAR will focus on product development and marketing aspect to generate more livelihoods in each community.

Current Status of Mariculture Development in the Philippines

The establishment of MPs has brought positive impact in the sites wherein these are established as it helps increase fish production. One evident testimony is the success story of Mariculture Park in Lanao del Norte.

Since the start of Mariculture Program in 2010, bangus production almost tripled from Php 132,800 to more than Php 500,000 in its annual gross income. The Provincial Agriculture Office (PAO) reported that in 2010, the province started with only 10,000 bangus fingerlings in one fish cage which eventually expanded to 30,000 bangus fingerlings in three fish cages in the following year. The gross income from bangus production in 2012 was recorded the highest level at Php 563, 830.75.

As of 2012, 67 mariculture parks had been established all over the Philippines. Eastern Visayas has 15 MPs, MIMAROPA has 9, while Bicol and Central Visayas have 6 each. In terms of the production units of MPs, Region 9 produced the highest number of units with 963 fish cages, followed by Region 8 and ARMM with 638 and 556 cages, respectively.

Fish species that are presently cultivated in MPs include: milkfish (*bangus*), pompano (*pampano*), red grouper (*suno*), siganid (*kitang*), seabass, (*apahap*), mouse grouper (panther), tilapia, (saline), red snapper (*maya-maya*) and tiger grouper (*lapu-lapu*). Other fishery products include: seaweeds, sea urchin, and sea cucumber.

Challenges and Opportunities in Mariculture

Mariculture is indeed a good alternative source of livelihood for the rural coastal communities if the small-scale fishers will be given the opportunity of managing their own mariculture systems. Adopting mariculture systems all throughout the archipelago has high potentials for a dramatic increase in fishery production that would lead to lower fish prices and more affordable fishery products for the consumers. Thus, sustainable mariculture development in the Philippines should be included as one of the goals of LGUs in coastal areas in the Philippines for a more prosperous fishery industry.

In addition, the marine environment will be better conserved with the establishment of mariculture parks. In a research paper titled, "Mariculture Development and Livelihood Diversification in the Philippines," by Salayo et al., they concluded that, "Responsible practice of mariculture technology will also ease environmental pressure in terms of reduced extraction of fish and form part of the strategies for poverty reduction."

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Climate change

to bring woes to for fisheries sector

by VICTORIANO B. GUIAM

Back in the mid-1970s, the world began to take notice that the planet's climate was warming amid warnings from climate scientists. Since then, we have learned a lot about the harm that climate change can potentially do to the environment particularly on marine resources and fisheries.

Now, we know that if the sea surface temperature were to rise by two degrees Celsius tomorrow, we will witness the start of widespread death of coral reefs and the disappearance of commercially important marine life, and more frequent "fish kills" in brackishwater aquaculture, each of which spells big trouble for the fisheries sector. We are no strangers to these grim scenes, as we have seen these happen before in the past. But these past events serve as portents of even more dire things to come under the looming shadow of climate change.

Perils of Climate Change to Marine and Inland Fisheries

Philippine agriculture and fisheries have long been subjected to many hazards and risks from typhoons and droughts even before the arrival of climate change. However, the profound effect of climate change is that, with the shift in the natural systems, this will also alter the dynamics of the coastal environment, eventually affecting the coastal communities. Impacts on the environment exemplified by coral bleaching and mortality, changes in the chemistry and physical dynamics of the waters plus the alteration of migratory and reproductive patterns of marine organisms shall all lead to significant changes in coastal fishery and the decline in fish availability which will adversely affect the well-being and productivity of the fisheries industry (Capili et al, 2005).

By the 2050s in Asia, it is projected that climate change will compound the human pressures on natural resources and the environment. Environmental degradation is as much a cause for concern as climate change. As it is, the Philippine fisheries systems are facing a collapse due to overfishing (Daw-as et al, 2010).

Only five percent of the county's coral reefs remain in excellent condition, mangroves have declined by as much as 75 percent in the last 23 years while seagrasses lost 30-50 percent of its cover over the last 50 years (PNCC, 2008). Authorities are certain that climate change impacts will get worse as the environment degenerates further. Stated another way - if the environment is already in a sorry state, climate change will make it even sorrier.

There are various injuries to the environment and fisheries that can be inflicted by climate change. Four of the bigger concerns are:

Extreme weather events

- Enhanced typhoons can cause extensive damage to coral reefs as in the reported case of Danjugan Island in Negros Occidental in the 1980s (PNCC, 2008).
- These can alter the characteristics (depth, salinity patterns, and water turbidity) of near shore habitats (mangroves, sea grasses, coral communities) which will affect larval nursery grounds and fish seed supply for aquaculture (De la Cruz, 2010).
- Treacherous waves can capsize and destroy small fishing boats making it difficult and dangerous for fishermen to catch fish thus affecting their livelihood.
- Present designs of fish cages and framework/ structures not strong enough will not be able to withstand the devastating strength of typhoons and extreme weather events.

Ocean acidification

- According to experts, the concentration of carbon dioxide in hotter waters will rise to a level that can exceed the ocean's buffering system and will tend to increase the acidity of seawater (pH from 8.3 to 6-7). With rising ocean acidity, marine organisms such as shrimps, oysters, and corals will be unable to form their shells in a process known as calcification which will affect their growth and reproduction (Retrieved from "http://en.wikipedia.org/wiki/ Fisheries and Climate Change) thus reducing the availability of mollusks and shrimps and lead to even more coral bleaching (De la Cruz, 2010).

Higher water surface temperatures

- Hotter waters can lead to the bleaching of corals due to stress especially under intense solar radiation. The affected reefs are unable to sustain coral-feeding fish and other marine life. The first documented mass bleaching event in the country was reported in 1998 in areas in Bolinao, North Palawan, Tubbataha reefs and Kalayaan Island Group (PNCC, 2008).
- Hotter water can give rise to high sedimentation and high wave activity that can reduce the seagrass population (De la Cruz, 2010), a condition which can lead to the loss of fish that are dependent on seagrass as a food source and as a habitat.
- With changes in sea temperature, pelagic fish will move or migrate to more favorable environments (Pido et al, 2010). In 2007, the reduction in tuna trade in General Santos City by 80 percent was attributed to the warming temperature of water which was said to drive tuna species deeper underwater making it difficult for fishermen to catch them (Greenpeace, 2005 cited by PNCC, 2008). As ocean temperatures rise, some fish species will migrate northwards (Ahmed, 2005 cited by Pido et al, 2010).
- Mortality of cultured fishes, seaweeds and shellfishes will increase with rise in temperature above the water temperature for normal growth of many species (28o-30oC).
- As water warms, its ability to dissolve gases decreases. Massive fish kills can occur in inland water bodies with dissolved oxygen depletion and accompanying high temperature and reduction in water depths especially during El Niño episodes. In 2010, massive fish kills of tilapia in floating cages in Magat Reservoir in Isabela were reported (De la Cruz, 2010).

Sea level rise

- It may take place over many, many years but when it does, sea level rise shall cause coastal habitat drowning and coastal erosion. Information generated by the UP-Marine Science Institute shows that almost all wetland areas and other low-lying habitats in the Philippines where many fish reproduce will be inundated by rising sea levels (David et al, 2010). It will also submerge the low-lying dry land areas, erode shorelines, and exacerbate storm flooding (Perez et al, 1999 cited by De la Cruz, 2010).
- Sea level rise and increased flood heights, together with typhoons and storm surges, will inundate and destroy inland aquaculture and farm facilities (De la Cruz, 2010) and cause damage to private property (houses and assets) in coastal fishing communities (David et al, 2010) and can lead to the displacement of coastal communities (De la Cruz, 2010).
- With flooding and intrusion of salt water, coastal areas can be rendered unfit for fisheries. Increased salinity of mangrove areas and estuaries can have negative impact on the less salt-tolerant species of mangrove trees and on mangrove-resident fish.

"When ocean circulation patterns and direction of horizontal currents change, these could alter the distribution and abundance/ upwelling of natural fish food and nutrients in the sea and may make specific locations unsuitable for certain species..."

In time, there can be deep changes in the conditions for fisheries, mainly on fishstocks and their availability to fisheries since the impact of climate change will be on their abundance, distribution, migration, and changes in catch compositions (Herrick Jr, 2005 cited by Pido et al, 2010). Most species of marine fish are adapted to specific environmental conditions. When ocean circulation patterns and direction of horizontal currents change, these could alter the distribution and abundance/upwelling of natural fish food and nutrients in the sea (De la Cruz, 2010) and may make specific locations unsuitable for certain species such as sardines. Some species will go extinct in particular areas. Predators and their prey will move to different areas, thus disrupting the existing food chains (IPCC, 2007).

For the commercial fishing industry, boats and land-based processing equipment may become obsolete and may not be useable for "new" types of fish that may emerge in traditional fishing grounds. This will force the search for the usual fish in more distant places. People employed in or dependent on the industry may have to find new jobs. At the extreme end, the fishing industry may not be able to deal with fisheries collapses as in the past (Herrick Jr, 2005 cited by Pido et al, 2010)

Another consequence of climate change is the appearance of microbial blooms which can be inimical to human health (IPCC, 2007). Since 1983, the occurrence of red tide or pyrodinium blooms has been a threat to human health and the fisheries industry. It has been hypothesized that the occurrences of coastal algal blooms and the appearance of novel, noxious species could be the first detectable signals of climate change (PNCC, 2008).

From the frying pan into the fire

As we have a coastline of 34,000 km that is among the longest in the world, and 267,000 sq. km. of water, about 70 percent of the municipalities depend on the coastal and marine ecosystems as the sources of their livelihood (PNCC, 2008). While having an extensive coastline is a key environmental and economic resource, it is also a liability as it makes us particularly vulnerable to climate change.

A one-meter rise in sea level is projected to affect 64 out of 81 provinces, covering 703 out of 1,610 municipalities, inundating almost 700 million square meters of land and potentially displacing at least 1.5 million Filipinos (Greenpeace, 2007 cited by PNCC, 2008). With climate change effects intensifying, it is expected to spur the search for other means of livelihood and increase migration to other places (Capili et al, 2005).

Historically, the country has suffered disasters from extreme weather events that have caused tremendous losses. From 1975 to 2002, intensifying tropical cyclones caused an annual average of 593 deaths and damage to property of about 4.5 billion pesos including damage to agriculture of 3 billion pesos (PNCC, 2008). Under climate change, the extent of losses may surpass these.

The FAO (De la Cruz, 2010) has indicated that: 1) all fisheries resources and stocks are highly vulnerable to the impacts of climate change; 2) estimates of fisheries stocks in the changing climatic condition will render high degree of uncertainty; and 3) there is lack of capacity on new fields of science and technology spawned by needs to mitigate and adapt to climate change. Further, research on the economic implications of climatic changes on fisheries has been limited and fragmented (Herrick Jr, 2005 cited by Pido et al, 2010), thus spelling the need for greater capacity to understand the impacts of climate change.

Climate change is not solely an environmental issue but is very much a development issue as well (PNCC, 2008). Climate change can further increase rural poverty unless measures are taken to address its risks.

According to WorldFish International, conserving ecosystems and protecting livelihoods will depend to a large extent on stakeholders' ability to predict the impact of climate change and on communities' capacity to adapt. This makes it imperative to implement both mitigating and adaptive strategies that would help fisherfolks cope with the consequences and impacts of climate change, and build up the capacity of poor and vulnerable communities, and, at the same time, provide income and employment opportunities (DA-BAR, 2011).

R&D wades into the picture

Even if climate change is projected to take place over decades, now is the time to begin decisive action. In early 2013, Agriculture Secretary Proceso J. Alcala tasked the entire DA to deal with climate change, making it a priority to mainstream climate change measures into the DA's programs. A major thrust of the DA's Climate Change Program is for science and technology to be fully engaged and supported to spur innovation in developing tools, technologies and best practices of local communities for climate change mitigation and adaptation. The strategy is to increase the resilience of the agriculture communities (DA, 2009). The DA-BAR has been placed in charge of developing the program's R&D component.

Back in 2009, the DA-BAR, in collaboration with experts from UPLB, UP Diliman, DOST-PAGASA, SEARCA, DA-BSWM, had already crafted the broad outlines of the Agriculture and Fisheries RD&E Program on Climate Change. In June 2011, the program was updated and made ready. On the fisheries side, the program aims to improve the adaptive capacity of the fisheries sector to the threats of climate change. It adheres to the DA's climate change policy thrust which is set on mitigation and adaptation with adaptation as the anchor strategy.

Currently, program components for adaptive research beneficial to the fisheries sector include:

- Documentation of indigenous knowledge for climate change adaptation;
- Developing sound methodologies for localized seasonal climate forecast system;
- Establishment of climate change-sensitive mariculture zoning system;
- Development of agriculture-aquaculture farming systems in vulnerable areas;
- Improving capacities for climate risk assessment and management;
- Analysis of the carrying capacity of aquaculture areas in the context of climate change;
- Development of fish varieties for resistance to biotic and abiotic stresses due to climate change;
- Estimation of loss in aquaculture production due to climate change;
- Vulnerability mapping in coastal areas; and
- Assessment of marine resources/marine protected areas and changes in spatial distribution and migration patterns of fish over time.

Taking the cue from the DA's Climate Change Program, other adaptation strategies included are: 1) improving fisheries infrastructure and machinery for climate change adaptation; and 2) freshwater production using cost-effective community-based hybrid biomass-solar desalination systems.

The DA's effort is geared towards "weather proofing" fishing communities. For this to happen, we need to empower our fisherfolk by providing them with the appropriate technical knowledge in coping with the anticipated impacts of climate change. As BAR Director Nicomedes P. Eleazar puts it, "a well-informed and empowered clientele means better protection for communities of farmers and fisherfolk. Through an information-driven, responsible management of agricultural resources, we will be able to meet the challenges and conditions that may be imposed on the agriculture sector by climate change." ***(continue on page 22)***

> ***"Through an information-driven, responsible management of agricultural resources, we will be able to meet the challenges and conditions that may be imposed on the agriculture sector by climate change."***

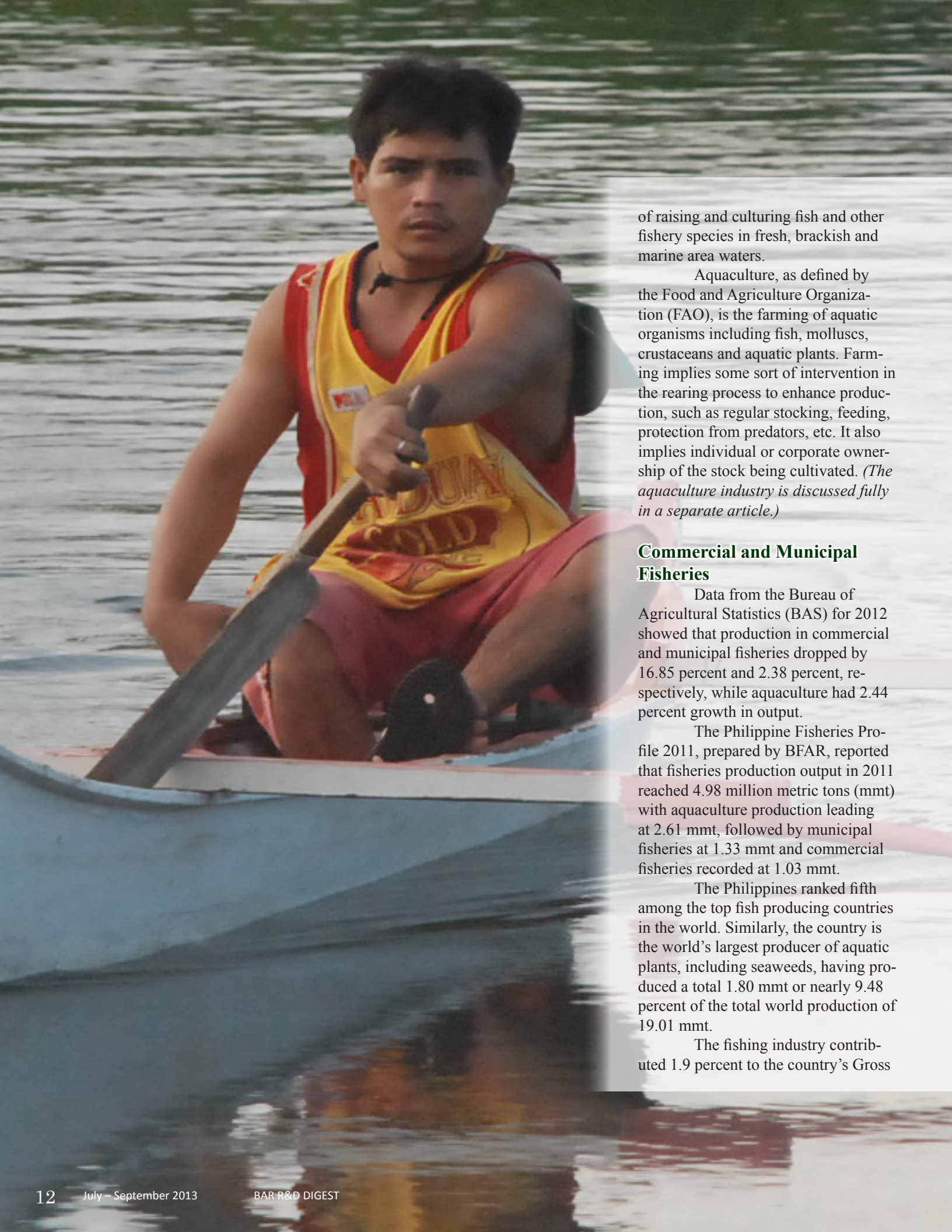
Addressing a backslide in FISHERIES PRODUCTION

by PATRICK RAYMUND A. LESACA

The country is an important producer of fish in the world and fisheries is an important sector. According to the Bureau for Fisheries and Aquatic Resources (BFAR), the fisheries sector provides direct and indirect employment to over one million people, or about 12 percent of the agriculture, fishery and forestry sector labor force estimated at 6,589,176 person. The fisheries sector is a net earner of foreign exchange for the country. Among the country's major fisheries export commodities include: tuna, shrimp/prawn and seaweeds, while the major imports are: chilled/frozen fish and fish meal.

The fisheries sector is divided into three sectors: commercial, municipal, and aquaculture. As stated in the Fisheries Code of 1998 (RA 8550), Commercial fishing refers to the taking of fishery species with passive or active gears for trade, business or profit beyond subsistence or sports fishing. This is further classified to: a) small-scale commercial fishing (with passive or active gear utilizing fishing vessel of 3.1 gross tons up to 20 gross tons); b) medium-scale commercial fishing (with passive or active gear utilizing fishing vessel of 20.1 gross tons up to 150 gross tons); and c) large-scale commercial fishing (with passive or active gears utilizing fishing vessels of more than 150 gross tons weight).

Municipal fishing refers to fishing within municipal waters using fishing vessels 3 tons or less in weight or fishing not requiring the use of fishing vessel while aquaculture fisheries involves all forms



of raising and culturing fish and other fishery species in fresh, brackish and marine area waters.

Aquaculture, as defined by the Food and Agriculture Organization (FAO), is the farming of aquatic organisms including fish, molluscs, crustaceans and aquatic plants. Farming implies some sort of intervention in the rearing process to enhance production, such as regular stocking, feeding, protection from predators, etc. It also implies individual or corporate ownership of the stock being cultivated. *(The aquaculture industry is discussed fully in a separate article.)*

Commercial and Municipal Fisheries

Data from the Bureau of Agricultural Statistics (BAS) for 2012 showed that production in commercial and municipal fisheries dropped by 16.85 percent and 2.38 percent, respectively, while aquaculture had 2.44 percent growth in output.

The Philippine Fisheries Profile 2011, prepared by BFAR, reported that fisheries production output in 2011 reached 4.98 million metric tons (mmt) with aquaculture production leading at 2.61 mmt, followed by municipal fisheries at 1.33 mmt and commercial fisheries recorded at 1.03 mmt.

The Philippines ranked fifth among the top fish producing countries in the world. Similarly, the country is the world's largest producer of aquatic plants, including seaweeds, having produced a total 1.80 mmt or nearly 9.48 percent of the total world production of 19.01 mmt.

The fishing industry contributed 1.9 percent to the country's Gross

Domestic Product (GDP) at then current prices in 2011. This translates to some P183.1 billion. The industry also accounted for 14.4 percent of the Gross Value Added (GVA) in agriculture.

In terms of employment, the industry employed close to 1.7 million fishing operators of which the municipal fisheries sector accounted for more than one million operators while the commercial and aquaculture sectors add some 16,500 and 226,200 operators, respectively. The domestic demand for fish is substantial with an average yearly fish consumption of 36kg per person.

In an assessment report published under the Philippine Development Plan 2011 – 2016, it was reported that, while the agriculture sector's growth was driven primarily by fisheries at 1.21 percent, the growth was partly due to the expansion of aquaculture and robust demand for commodities such as seaweeds. Meanwhile, the productivity of municipal fisheries, such as small-scale capture fisheries, has been declining. This can be attributed partly to overfishing and poor enforcement of fishery laws. The national stock assessment of BFAR suggests that two-thirds of the 12 major fishing bays in the country are already overfished.

Increasing Fishery Output

Given this scenario, the government is now faced with constant challenges, not only on how to increase the country's fishery output, but also ensure that the fishery industry and the fisheries sector remain important components of the economy as the fishery industry has been a major contributor to social stability through livelihoods and employment that it generates. If fisheries R&D is to be the cutting edge of the industry's progress, its technical fisheries and manpower must be further developed and be deployed to where R&D will be most effective.

In a nutshell, BFAR as the agency mandated and responsible for the development, improvement, management and conservation of the country's fisheries and aquatic resources, it has lined-up specific action plans. These include: 1) preparation of the National Fisheries Industry Development Plan; 2) formulation and implementation of a Comprehensive Fishery Research and Development Program, such as, but not limited to, sea farming, sea ranching, tropical / ornamental fish and seaweed culture, aimed at increasing resource productivity improving resource use efficiency, and ensuring the long term sustainability of the county's fishery and aquatic resources; 3) provision of extensive development support services in all aspects of fisheries production, processing and marketing; 4) coordination with LGUs and other concerned agencies for the establishment of productivity-enhancing market development programs in fishing communities, in the process enabling women to engage in fisheries / economic activities and contribute significantly to development efforts, among others. ■

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> ***"If fisheries R&D is to be the cutting edge of the industry's progress, its technical fisheries and manpower must be further developed and be deployed to where R&D will be most effective."***

Keeping the country's edge in Aquafarming industry

by RITA T. DELA CRUZ

Being archipelagic in nature, the Philippines is abundant in natural resources and its bodies of water are well endowed with bountiful harvests from the sea.

The aquaculture industry, being naturally diverse in species and culture systems in various ecosystems, plays a significant resource both for food and livelihood. Farmed milkfish, carp, and shrimp are mostly harvested for domestic consumption, sustaining about half of the protein requirement of the Filipinos' seafood diet.

It is an important segment of the fisheries sector. In 2012, aquaculture accounted for more than half of the country's total fisheries production or 52.32 percent as reported by the Bureau of Agricultural Statistics (BAS). The remaining percentage came from commercial fisheries (21.31 percent) and municipal fisheries production (26.37 percent).

Aquaculture continues to gain attention for its potential for increasing the country's fish production. In fact, the Philippines consistently ranks among the top 10 aquaculture countries annually according to the Food and Agriculture Organization (FAO).

Over the years, aquaculture has expanded as a result of technological developments and widening knowledge on the biology and life cycle of various cultivable species. Also, production intensification in existing fishpond areas is being carried out to increase yields. Although this is the case, the stability in the sector has not been fully realized. As they say, even normally still water can be stirred by outside forces causing disturbance or trouble for a growing industry. Presently, the aquaculture industry isn't as calm and stable as it was in 2012.

BAS reported that aquaculture



produced a total of 2.5 million metric tons in 2012. This production is 2.54 percent (or 66,154.46 metric tons) lower than the 2011 figures. Aquaculture production dropped in all quarters of 2012 with the biggest decrease observed during the fourth quarter at 4.18 percent or 35,861.45 metric tons.

The decline in production was mainly due to the decrease in seaweed production, the largest contributor in the aquaculture sector. Seaweed production was pegged at 1,751,070 metric tons contributing 68.89 percent to the total aquaculture production of the country. Production of seaweed declined by 4.88 percent or 89,762.22 metric tons last year. It exhibited a downward trend throughout the year with the biggest decrease registered in the fourth quarter at 7.37 percent or 47,992.48 metric tons. Infestation with the dreaded "ice-ice" disease was reported as the major culprit for the decline among the top seaweed producing provinces. Also, the low buying price of seaweed and weather disturbances that prevailed throughout the year and habitation by assorted fishes and sea turtles of a number of seaweed farms in the first quarter of the year forced some farmers to stop operation.

Meanwhile, the rest of the aquafarm types showed better performance except for oyster and freshwater fish pens. Fin fishes and shellfishes including milkfish, tilapia, tiger prawn, oyster and mussel contributed 31.11 percent to the total aquaculture production.

Seaweeds

Seaweeds are an important aquatic resource with the Philippines one of the few countries in the world which have pioneered in the farming of these plants in substantial quantities. Seaweeds are a good source of colloidal materials which are processed for various pharmaceutical, cosmetic, and food purposes.

On the production side, seaweed is essentially an industry for the small grower providing important livelihood in the generally poor coastal areas. On the processing side, it is considered a promising industry given that new investors continue to come in. Given the increasing international demand, the Philippines has been able to capture a significant portion of the market, although improvements are still needed in the processing aspect.
The 2012 seaweed production was relatively unstable. The BAS reported 1,751,070.64 metric tons volume of production which was 4.88 percent lower than the 2011 record.

The major decline was due to the infestation of seaweed farms with ice-ice disease throughout the year which hit the top producing provinces that include Tawi-Tawi, Sulu, Palawan, Zamboanga City, and Bohol. According to BAS, another reported cause was unfavorable weather conditions combined with strong winds and rough seas that brought negative effects on seaweed production. Other causes for the decline were uncontrolled presence of sea turtle and siganid fry in the production areas during the first half of 2012 which caused damage and destruction of seaweed plants, the scarcity of good planting materials, flash floods, sudden changes in temperature, and existence of sea grass that negated production output. In other production leading areas, many operators opted to temporarily stop seaweed culture due to high cost of farming materials and the continuous drop in buying price. Invasion by epiphytic plants in the seaweed farms caused poor growth of the crop thus reducing production output.

Fin fishes

Next to seaweeds, the culture of finfishes, comprised mainly of milkfish, tilapia, carp, and catfish, recorded an increase in production in 2012.

Production of milkfish went up by 3.80 percent, from 372,580.80 metric tons in 2011 to 386,728.92 metric tons in 2012. The increase

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in production was due to good farm management, availability of quality fry/fingerling and proper feeding practices. Milkfish production from brackishwater fishponds and fish pens registered increases of 2.72 percent and 6.65 percent, respectively. Meanwhile, harvests from brackishwater fish cages dropped by 2.76 percent most due to high mortality rate, as reported by operators particularly, in San Fernando, La Union during the second half of the year. Harvests of milkfish from freshwater fish pens and fish cages dropped by 2.01 percent. Among the noted causes were the full implementation of the dismantling of illegal fish cages in Taal Lake, delayed stocking in Sultan Kudarat due to continuous repairs of fishing nets and replacement of old bamboo poles, and financial constraints. The total 2012 production of milkfish from marine fish pens and fish cages of 112,690.27 metric tons was 8.40 percent higher than 2011's level of 103,958.20 metric tons.

Production of tilapia from all aquafarm types was also brighter in 2012. It was higher by 1.22 percent or 3,150.53 metric tons this year compared in 2011. Tilapia production came mostly from freshwater environments. Gains were observed in all types of aquafarms except freshwater fish pens which registered 21,379.50 metric tons, a figure 888.73 metric tons lower than last year's production. Harvest of tilapia from freshwater fishponds grew by 0.79 percent. Production of tilapia from freshwater fish cages registered an increase of 3.19 percent in 2012. This was contributed by major producing provinces of Batangas, Camarines Sur, Albay and Rizal. Harvests from brackishwater fishponds went up by 1.32 percent this year. Volume of harvests from brackishwater fish pen/cages increased by 8.68 percent and production from rice fish farms went up by 42.27 percent in 2012. Likewise, production of tilapia in small farm reservoirs (SFRs) also posted an increase of 42.98 percent and 247.57 percent in marine fish cages.

Production of carp in 2012 was 17,703.89 metric tons. This was 2.09 percent more than the 2011 output. Production was notably bigger during the fourth quarter of the year. Production in fishponds was higher in the last quarter but it was down from first to third quarter of 2012. Good pond water salinity and quality of fingerlings stocked accounted for the increase.

For catfish, production was reported to be 15.26 percent or 3,606.42 metric tons higher than the 2011 production. The combined output gains in Central Luzon provinces were realized with the early onset of rainfall, good management and proper feeding that enhanced the growth of catfish. Harvests of catfish from small farm reservoirs (SFRs) decreased by 6.90 percent due to overflowing of fish ponds mainly due to continuous rains and limited supply of fingerlings.

Shellfishes

Major contributors for species categorized as among the shellfishes are tiger prawn, mudcrab, oyster, and mussel. Except for oyster, production numbers in 2012 show an increasing

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Total production of tiger prawn was estimated at 48,196.44 metric tons which is 1.48 percent higher than the 2011 record. The biggest output increase of 17.40 percent was observed in Lanao del Norte and this was traced to the impact of commercial feeds used and the intense stocking in response to high demand for tiger prawn for export.

For mudcrab, the 2012 production at 16,359.63 metric tons was up by 4.00 percent compared to the previous year's figure of 15,730.91 metric tons. The increase was attained due to a big shift to mud crab culture by aquaculturists, availability of quality crablets, and high demand for mudcrabs in the local and export markets.

Mussel production maintained its upward trend and recorded a 14.34 percent growth in 2012. Increases in the number of operators and area harvested were reported due to high demand. The adoption of the string line technology in planting mussels was also noted. The absence of red tide with good water condition resulted in the occurrence of quality spats, allowing operators to culture more mussels.

Meanwhile, oyster production dropped by 3.79 percent due to the prohibition on gathering shellfishes because of fears of red tide contamination, removal of oyster beds, specifically, along Agno River during the second quarter due to unavailability of oyster spats.

Prospects for the Aquaculture Industry

Although a 2.54 percent decline was reported in the last year's volume of production in aquaculture industry, the numbers are still considered good. Mostly, the slight drop was attributed to the decline in seaweed output due to infestation with ice-ice disease that ravaged its production particularly during the last quarter of 2012. Its spread is crucial since seaweed production contributes more than half or 68.89 percent of the total aquaculture production.

Dr. Catalino R. de la Cruz, technical consultant for fisheries at the Bureau of Agricultural Research (BAR), stressed the need for "putting efforts rightly" in order for the aquaculture industry in the Philippines to become viable, environmentally-sound, and more importantly, socially equitable. He said that achieving all three aspects are important but ideal. The first two (viable and environment-sound) can be achieved but the third (socially equitable) poses a real challenge, although according to him, "it can be done." He added that if technologies developed are expensive to adopt and only moneyed investors can invest in these, how can aquaculture be socially equitable? Thus, efforts to identify more aquaculture species and develop more technologies where majority of those in the different socioeconomic classes can engage in should be relentless.

Although, the Philippines is consistently among the top producing countries in aquaculture, Dr. dela Cruz emphasized the need to catch up with its Southeast Asian neighbors in terms of technology development. "We can do this if we put in our efforts rightly to where it is needed. Effort is important. But knowing where to make a properly timed effort makes all the difference," he said.

He also underscored the need for more research funds, more action from our fisheries researchers and administrators, and for state universities and colleges to be more involved in downstream research and in interfacing with local government unit extension workers when it comes to facilitating the delivery and adoption of aquaculture technologies. ■

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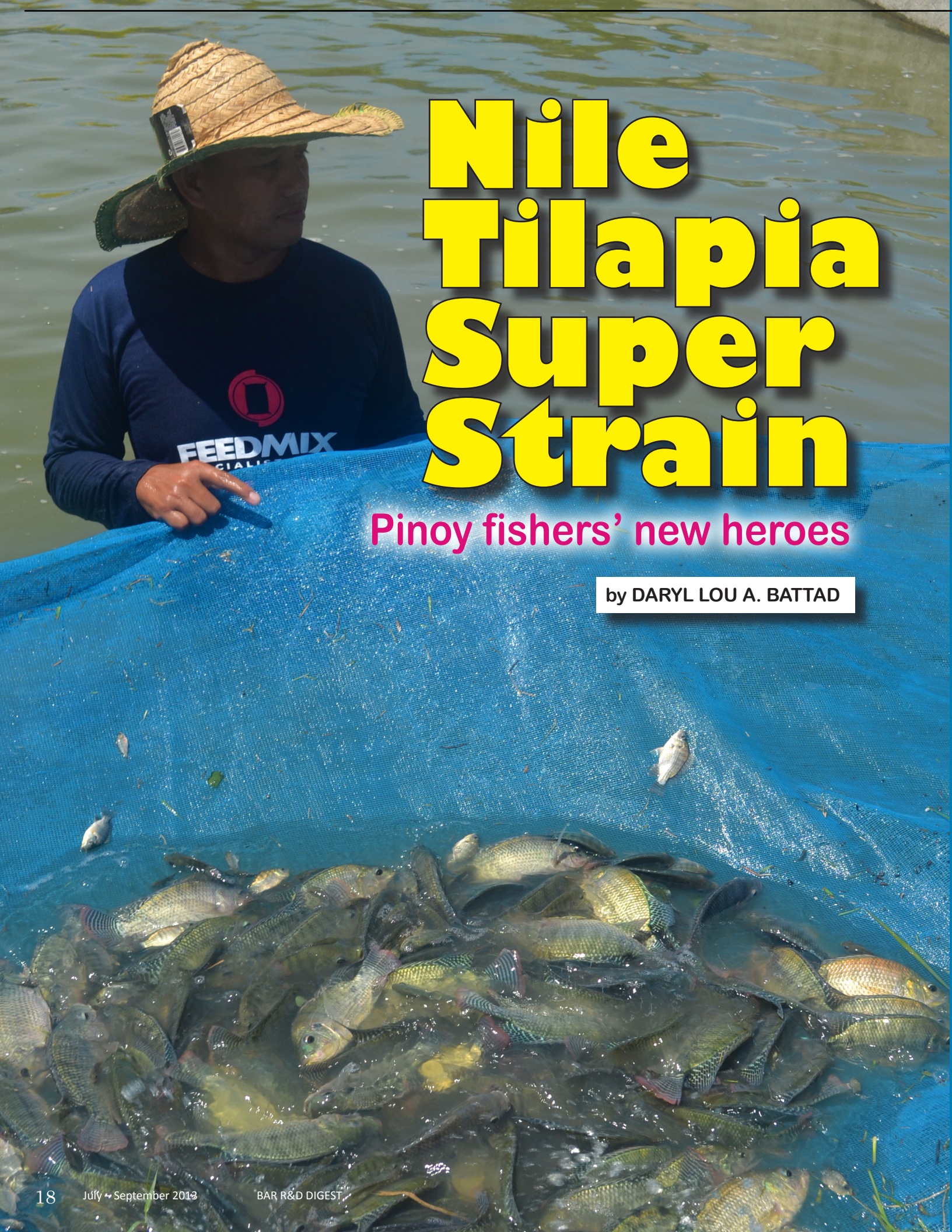


Nile Tilapia Super Strain

Pinoy fishers' new heroes

by DARYL LOU A. BATTAD

Who reigns supreme? This is the question the answer to which the project, "Evaluation of Nile Tilapia Strains for Aquaculture in the Philippines," set to find out.

The WorldFish Center, in collaboration with the Department of Agriculture-Bureau of Agricultural Research (DA-BAR), Bureau of Fisheries and Aquatic Resources-National Freshwater Fisheries Technology Center (BFAR-NFFTC), and Freshwater Aquaculture Center-Central Luzon State University (FAC-CLSU), implemented a project to determine the best performing strain of Nile tilapia in the Philippines.

Along with the identification of the 'super strains,' the project also seeks to improve the genetic performance of the strains through breeding schemes and to expand the aquaculture industry by involving both large and small scale tilapia growers.

Aiming for the Nile Super Strain

It was in the early 70s when Nile tilapia was first introduced in the Philippines. A native of Africa, it has since become the second most important aquaculture fish next to milkfish. It has provided significant income to farmers but over time the produce has declined which led various institutions to develop several strains of Nile tilapia better suited to the aquaculture needs of the country.

There are four Nile tilapia strains popular here in the Philippines which are also being used in this project as experimental stocks. These are: 1) Genetically Improved Farmed Tilapia (GIFT) developed by WorldFish Malaysia, 2) FAC Selected Tilapia (FaST) strain by CLSU, 3) Genetically Enhanced Tilapia Excellent Strain (GET-EXCEL) by the BFAR; and 4) GIFT Feedmix Fortified (GIFTff), developed by the GIFT Foundation.

The continuing need for more systematic measures for improving the quality of tilapia grown in the country is fundamentally recognized to maintain the Philippines' global standing in tilapia culture. "We should sustain our position as one of the top five tilapia producers in the world after China, Egypt, and Indonesia," said Dr. Tereso Abella of the FAC-CLSU. "The possibility of us becoming the lead producer and exporter of tilapia, especially tilapia fillet, is not very far," he added.

Improving Tilapia Genes

The first tilapia breeding program started in 1986 through the efforts of FAC-CLSU, the International Development Research Centre (IDRC), and the University of Dalhousie in Canada. A year later, the International Center for Living Aquatic Resources Management (ICLARM, now the WorldFish Center) organized a landmark workshop, "Tilapia Genetic Resources for Aquaculture". Such efforts opened doors and opportunities for tilapia breeders and enthusiasts towards the improvement of tilapia genes.

In the Philippines, genetic deterioration has been pointed out as one of the causes of the decreasing performance of the tilapia industry in general. According to studies, inbreeding and accidental hybridization between two different species produced low quality tilapia broodstock. Because of its popularity among fishers, traders, and consumers, the call for improving its genetic features had to be responded to by tilapia researchers and culturists.

The focus of genetic improvement of tilapia is on the selection of strains for faster growth and which exhibit high survival rate. Although there have been a number of performance evaluation studies for Nile tilapia, this project targeted the relative growth performance of tilapia strains that are currently cultured in the Philippines. Currently the most common and popularly cultured strain here in the country is the GIFT strain that has undergone 13 generations of selection. The GIFT strain will be used in comparing the locally-produced strains of tilapia to determine the best one.

"This is a very significant and timely project because apart from our goal of remaining as one of the world's top producers of tilapia, we also want to help our local tilapia raisers to be competitive in terms of income," said Dr. Nicomedes P. Eleazar, director of DA-BAR.

The development of an experimental protocol for the evaluation of tilapia paves the way to the identification of a super strain. Once a super strain has been determined, it is then distributed to fishers and hatcheries which can lead to an increase in fry availability and a decrease in the cost of seed stock.

The long-term impact of the success of this project is that it will give farmers more tilapia varieties to choose from. According to a study conducted by the Asian Development Bank (ADB) in 2005, improved strains have significantly contributed to the development in terms of social welfare, income, and well-being of the poor farmers in the Philippines. The GIFT strain, with about 70 percent of tilapia cultivated in the Philippines, is responsible for much of the upliftment of farmers. With the current efforts in further improving these strains, tilapia culture in the Philippines might just turn out to be the most developed in Asia and even the world. ■

For more information please contact Dr. Tereso Abella of the Freshwater Aquaculture Center-Central Luzon State University (FAC-CLSU), Science City of Muñoz, Nueva Ecija.Tel. No: (044) 456-0681, Email: teri_abella@yahoo.com

Conservation talks for Christian Crab

by DIANA ROSE A. DE LEON

GAINING GROUND

Resource conservation and its management are two of the priorities being pushed by the fishery sector to ensure that there is a stable food supply for Filipinos. With the data showing a decline in productivity in fisheries, protecting and conserving the remaining aquatic resources and extending their productivity are major aims of the government. National and local laws and policies are already in place and are being enforced in critical fishing areas to stop further aggravating the situation.

Such is the case with San Miguel Bay (SMB) which is located between the provinces of Camarines Norte and Camarines Sur and where fishing and fishery-related activities are the main sources of livelihood in the surrounding municipalities. Assessment studies on SMB show the gravity of fishery resource depletion in the area and, if this remains unmanaged, the people depending on SMB will greatly suffer the repercussions.

To develop resource enhancement strategies in SMB, the Bureau of Agricultural Research (BAR) funded a project titled, "Swimming Crab Fisheries in San Miguel Bay with focus on Christian Crab (*Charybdis feriatus*, Linnaeus, 1758)" implemented by the Bicol University (BU). With the overfishing of Christian crab in SMB, the project sought to provide solutions and strategies for sustaining its population.

The "Holy" Crab

Christian crab belongs to the family Portunidae which is known for flattening its fifth pair of legs into broad paddles for swimming. It can be found in the Indo-Pacific region from Japan, China, Indonesia and Australia to Sri Lanka, Southern Africa, and Persian Gulf. It is a

bottom-dweller and prefers to live in sandy to sandy muddy substrates.

The origin of the name, Christian Crab, is said to be a from a sanctum mythology. According to the story, St. Francis Xavier, a Jesuit priest, blessed a crab for bringing back his lost crucifix. Since then, the crab has borne the figure of a cross on its carapace. It is believed that its descendants are today's "Christian crabs". It is also called the crucifix crab for its distinguishing cross-shaped mark on its carapace. Its scientific name feriatus means a "holy day." In some cultures, the crab is treated as sacred and, thus, its shell is often sold as a religious item.

Regardless of its origin, the said crustacean is in the spotlight for being a high value commodity. It is prized for its large size, high quality of meat and soft exoskeleton. Compared to P*ortunus pelagicus*, Christian crab commands a premium price (US$8 to US$15 per kilogram) in the Asian markets.

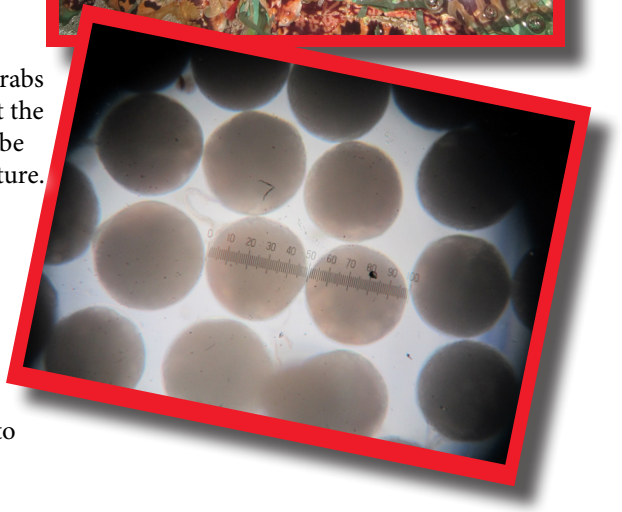
In the Philippines, SMB is one of the known sources of Christian crab in the country. The issue raised is that Christian crab in the country is not commercially cultured, thus the market relies solely on wild stock. With high demand for the commodity, coupled by the lack of interventions to support the growth of Christian crab industry, fast decline in crab catch has been observed over the past several years.

Status of Christian crabs

The population of swimming crabs in the country is suffering from over- and indiscriminate fishing because of high demand in the international and domestic markets. This BAR-BU assessment project is an attempt to determine the status of swimming crabs, with focus on Christian crab fisheries and its reproductive biology, which will serve as a basis for formulating resource conservation and management strategies. It is a 15-month project that started in November 2011 and was completed in January 2013.

In the study, six species of swimming crabs in SMB were identified. These are: *Charybdis feriatus, Portunus pelagicus, Portunus sanguinolentus, Scylla oceanica, Scylla serrata*, and a member of the genus, *Thalamita*. It was found out that *Charybdis feriatus* and *Portunus pelagicus* are the most heavily over-fished.

Three hundred crab specimens were collected monthly in Tinambac, Calabanga, and Cabusao in Camarines Sur and in Mercedes in Camarines Norte. Data sought in the study included the population structure of swimming crabs, estimate of growth and mortality by species, the fishing gears used, estimated annual production and species composition, CPUE (catch per unit effort) and exploitation rates by species, and existing market and channels of distribution. Also, 30 Christian crab samples were collected monthly for reproductive assessment. Data such as gonad maturity, Gonado-somatic index (GSI), fecundity, and size at first maturity were also gathered.



Based on the findings of the study, it supported the results of earlier studies that showed the exploitation rate in SMB for Christian crabs and *P. pelagicus* as exceeding the optimum exploitation rate, which means over-fishing. If excessive catching of adult crabs remains unregulated, it is possible that the remaining spawning biomass will not be able to sustain its population in the future.

Movement towards a Sustainable Christian Crab Fishery

Due to lack of efforts towards improving the swimming crabs' population in SMB, several consultation-workshops were initiated by the project implementers to come up with more participatory and

With the willingness and dedication of the concerned stakeholders to contribute to the conservation of Christian crabs in San Miguel Bay, the project serves as the start of a catalytic action towards the rise of the Christian crab industry in the country.

sustainable Christian crab fishery resource conservation and management strategies.

In coordination with the local government units (LGUs), Bureau of Fisheries and Aquatic Resources (BFAR) 5, Department of Science and Technology (DOST), and BAR, an action planning workshop for SMB municipalities was called. Forty-two representatives from the LGUs of Basud, Mercedes, Sipocot, Cabusao, Calabanga, Tinambac, and Siruma attended the event. Inclusion of crab fisheries in the Coastal Resource Management Plans (CRMP) and the total prohibition of the use of active fishing gears such as baby trawls were recommended among the courses of action.

Using the data derived from the study, the implementers formulated drafts of strategies that were presented during the "Stakeholders Consultation and Presentation of Resource Enhancement Plan for Marine Crab in San Miguel Bay". This was attended by representatives from DOST 5, BFAR 5, Integrated Fisheries and Aquatic Resource Management Council (IFARMC), and key officials of municipalities bordering SMB.

Out of the five options presented, three were chosen as the most appropriate and workable strategies to be implemented by all concerned LGUs. These are: 1) close season during periods of peak reproductive activity of Christian crabs particularly in December and January where higher percentage of Gonad Somatic Index or GSI, mature and gravid crabs were observed; 2) the collection of egg-bearing swimming crabs which will be held in a spawning tank, hatched and the larvae returned to the fishing grounds or in marine protected areas (MPA); and 3) diversification of alternative livelihoods, especially those that are non-fisheries related.

With the willingness and dedication of the concerned stakeholders to contribute to the conservation of Christian crabs in SMB, the project may serve as the start of a catalytic action towards the rise of the Christian crab industry in the country. ■

For more information about the project, please contact the project proponent, Dr. Plutomeo M. Nieves of the Bicol University Tabaco at Tel. No: (052) 830-0012/487-5247, Email: plutz1122@yahoo.com

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Climate change...*from page 10*

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Culturing Hanginan

a commercially-important sea cucumber species in the Philippines

by ANN CAMILLE A. BRION

Perhaps one of the most overlooked underwater species is sea cucumber. This small creature, with its flexible sausage-shaped body and tentacles surrounding its mouth, has one of the most important contributions in the fisheries sector ecologically and economically speaking.

Two-way importance

Considered as the "earthworms of the sea floor", the sea cucumbers generally feed on organic matter in the sediment. There are species which filter the particles from the water column, thereby reducing excess organic matter in the water. When it buries itself into the sea floor, it helps in oxygenating the sediment so that other organisms can live well beneath the surface.

For people living in the coastal areas, sea cucumber is an important source of livelihood. Dried sea cucumber is one of the most common forms of its processed product and is known in the international market as *trepang* or *beche-de-mer*. These dried sea cucumbers are considered high-value export commodities. Philippines is one of the *trepang* exporting countries which caters to the demand of other Asian countries including China Hong Kong Special Administrative Region, Singapore, Republic of Korea, Taiwan Province of China, and Japan (Gamboa, Gomez and Nievales, 2004 as cited by Choo, 2008). Traditionally, sea cucumbers are used in the preparation of various dishes such as soups and noodles. Dried sea cucumbers are rich in protein and are said to reduce arthritic pain, treat high blood pressure, and other illnesses.

Given the increasing demand for sea cucumbers, yet lack of management measures that will ensure its conservation, the sea cucumber industry is facing the problem of overexploitation and inevitable decline in their population. Overfishing can result to their local extinction which would impact the welfare not only of the people but of the environment as well.

A sought-after sea cucumber species

In the country, *Stichopus horrens* is considered as one of the sought-after species that is being sold commercially. Locally known as *hanginan, S. horrens* is a nocturnal species which remains hidden in the crevices of the reefs during the day. In China and Malaysia, such species is used in the nutraceutical industry and as traditional medicine. It is believed to possess medicinal properties, and is thereby often processed into products such as gamat oil, gamat water, balm, or mixed as ingredients in toothpaste, coffee and soap. Here in the Philippines, hanginan is a popular delicacy in Mindanao among our Muslims brothers which is prepared especially during Ramadan.

Efforts to culture a commercially important species

Given the vast diversity of sea cucumbers, there is a need to develop culture techniques for commercially important species such as *S. horrens*. Currently, only sea cucumber that can be mass cultured is *Holothuria scabra*. Culture initiatives were developed by the University of the Philippines-Marine Science Institute (UP-MSI) in 2000.

This prompted Dr. Marie Antonette Meñez of UP-MSI to lead the project on "Experimental Scale Culture of the Sea Cucumber Stichopus horrens (Selenka)". Through the project, research was undertaken to determine the reproductive activities of the species, to characterize its spawning behavior, and to determine the success rate of in situ fertilization. Information generated from these activities would provide valuable inputs for the development of appropriate management strategies for the said species.

Field observations and collection were conducted in Masinloc, Zambales. Collected species were measured, dissected, and the gonads were collected. Upon studying the structure of the gonads (glands in which sex cells are produced), it was revealed that the species are dioecious. This means that the *S. horrens* has distinct sexes, male and female. Through the use of an inverted microscope, the sexes were distinguished and described as follows: male gonads are thinner, with yellow-orange color, and the tubules are highly branching while the female gonads are thicker, with light yellow color, and the tubules are less branching.

Field observations on the spawning events of *S. horrens* revealed that the animals spawn during the evening a few days after the third quarter of the moon. When spawning, the species tend to stretch and sway the anterior part of their body (resembling a standing position). The animals were also observed to be aggregated during the observed spawning events. This poses an implication towards maintaining an effective spawning population of sea cucumbers.

The project also embarked on the experimental scale culture of the *S. horrens* that will help in developing optimal rearing strategies for the reproduction of the species. In the production of juvenile (young) *S. horrens,* eight spawning events were observed in the hatchery tanks at the Bolinao Marine Laboratory. Out of the eight, only four batches produced a total of 1, 604 early juveniles.

To determine other factors that can improve the rearing of larvae and production of juvenile, larvae were fed with the algae *Isochrysis galbana* (Ig) and *Chaetoceros calcitrans* (Cc). Higher survival of the larvae was recorded when fed with a 50-50 mixture. Mixed diets, according to previous studies, may provide better nutrition during stages of development. Larger growth was also observed when the species were fed with Cc and Ig-CC mixed diet. However, developmental stage was observed to be faster when fed with Cc alone.

Settlement induction was also carried out. Treatments utilizing the algae Sargassum and Spirulina as pastes were used as inducer. The number of larvae which have successfully settled and became juveniles was higher using the Sargassum treatment with 1.43 percent survival rate as compared with the Spirulina treatment with 0.62 percent survival rate.

Through bottom-set sea cages which served as an ocean nursery, the early juveniles were reared in the field. It was observed that an additional surface area may not necessarily affect and/or enhance the growth and survival of the juveniles. Experiments on the regeneration potential of the juvenile *S. horrens* as well as behavioral experiments on their habitat preference and effect of light were also conducted.

Commercially important marine resources such as sea cucumbers that are thriving in the wild are the ones highly vulnerable to over exploitation and drastic species depletion. In order to protect and preserve them, regulations and management policies should be closely implemented to include monitoring of fishing activities. Backed up by strict enforcement, they will play an important role in the sustainability and survival of such invertebrates.

Meanwhile, research and development efforts focused on technologies for the cultural management of sea cucumbers such as this project should also be strengthened as these are essential in promoting the conservation of the species and to increase production so as to meet the demands of the local and international markets. ■

For more information about the project, please contact Dr. Marie Antonette Meñez of the University of the Philippines-Marine Science Institute (UP-MSI), Diliman, Quezon City at telephone number: (02) 922-3959 or through email: meneza@upmsi.ph

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CPAR ON TILAPIA: Breaking Boundaries in Bukidnon

by ZUELLEN B. REYNOSO

Landlocked provinces face more difficulty in providing fish and other fisheries products for local and overseas markets compared to those with direct access to coastal areas. Attention is therefore more focused on other income-generating ventures like agriculture. The local fisheries sector lags in overall development as there are other priorities for a province with no coastal area. Bukidnon is one such province.

A Caged Bukidnon

Bukidnon, located in the northern part of the Mindanao region, is a landlocked province. Clockwise, it shares its borders with Misamis Oriental, Agusan del Sur, Davao del Norte, Cotabato, Lanao del Sur, and Lanao del Norte. Bukidnon is named after the tribes who initially lived in the area. Literally, Bukidnon is translated as "people of the mountains". Known as the "food basket" of Mindanao, Bukidnon remains limited by its inability to produce sufficient amounts of fish and fishery products to supply market demand.

The physical attributes of being landlocked with no direct access to oceans is detrimental to the development of Bukidnon as a complete food basket. Although the province's economy relies on agricultural crops and is a major producer of fruits (more popularly, pineapples and bananas) and vegetables as well as corn, coffee, sugar, rubber, and rice, local agri-fishery development remains incomplete. Coupled with nonexistent sea and airports in the province, the fisheries sector of Bukidnon seemed to have no fighting chance - until freshwater aquaculture came into the picture.

Hope in Freshwater Aquaculture

Freshwater aquaculture is a product of research and development (R&D) initiatives that aim to increase production of fish, mollusks, crustaceans, and even aquatic plants. Also known as aquatic farming, this technology gives even landlocked communities a chance to provide for demands for fishery products by putting to good use enhanced production and postharvest techniques that they can learn. Aside from dikes, materials that are easily obtained like bamboo poles and inexpensive nets could be used to build inland freshwater pens.

According to Science Daily, half of the global consumption of fish is now being raised in farms. This proves the success of aquaculture. With this technology, we can not only increase the local production of fish and finfishes and other marine products, but also arm communities with the capacity to produce, regardless of their available natural resources or whether they are a landlocked province or one with access to coastal waters.

Breaking the Boundaries in Bukidnon

In a bold step to improve the status of the fishery industry in Bukidnon, the Bureau of Agricultural Research (BAR) and the Bureau

of Fisheries and Aquatic Resources – Regional Fisheries Research and Development Center 10 (BFAR-RFRDC 10) joined together for the project, "Community-based Participatory Action Research (CPAR) on the Application of Improved Farming Technologies and Alternative Feeding Management Techniques for Tilapia Culture in Brgy. Bacusanon, Brgy. Pigtauranan, Pangantucan, Bukidnon". The project aims to: 1) develop tilapia as a prime fisheries product, 2) generate job opportunities, and 3) increase the income of farmers through the development of the barangay as a tilapia-producing area.

With a two-year duration, the project began by educating the farmers about tilapia production in freshwater ponds. According to the proponents, Vianney Anthony A. Gapup and Gigi C. Albor, project leader and OIC-Center manager, respectively, technologies that will be used to increase production and quality of tilapia as well as to lower cost will be "delayed feeding strategy, all male strategy, *tilanggit* production, weekly fertilization strategy, and percentage satiation method." Orientations, hands-on trainings, establishment of rearing ponds and CPAR site, and field visits are among the tools used to equip the participants with knowledge to make production happen. Ten culture sites have also been established in Brgy. Bacusanon with five cooperators involved. Continued efforts of local government units and agencies, as well as support from the community, paves the way for sustainable development that benefits the many. Successful initiatives, such as this project, are testament to the conviction that shortcomings and "boundaries" can be overcome with the right attitude and drive.

Bukidnon, a landlocked province, is now able to break free from its half-full "food basket" situation and be recognized as a producer of quality food items from both the land and, in this case, freshwater ponds. ■

For more information about the project, please contact Vianney Anthony A. Gapuz, Project Leader, BFAR-RFRDC 10, Macabalan, Cagayan de Oro City. Mobile No: 0917-7052488, email: aquaresearch10@gmail.com

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Reaping benefits from CPAR POLYCULTURE fish farming

by LEILA DENISSE E. PADILLA

Hagonoy, Bulacan, the rural community of Brgy. San Pedro, has more than 900 households, half of which are engaged in fish farming of milkfish, giant tiger prawn, tilapia, and mud crab in brackish water ponds.

Seeking to help improve their livelihood and sustain environmental vigor, the Bureau of Fisheries and Aquatic Resources (BFAR) Regional Office 3, with the support of the Bureau of Agricultural Research (BAR), conducted the project, "Community-based Participatory Action Research: Polyculture of Milkfish and Black Tiger Prawn in Brackish Water Ponds in Hagonoy, Bulacan". The project aimed to introduce the importance of a polyculture system and its benefits.

Indetifying Issues on Mortality, Income, and Practices

During the Participatory Rural Appraisal (PRA) conducted in Brgy. San Pedro, it was learned that the fishing community has been employing different culture systems for a certain season of the year. It was also found that mud crab and tiger prawn were being cultured simultaneously and that tilapia is occasionally added to increase production. At times, milkfish was also added to the three species. "They are not aware that milkfish and tilapia compete for natural food in the pond while mud crab can cannibalize prawn especially during its molting. This in turn could be the reason for the high mortality in prawns," explained Dr. Lilian Garcia, Regional Fisheries Research and Development Center (RFRDC) manager, and lead proponent of the CPAR the project.

Issues on insufficient capital and use of banned chemicals also surfaced during the PRA. It was further found that fish farming operations were not performed regularly due to the lack of capital and that the health of the environment was gradually suffering because of the use of sodium cyanide, a pesticide banned for its hazardous effects on organisms other than rats.

Introducing Improved Eco-friendly Aquaculture Interventions

With the ultimate goal of alleviating poverty among the fish farmers and of attaining food security

through improved fish farming technology, the project sought to: 1) improve the aquaculture practice and farming skills of fish farmers, 2) improve production and income of fish farmers, and 3) showcase a sustainable and environment-friendly fish farming technology.

In a polyculture system of farming, two or more aquatic organisms are placed in the same culture environment to maximize the use of resources and therefore increase production. The organisms involved should have different feeding behaviors in order to avoid cannibalism and competition which can directly affect production and income.

In Brgy. San Pedro's case, it was found that the polyculture system being implemented was counter productive. The growers have cultured four species together, milkfish and tilapia which were found to be competing for space and food. This in turn affected the quality of their harvest and income.

To address these problems, management interventions on better pond preparation, stocking, and harvesting were recommended. The combination of milkfish and giant tiger prawn in a polyculture was employed.

"The proposed management system was based on the recommended technology on the polyculture of milkfish and giant tiger prawn by noted authors, Kuntiyo and Baliao, and others ," explained Dr. Garcia.

In pond preparation, soil samples were taken and sent to the soil laboratory for analyses (organic matter, pH, nitrogen, iron, acetate soluble sulfate). The water inlets and outlets were installed with nylon screen to prevent loss of stocks and entry of unwanted species.

After drying the pond until cracks were visible, plowing and leveling were done to eliminate toxic gases, weeds, pests, and predators. Basal fertilization through the application of dried chicken manure (500 kg/ha), urea, and di-ammonium phosphate was conducted to induce the

growth of *lumot*, an algae that serves as food for the growing milkfish. Dried coconut leaves (50 pcs/ha) were also installed in the pond to serve as refuge for the prawns.

"Water was admitted gradually by gravity 5 cm at a time until stocking depth of 30 cm is reached in about 3 to 4 weeks to allow sufficient growth of natural food. In all, it takes a month to prepare the pond prior to stocking," the proponents explained.

Two-month old milkfish fingerlings and one-month old prawn juveniles were used for stocking. Feeding depended on the body weight and was adjusted monthly. Water quality parameters such as pH, temperature, dissolved oxygen, salinity, transparency, and water depth were monitored monthly as well as the growth of fish stocks. Practices such as fertilization, water management, and weed/pest eradication were also monitored regularly.

Harvesting was done after 120 days culture period. The stocks were sold to interested buyers and the ponds were drained afterwards. Soil samples were again taken for laboratory analyses. It is important that the fisherfolks keep records of the weight of the harvested stocks, as well as the previous sampling results in order to keep track of developments and to easily identify and resolve problems to improve quality and quantity.

"The project, if consistently successful, will become a model fish farming system in the municipality of Hagonoy and nearby coastal communities. What cannot be discounted also is the promise of long term sustainability since inputs and the entire technology package is environment-friendly," stated Dr. Garcia as a conclusion.

The project is currently on-going with seminars and training being conducted every after cropping period to inform and educate other fishermen in Brgy. San Pedro about the process and benefits of the technology. ■

For more information about the project, please contact Dr. Lilian C. Garcia, RFRDC Manager, BFAR Regional Office 3, Diosdado Macapagal Government Center, Maimpis, City of San Fernando, Pampanga. Tel. No: (045) 455-0824, Email: bfar_3@yahoo.com.ph

> "The project, if consistently successful, will become a model fish farming system in the municipality of Hagonoy and nearby coastal communities."

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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 National Research & Development System for Agriculture and Fisheries (NaRDSAF).

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Increasing profit from Bangus through processing technologies

by RITA T. DELA CRUZ

Milkfish (*Chanos chanos*), locally known as bangus, is an important food fish among Filipinos not only because it is the national fish of the country but mostly because it belongs to the very top of their diet, regardless of one's social status.

As a livelihood, milkfish production is a profitable source of income. In fact, in a paper authored by the group of Wilfredo G. Yap titled, "Milkfish Production and Processing Technologies in the Philippines," milkfish is considered the "superstar of Philippine aquaculture" owing to its relevance as the most important fish species being farmed in the country. It is cultivated in freshwater, brackishwater, and marine environments. According to Yap, milkfish provides, not only reasonably priced nutritious protein to millions of people in the Indo-Pacific region, but also livelihood opportunities to countless families engaged in aquaculture.

As an important fishery resource, production of milkfish in the Philippines for the last four years (2009-2012) has also been favorable, providing steady growth for the aquaculture industry. According to the Bureau of Agricultural Statistics, production in 2012 went up by 3.80 percent from 372,580.80 mt in 2011 to 386,728.92 mt. The increase was mainly attributed to good farm management, availability of quality fry/fingerling, and proper feeding practices.

Even with the steady growth of the industry, experts believe that it can still grow further particularly in the far-flung bangus-producing areas. A case in point is in Region 13 (CARAGA), particularly in Masao, Butuan, although not a leading producer, where the community heavily relies on bangus production. The area has both mariculture park and fishponds.

Mr. Miguel Baay of the Department of Agriculture- Bureau of Fisheries and Aquatic Resources (DA-BFAR) 13 revealed that bangus is the only species grown in both the mariculture park and in fish ponds due to its adaptability to both saline and non-saline environments. Bangus is also a wide-known species hence, it has become the main source of income of the families in the area. And because there is no processing plant within the community or anywhere near the CARAGA region, bangus can only be sold in fresh form in the market.

Hoping to provide additional source of income for those families living near mariculture parks and fishponds, Baay and BFAR CARAGA introduced interventions, particularly bangus processing technologies. The idea was realized through a project titled, "Community-based Participatory Action Research (CPAR) Program: Bangus Processing in Masao, Butuan City" which was initiated in 2011.

CPAR on Bangus Processing

The CPAR project on bangus processing was chosen because majority of the people in Masao is into bangus production. Bangus is mainly sold as fresh fish in the market as it will be an added cost for them to have it processed or deboned because there is no nearby processing plant in the area. Aside from the livelihood that will be generated with the establishment of a bangus processing plant in the community, the project will encourage more fishermen to go into bangus production. Moreover, operators with idle fishponds will return to bangus

production once the demand increases.

The project is implemented by the Department of Agriculture-Bureau of Fisheries and Aquatic Resources 13, CARAGA Fisheries Research and Development Center (CFRDC), led by its center manager, Mr. Miguel O. Baay. The project is being implemented as a community enterprise, to create livelihood opportunities, particularly for the housewives, on bangus processing.

One of the components of the project is the construction of a bangus processing plant which will serve as the center for bangus deboning for the fisherfolk in Masao.

The plant site was carefully chosen and was established in a vacant barangay lot which, according to Baay, is "free from flood and pollution, with adequate potable water supply, and most importantly, from where waste materials can be disposed of properly." The site is also strategically located near the fishpond areas and is accessible through regular transportation.

Deboning and Other Value-adding Processing Technologies

Bangus can be processed into various products using traditional, non-traditional, and value-adding technologies. Although these protocols were already standardized as early as 1978, they were adopted only recently, according to a WorldFish report.

Among the various processed bangus, deboned bangus is undoubtedly the most popular value-added milkfish product. It is sold fresh-chilled, smoked, marinated and chilled, or individually packed and frozen, enjoying a good market both locally and abroad. The Food and Agriculture Organization (FAO) reported that the Philippines is the only country in the world that produces boneless milkfish to date. The production of boneless bangus also paves the way to the rise of other value-added products as processors find ways to use the trimmings and bits of flesh that are invariably removed with the bones. These new milkfish products include fishballs, milkfish lumpia, quekiam, embutido, and chicharon from the skins.

Boneless bangus is a product of a tedious process involving the removal by hand of more than 170 inter-muscular bones. Deboning would seem to be a simple process for most other species of fish but not for milkfish.

One of the unique characteristics of milkfish that serves to limits its marketability is its numerous spines. According to Yap, "a milkfish has 43-44 epaxial intermuscular bones found on each side of the dorsal muscle, 22 -24 spines in between the muscle segments on each side, and two large arch-shaped spines, followed by approximately 19 Y-shaped spines and ending in three single delicate spines in the mid portion of the body on each side." He added that deboning makes milkfish more acceptable to a wider range of consumers so it is one way of value-adding. From the deboned bangus, it can be further processed into various smoked and frozen products to prolong its shelf-life and further widen its market.

Women Association of Expert Deboners

For the CPAR project, the objective is to establish a plant that will process bangus harvested from the mariculture parks and fishponds in Masao. Once fully established, the association will operationalize it and the fisherfolk can sell their harvested bangus directly to the processing plant.

Currently, the direct beneficiary of the CPAR project is the Bangus Processing Association, a group of 27 housewives in Masao. The association was formed and established in March 2013 after they completed their trainings on bangus processing technologies which is also a component of the project.

According to Mrs. Evangeline Ighot, president of the association and a cooperator of the project, their group envisions the processing plant as a means for the association to generate income as well as minimize the fluctuation of prices of bangus in times of abundant harvest. The association targets the region of CARAGA as one of the potential markets for deboned bangus. "Our barangay has a mariculture park consisting of about 72 cages and an estimated 50 fishponds," she reported.

To enhance the bangus processing capabilities of the cooperators/beneficiaries and to inculcate food safety among clients, a series of capability building training activities was conducted. The trainings were composed of: 1) Bangus processing and fish packaging and labelling, and 2) Food safety focus on Good Manufacturing Practices (GMP).

The first training was held on April 14-15, 2011 wherein the resource speakers were the Fish Processing Team from BFAR 13 and DOST Regional Office personnel. The topics included: proper handling of fresh fish; methods of fish processing; salt ratio and proportion; steps in bangus deboning; hands-on-training on deboning, marinating, drying and smoking soft-boned bangus; packaging and labelling; function of packaging; packaging development process; modern packaging concepts; purpose of labels; part of a label; and labelling requirements.

The second training which focused on GMP was held on 11 May 2011 with, Ms. Anna Melissa Talavera, chief of BFAR 13 Fish Health Laboratory, as lecturer. The training, according to Mr. Baay focused on compliance with a "set of rules, guidelines and practices related to hygiene and sanitation specific to plant location where the product is being manufactured. Specifically, the topics included: sanitation standard operation procedure, how do microorganisms get into the plant, Sanitation Standard Operating Procedures (SSOP) criteria, role of SSOP in the processing plant, plant hygiene, GMP, and key areas of GMP.

Currently, the group of Baay is complying with the Hazard Analysis and Critical Control points or HACCP, which is required prior to operation of the plant.

Through the establishment of a bangus processing plant, the association hopes to produce around 1,000 deboned bangus every month or 30 kg/day to provide a steady supply of processed fish in the area. But, according to Baay, in order to optimize the potential of the processing plant, they are hoping to increase their initial target. ■

For more information about the project, please contact Miguel O. Baay, Project Leader and Center Manager, CARAGA Fisheries Research and Development Center (CFRDC),BFAR 13, Masao, Butuan City. Tel. no. (085) 345-5214, email: rfrdc_caraga@yahoo.com

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Tilapia ice cream minus the "fishy" taste

With tilapia flakes as main ingredient, an ice cream without a fishy aftertaste was developed and produced by the Central Luzon State University (CLSU) led by Prof. Dana Vera Cruz, a professor at the College of Home Science and Industry. This endeavor according to Prof. Vera Cruz was a result of the challenge posed by Dr. Tereso Abella, director of the CLSU Freshwater Aquaculture Center (FAC)s, one of the agencies involved in the propagation of an improved breed of tilapia in the country.

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