The Role of S&T in the Formulation and Assessment of Selected Fishery Policies[1]

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ABSTRACT

Effective fishery policies invariably trace their roots from science-based assessment of the issues involved. Such assessment is characterized by a systematic process of problem identification, empirical examination of alternative solutions and a decision criterion designed to achieve the best possible outcome for the society at large. The paper discusses some concrete cases where S&T projects supported by PCAARRD became instrumental in the formulation and assessment of some important fishery policies in the country. The role of S&T is highlighted in each case and the paper concludes with a set of insights and recommendations on how such roles can further be strengthened.

INTRODUCTION

The world is changing rapidly and many of these changes are having profound effects on the environment, including our fisheries resources. Philippine fishery resources and biodiversity are at risk due to heavy exploitation and environmental degradation. Over the years, the practices of overfishing and illegal fishing remain persistent. Rampant disposal of solid wastes and discharge of chemical wastes have also become serious concern that puts inland aquatic resources in danger. Siltation and sedimentation of the water ecosystem due to deforestation, mining and other human activities have also caused shallowing of the riverbeds.

The primary reason for the undesirable state of fisheries resources is failure in governance (FAO, 2017). However, this responsibility should not be considered as solely of the government's. It is a responsibility that must be shared amongst fishers, fisheries management authorities, fishery and environmental scientists. With these pressing environmental concerns, fishery policy becomes more challenging because of its diverging impacts on food security, poverty alleviation and environmental sustainability. These interrelated problems need better connected policy responses based on more systematic and rigorous analysis of the underlying causes and possible solutions. The fisheries sector is one

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of the most important sources of food and livelihood in the country. Fish is the country's second staple food next to rice (PSA, 2017). Although its share to the gross domestic product is a mere 2%, the gross value added (GVA) at constant prices of the industry amounted to Php123 billion. In terms of employment, 1.3 million Filipinos (January 2016 Labor Force Survey) are engaged in fishing. Based on 2002 estimates, the labor force is comprised of 85% municipal fishers, 14% aquaculture and 1% commercial. Given the state of fishery resources, the municipal fishers who, more often than not, are marginalized groups, are also the most affected.

This paper will provide information on the significant role that science can play to inform policy. The right mix of policies is needed to improve the performance of the sector. We argue that science should be at the heart of policy making. As case study, this paper will look into selected S&T projects supported by PCAARRD and the contribution they made in the policy formulation and assessment of selected fishery polices. This includes initiatives on sardines, tuna, sea cucumber and coral reef management.

FISHERIES SITUATIONER IN THE PHILIPPINES

The Philippine fishery industry is composed of aquaculture, municipal, and commercial fisheries. Municipal fisheries refer to fishing done in inland and in coastal waters within 15 km from the coastline using vessels of 3 gross tons or less, or without the use of vessels. Commercial fisheries operate outside the municipal waters using vessels of more than 3 gross tons. Aquaculture involves aquatic organisms in fresh, brackish and marine waters.

The Philippines ranked 8th among the top fish producing countries in the world in 2014 with its total production of 4.7 million metric tons or about 2.4% of the total world fisheries production (Philippine Fisheries Profile, 2015). For the period 2014 to 2016, the average annual contribution of fishery to the country's gross domestic product (GDP) at constant 2000 prices amounted to 2% (PSA, 2017). In 2016, the gross value added (GVA) at constant prices of the industry amounted to Php123 billion, contributing 2% and 1% to the country's GDP and Gross National Income, respectively. Its share to the agriculture, fishery and forestry sector GVA is 17%. The industry employed a total of 1.3 million fishing operators in 2016 down by 305,995 in 14 years.

The total fisheries production in 2015 reached 4.6 million metric tons valued at 240 billion pesos (Table 1). Aquaculture fisheries produced greater proportion of the catch at 50.5% followed by municipal (26.2%) and commercial fisheries (23.3%). The foreign trade performance exhibited a net surplus of US$511 million from total export value of US$943 million and import value of US$432 million.

Table 1. Contribution by sector to total Philippine fisheries production, 2015.

Sector	Quantity (MT)	%	Value ('000 P)	%
Aquaculture	2,348,161.09	50.5	93,340,915.68	38.9
Municipal Fisheries	1,216,526.72	26.2	81,486,171.48	34
Commercial Fisheries	1,084,624.70	23.3	64,875,286.41	27.1
Total	**4,649,312.51**	**100**	**239,702,373.57**	**100**

Source: Philippine Fisheries Profile, BFAR, 2015

FISHERY POLICIES IN THE PHILIPPINES

Recent international developments underscore the importance of fisheries reform. The discussions among World Trade Organization (WTO) member countries are continuing to improve global disciplines for fisheries subsidies. Fisheries subsidies refer to government actions or inactions that are specific to the fisheries industry and that modifies— by increasing or decreasing— the potential profits by the industry in the short-, medium- or long-term (FAO, 2017). New proposals are being prepared for presentation at the WTO's upcoming Ministerial Conference in December 2017. Similarly, the World Summit on Sustainable Development has issued a call to phase out subsidies that inhibit sustainable development. This include subsidies that contribute to illegal, unreported and unregulated fishing and to over-capacity.

In the Philippines, there are four (4) main laws providing the governing and policy framework for the management of fisheries. These include the Philippine Fisheries Code of 1998 (Republic Act (RA) 8550) and its amendment (RA 10654); Local Government Code of 1991 (RA 7160); Agriculture and Fisheries Modernization Act of 1998 (RA 8435); and National Integrated Protected Areas System Act of 1992 (RA 7856).

The Philippine Fisheries Code is the primary legislation empowering the management of fisheries. It sets out the overarching policies and objectives to be pursued in the management of fisheries as well as powers to regulate municipal and commercial fisheries, aquaculture and post-harvest activity, create fisheries reserves, protect fisheries habitats and to impose sanctions. It also provides for the creation of the Bureau of Fisheries and Aquatic Resources (BFAR) which has the overall responsibility for fisheries management at the national level and the Fisheries and Aquatic Resource Management Council (FARMCs) whose function is to assist in the formulation of plans and policies for the management and development of fisheries and in the enforcement of laws. The amended Fisheries Code, on the other hand, provides for necessary and tougher mechanisms to curb the illegal, unreported and unregulated fishing (IUU).

In support of fishery management policies, the Fisheries Code also provides for the establishment of regulations addressing access to fishery resources and declaration of closed fishing seasons and catch ceilings for conservation and ecological purposes– based on available evidence.

For marine capture fisheries management at the municipal level, the management responsibility is demarcated to municipal local government units (LGUs) as mandated by the Local Government Code of 1991. Specifically, the municipal LGUs govern fisheries within their jurisdiction of 15-km radius. LGUs are expected to put in place ordinances to give effect to the national laws and add any local requirements.

While the Fisheries Code is resource conservation and management-oriented, the Agriculture and Fisheries Modernization Act of 1997 is development-oriented. AFMA focuses on improving and modernizing production and marketing services, infrastructure services and facilities in the rural areas such as irrigation and farm machineries and equipment, human development programs, research, development and extension, and trade policies.

The National Integrated Protected Areas System Act provides for the establishment and management of protected areas declared by the Congress or at least initially designated by the President as such. These areas as defined by the law refer to the "identified portions of land and water set aside by reasons of their unique physical and biological significance, managed to enhance biological diversity and protected against destructive human exploitation." However, overlapping provision can be observed in the NIPAS and Fisheries Code with

regards to the establishment of sanctuaries/fishery refuges of Marine Protected Areas (MPAs).

SCIENCE FOR POLICY

Scientific researches generate empirical evidences useful in the whole policy-making process. In fisheries for instance, the problem of overfishing and overexploitation started to climb the priority ladder of the fisheries policy agenda when empirical evidences from various scientific studies consistently showed alarming declines in the productivity of the fishery sector, especially capture fisheries. Policy formulation is more effective if the process is informed by scientific evidences related to the causes and effects of observed problems as well as well as the advantages and disadvantages of proposed and alternative solutions. Finally, policy impact evaluation necessitates the use of scientifically sound approaches to ensure complete objectivity and conclusiveness of the evaluation findings.

SCIENCE-BASED INFORMATION FOR POLICY-MAKING AND ASSESSMENT: THE CASE OF PCAARRD

PCAARRD's banner programs are carefully designed in a way where we can have the best impact on national development through S&T. To ensure that the development being pursued is sustainable, our research outputs are also aimed at influencing and fostering an enabling environment for the sector. With very limited information on certain issues, policy makers cannot make an effective decision. Armed with knowledge and information generated from high quality research, our research products can provide insights on the causes and possible solutions to important issues. We believe that communicating useful and informed results or by championing particular policy outcomes, science can simplify the choices facing our decision makers. Research products are widely disseminated through electronic and print media. Policy dialogue, seminars, roundtables, consultations, and workshops are organized for policy advocacy. The PCAARRD stance on certain policy issues that impact significantly on the AANR sector is espoused through participation in policy deliberations at the Senate/Congress committee hearings, policy forums/symposia, and seminars. We do not simply produce knowledge. We put evidence to work because well-articulated policies are more often a result of evidence-based research and strong advocacy.

Sardines

The history of overfishing is well-discussed in the available literature. In a review of overfishing in the Philippines, Israel et al. (2016) found that the country has already reached maximum economic yield (MEY) of its demersal or bottom dwelling stocks as early as in the 1960s and water dwelling fish species have been overfished with Catch per Unit Effort (CPUE) falling since the 1950s. It also highlighted the results of the ICLARM study (2001) which measured the economic losses of overfishing at about Php 6.25 billion or Php125 million in foregone catch annually for the period 1998 to 2001.

Overfishing was also found to constrain sustainable development of the sardine industry. As a result, drastically declining production was observed since 2009 (Table 2). In 2011, sharp decrease of about 50% was recorded which required much needed attention to resolve. Sardine is one of the most important commercially important fish species and more so in the Zamboanga Peninsula. The region is the center of the country's sardines industry producing 50 to 60% of the country's annual supply based on the 2006 to 2015 data.

Table 2. Volume of production of sardines, Philippines, 2006 to 2015 (in '000 MT)

Region	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PHILIPPINES	210	207	236	324	334	233	246	229	256	290
NCR	4	4	6	3	5	3	6	8	14	22
CALABARZON	14	18	14	13	14	9	7	3	4	7
MIMAROPA	18	16	15	15	15	13	13	12	10	10
Bicol Region	9	11	13	14	16	17	18	15	13	11
Western Visayas	9	10	9	8	8	7	8	6	6	7
Eastern Visayas	10	11	13	11	11	11	8	6	5	5
Zamboanga Peninsula	**112**	**99**	**126**	**222**	**223**	**133**	**143**	**136**	**162**	**182**
Northern Mindanao	10	10	12	12	15	15	18	19	19	21
Caraga	4	4	5	4	5	5	5	5	4	5
ARMM	10	9	9	11	13	13	12	12	12	13

Source: Philippine Statistics Authority, 2016.

The collapse in sardines population prompted the ban on commercial fishing during spawning season for three months (December 1 to March 1) per year for a period of three years to counter the effect of overfishing. A closed fishing season was promulgated pursuant to the Fisheries Code by virtue of Joint DA-DILG Administrative Order No. 1 series of 2011. The administrative order established conservation area for sardines in the portion of the East Sulu, Basilan Strait and Sibuguey Bay of about 4,078 square nautical miles or 13,987.15 square kilometers encompassing the western municipal/national waters of Zamboanga del Norte, the waters bordering south and eastern waters of Zamboanga City and southern portion of Zamboanga Sibugay (Fig. 1).

At the height of the debate on the establishment of the closed fishing season in 2011, DOST and PCAARRD commissioned a study to examine the scientific basis of the implemented management strategy. The program, *Development of robust tools for managing sardine fisheries in the Philippines: Zamboanga Upwelling-Bohol Sea System*, was a multi-agency collaboration of University of the Philippines (UP)- Marine Science Institute (UP-MSI), UP Visayas (UPV), Mindanao State University (MSU)- Naawan, MSU Iligan Institute of Technology (MSU-IIT), and Jose Rizal Memorial State University (JRMSU) under the leadership of Dr. Cesar Villanoy. The reproductive biology of sardines was studied to establish patterns of production, spawning and recruitment of fish stocks. Gonadal maturity patterns according to lunar cycles were determined. It was observed that spawning begins in December until late February in Butuan Bay and Macajalar Bay, and late October to December in Dapitan-Sindangan Bay. The pattern for Dapitan-Sindangan Bay appeared fragmented because only few samples were collected in some lunar phases because of the ban. Pattern of gonado-somatic index (GSI) validated that spawning of sardine species occur around the northeast monsoon (NEM) (Fig. 2). NEM winds in the northern coast of Zamboanga drives upwelling which increases chlorophyll *a* and triggers plankton abundance. Upwelling areas are known as productive and biologically rich (de Guzman, 2013). The result of the study, therefore, provides the scientific support to the period of the ban, that is, December to March.

As an offshoot of the above study, another study was commissioned by PCAARRD, this time to examine the overall impact of the policy. The project, Impact Assessment of the *Closed Fishing Season for Sardines in Zamboanga Peninsula* was conducted in March 2015 under the leadership of Dr. Agnes C. Rola of the University of the Philippines Los Baños (UPLB). A multi-disciplinary team was organized composed of biologist, agribusiness expert, policy and institutional expert, socio-economist and sociologist from UPLB, Western Mindanao State University (WMSU), and JRMSU to determine if the regulatory policy on

sardine fishing indeed achieved its goals and objectives, whether these were achieved in an efficient manner, and to account for spill-over effects of the policy. The study covered assessment in the change in landed catch, impact on the processing and manufacturing of sardines, impact on income and livelihood (employment) of the affected fisher folks and other relevant stakeholders, assessment of the attitudes of the communities, assessment of the role of institutions and the factors facilitating or constraining implementation of the policy, and estimation of the net benefits to the society.

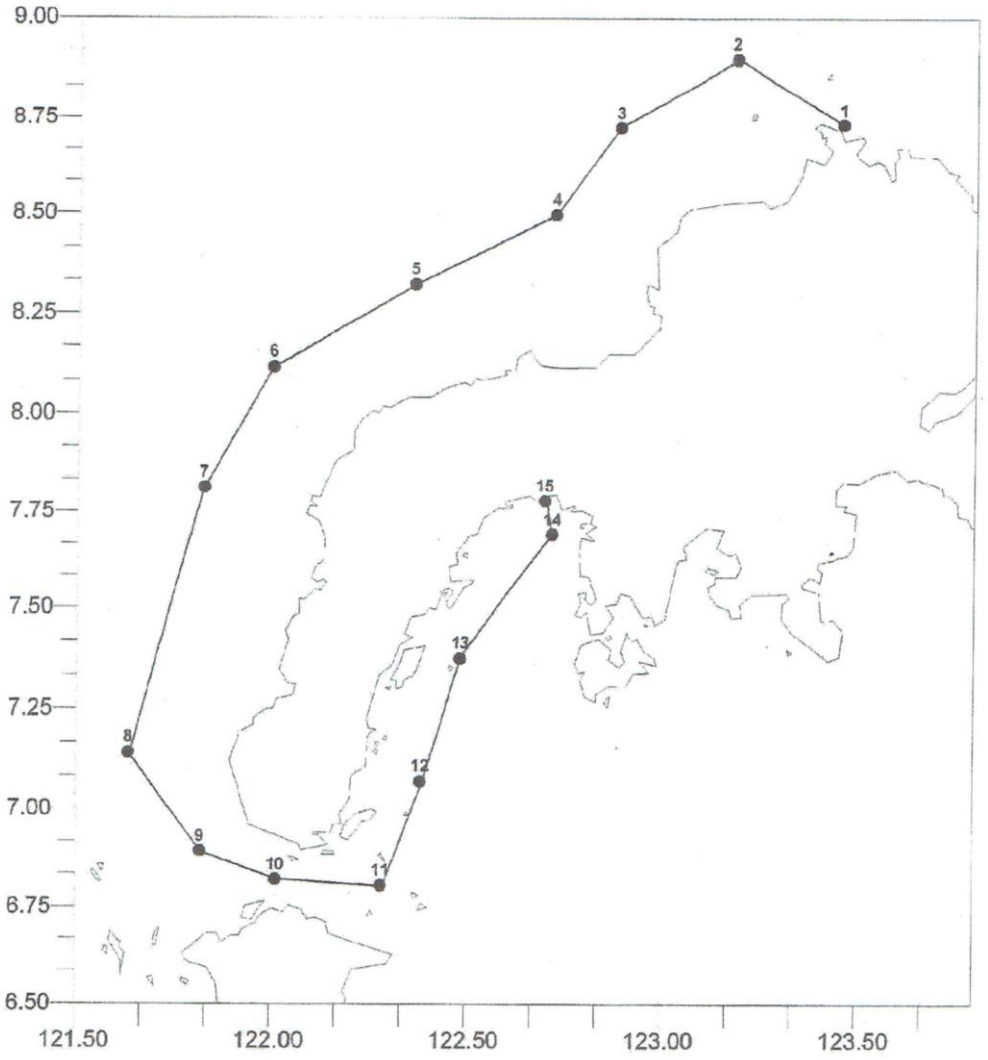

Fig. 1. Conservation areas for sardines in portions of East Sulu Sea, Basilan Strait and Zamboanga Sibugay

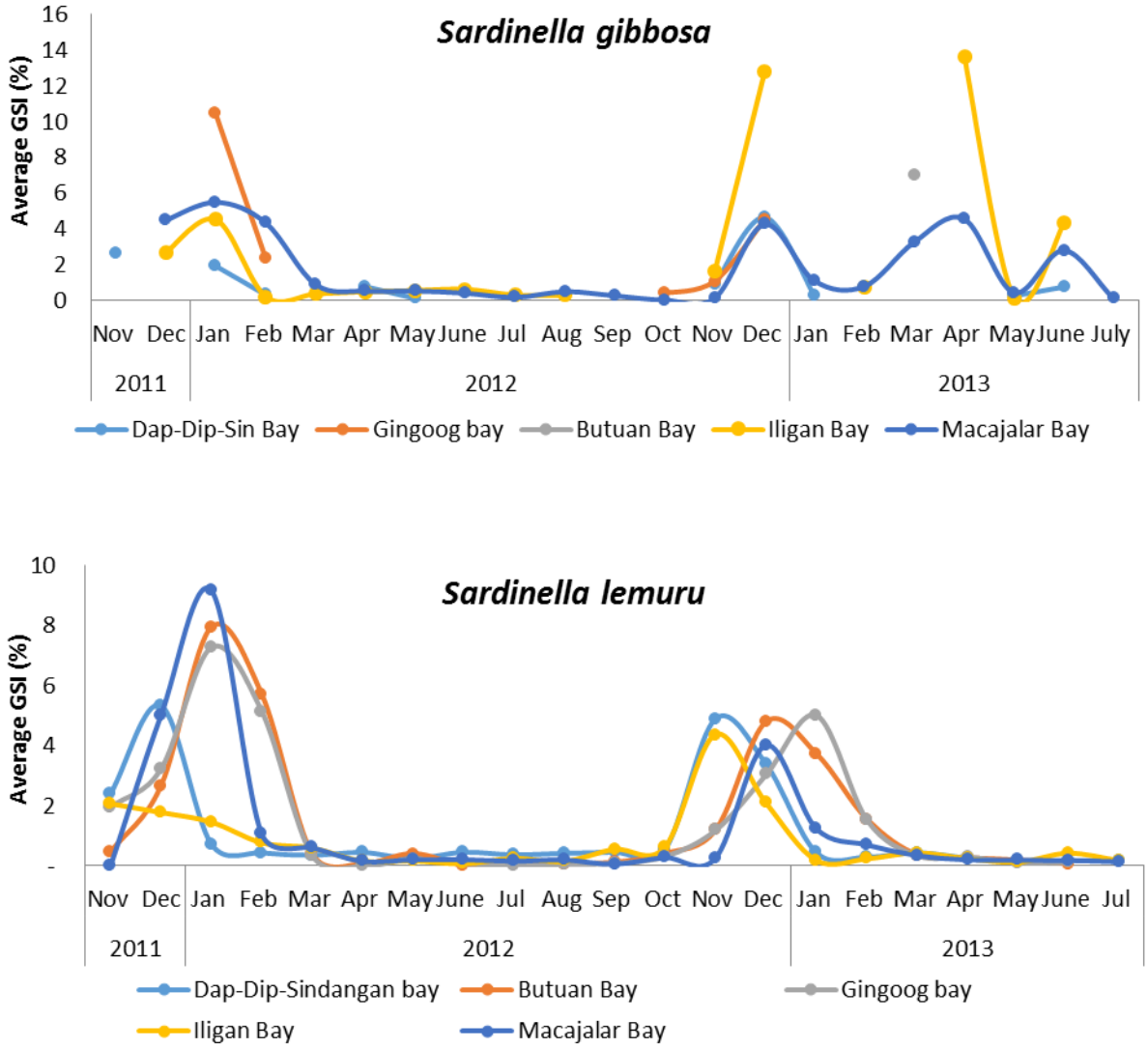

Fig. 2. Gonado-Somatic Index of two sardine species in the five bay sites of Northern Zamboanga Peninsula and Bohol Sea. (Source: de Guzman, 2013).

Results showed that there was an overall increase in the landed fish catch of sardines after the closed season months: for commercial fishery, 6%, -13% and 29% in the 1st, 2nd, and 3rd years of implementation and for municipal fishery 33%, 37% and 6%. In addition, increased values for high value non-sardine species were also observed. Consistently, the volume of canned and bottled sardines also increased by about 50% and 8%, respectively. Loss in factory wages during the closed season fishing months were estimated, on average, to be around P25,655 per household per year. Replacement jobs or alternative livelihoods were reported by most of the affected workers, which took them an average of 9 days to find. While it took around four months for the affected workers to be rehired, working hours and days increased during the open season earning for them overtime pay. Thus on the whole, the decrease in the household income from wages amounted to P1,530 only. If income from alternative sources during the closed season months were included, the total household income would be higher. In addition, the average number of workers in the canning industry initially decreased before it increased by 42% total average after the 2nd year, and by 15% in

the bottled sardine industry. These figures surpass the number of workers employed prior to the implementation of the policy.

The study also found that majority of the fishers know only about the policy in general, although only less than half understood the full details such as months covered, prohibited gears and penalties. Despite this, the fishers believed that the policy is important to increase fish stock, although concerns were raised on the provision of alternative livelihoods.

On the whole, the project found that there is positive impact to society, with the benefit cost ratio estimated to be 2.4. In general, the study recommends that the policy be continued.

Tuna

The Philippines is the world's fourth largest producer of fresh chilled and canned tuna products. The tuna industry accounts for 12% of total fish production and employs about 120,000 workers. Due to its high economic importance, rampant cases of juvenile fishing have been reported which led to decline in tuna stock. This prompted the Western and Central Pacific Fisheries Commission (WCPFC) to impose a two-year ban starting in 2010 on harvesting of tuna in Western Pacific areas. WCPFC is a treaty-based organization that aims to conserve and manage fish stocks in the Pacific Ocean. A couple of years prior to this, the Department of Agriculture issued Fisheries Administrative Order No. 226 series of 2008 as a conservation measure for juvenile tuna— particularly big eye and yellow fin. These two tuna-fishery resources have been exploited by purse-seine nets which have been observed to catch significant number of juveniles. The significant decline in the population is attributed to catching of juveniles by purse-seine nets. This type of fishing uses large fishing nets with rings at the bottom that is pulled together by a rope to prevent the fish from swimming down to escape the net.

The yellow fin tuna covers majority of the catch. The Philippine yellow fin tuna was believed to be part of a single stock of the greater Western and Central Pacific Ocean (WCPO) and jointly managed and fished by all members of the WCPFC (WCPFC, 2012). However, results of the DOST-funded program, *Management of Tuna Fisheries in the Philippines,* suggested otherwise. Initiated in 2010, researchers from the National Fisheries Research and Development Institute (NFRDI) conducted genetic characterization using DNA microsatellite markers which revealed that the Philippine yellow fin tunas are different from that of the Western and Central Pacific, particularly in the Bismarck Sea, Papua New Guinea. Comparison between the two yielded significant variation based on both genetic distances and pairwise differences (Aguila, 2015). This is possible given the biogeographical barriers such as eddies and upwellings as well as strong ocean currents like the North Equatorial Current on Philippine borders (Aguila, 2015). The depth of Philippine waters prevents tunas from crossing nearby areas. Variability in growth was also found with Philippine species indicating slower growth. The establishment of the genetic stock structure of the said species provided better scientific information to support conservation measures and management strategy.

More improvements still need to be made to raise tuna production that is anchored on sustainable development. In 2014, the European Union issued a yellow card warning to the Philippines due to its weak measures to fight IUU. As the world's largest importer of fisheries product, EU adopted the IUU Regulation in 2010. Under this regulation, fisheries products will not be allowed to access the EU market unless they are certified as legal. The yellow card is a warning call before trade sanctions are imposed. The imposition of trade sanction would have caused the Philippines over P9 billion pesos based on the 2013 value of exports. To avoid the ban, the Philippines was compelled to amend its Fisheries Code.

PCAARRD was among the members of the Technical Working Group (TWG) for the amendment of the Fisheries Code. PCAARRD supported the stricter regulations for IUU and now forms part of the Governing Board of the National Fisheries Research and Development Institute (NFRDI) which is the primary research arm of BFAR as mandated by the Law. The amended Fisheries Code lapse into law on February 27, 2015.

Sea Cucumber

The Philippines has the most diverse species of sea cucumbers but stocks are depleted due to unregulated harvesting. The open access nature of sea cucumber resources makes them vulnerable to overfishing. As a result, production has been declining from more than 4,000 MT in the 1980s to only 1,000 MT in the 1990s and now, to less than 1,000 MT. The widespread exploitation of undersized species was also reported as early as the late 1980s (Choo, 2008). While majority are exported, the Philippine sea cucumber products are mostly low-value species because of inappropriate sizes.

Having known these issues, the DOST funded the program, *Increasing Sea Cucumber Culture Production and Value for Dried Sea Cucumber Products*, in 2012 to reinvigorate the industry. The program aimed to establish a sustainable and globally competitive sea cucumber industry— one which provides equitable economic benefits to various stakeholders while maintaining a balance between productivity and biodiversity. The program was monitored by PCAARRD and implemented by UP-MSI and UPLB.

To reduce harvest pressures from the wild, sandfish culture technology was integrated with the existing marine aquaculture systems. Molecular approaches were utilized to delineate the population structure of sandfish (*Holothuria scabra*) to develop a framework for stock enhancement and restoration of natural populations. Partnerships were forged with private industries such as the Palawan Aquaculture Corporation and Alson's Aquaculture Production to increase production of premium-grade size sea cucumbers through the integration of sandfish in their hatchery and nursery production operations. Low-cost ocean nursery systems (i.e. floating hapas) were developed from readily available materials that can be easily replicated even by small-scale growers. Through this program, collaborators are now able to produce up to 10,000 release-size (>3 grams) sandfish juveniles per spawning batch. The *floating hapa* system was demonstrated to small-scale growers in Pangasinan, Palawan and Sarangani Province. Following its success, bottom-set cages and trays are being developed to mitigate seasonal constraints. In addition, a pilot communal sea ranch was established in Pangasinan in collaboration with Samahan ng Maliliit na Mangingisda ng Victory, Inc. (SMMVI) to optimize growth and survival of juvenile sandfish to reach harvestable size (320 grams).

Fig. 3. Bottom-set cages.

The results of the program served as important inputs in the finalization and approval of two important policies to achieve sustainable and globally competitive Philippine sea cucumber industry. In November 2013, BFAR issued Administrative Circular No. 248 which imposed size limits and required permits for trading sea cucumber to avoid overexploitation and encourage spawning of the species. It is now prohibited to gather, catch or trade fresh sea cucumbers that are below 320 grams and if in dried form, less than two inches.

The intervention on the production of cultured sandfish was complemented by technology package for postharvest processing to produce Class A premium grade *trepang*. The package includes degutting table, mechanical cleaner and hybrid dryer. Using the scientific information obtained from this, DOST and PCAARRD became instrumental in the development of the Philippine National Standards (PNS) for Dried Sea Cucumber, also in 2013. The attributes of the product include reduced microbial content, longer shelf-life and no foul odor. Given these, the Philippines is now able to command higher prices in both international and local markets.

National Assessment of Coral Reef Environment (NACRE)

The significant contribution of Philippine coral reefs to both global marine biodiversity and local economy has been constantly accentuated, yet corals remain massively threatened by both natural and anthropogenic stressors. Despite the continued deterioration of coral reef conditions, their specific responses to threats and ability to recover have not been fully documented and studied at a national scale in more recent times. The last intensive nationwide coral reef assessment was conducted in the late 1970s under the Investigation of Coral Reefs in the Philippines (ICRP) program, making the Philippines among one of the first countries to undertake a systematic inventory of its coral reefs. It is high time a new assessment be made- one that goes beyond updated information by taking into account the health of the associated seagrass and even mangrove habitats that operate together with coral

reefs for better conservation and management strategies of this resource. The ICRP benchmark standards needs to be updated.

To address this issue, PCAARRD funded a program, *National Assessment of Coral Reef Environments (NACRE)* in July 2014. The program is being implemented by the De La Salle University for three (3) years under the leadership of Dr. Wilfredo Y. Licuanan. Significant results have been developed including new scale to describe coral conditions (Table 3). The new scale is being adopted by the Department of Environment and Natural Resources (DENR) who is also undergoing assessment of coral reefs within the National Integrated Protected Areas System (NIPAS) sites through its program, Coral Reef Visualization and Assessment (CorVA) with views to quantify the impacts of marine protected areas (MPAs). However, the Fisheries Code still recognize the old benchmark. The next step is to lobby its amendment to incorporate the new scale to "ensure the rational and sustainable development, management and conservation of the fishery and aquatic resources in the Philippines."

Table 3. Previous and new scale to describe coral condition, 1970s and 2016.

Previous Benchmarks (Gomez *et al.*, 1981)	**New Benchmarks (Licuanan *et al.*, 2017)**	**Remarks**
0 – <25% (Poor)	0 – 22% (Poor)	Reefs in the Caribbean still accrete at 10% cover
25 – <50% (Fair)	>22 – 33% (Fair)	22% is the average for the Indo-Pacific in 2003
50 – <75% (Good)	>33 – 44% (Good)	33% is the average for Tubbataha in 2012-2014
75 – <100% (Excellent)	>44% (Excellent)	The highest in Tubbataha is 57% (identical methods)

Another important output of the program is the updated Red List of Corals to identify threatened and endangered species. The International Union for Conservation of Nature (IUCN) Red List index of species survival is illustrated in Figure 4. As the diagram shows, corals are in severe decline that the IUCN started to include them in 2007. In fact, many other corals are likely to be listed but lacked sufficient information to determine their status. The Philippines will be able to update this information based on the results of the study. Identifying the threatened and endangered species can help reverse this decline while also supporting the objectives of the Amended Fisheries Code.

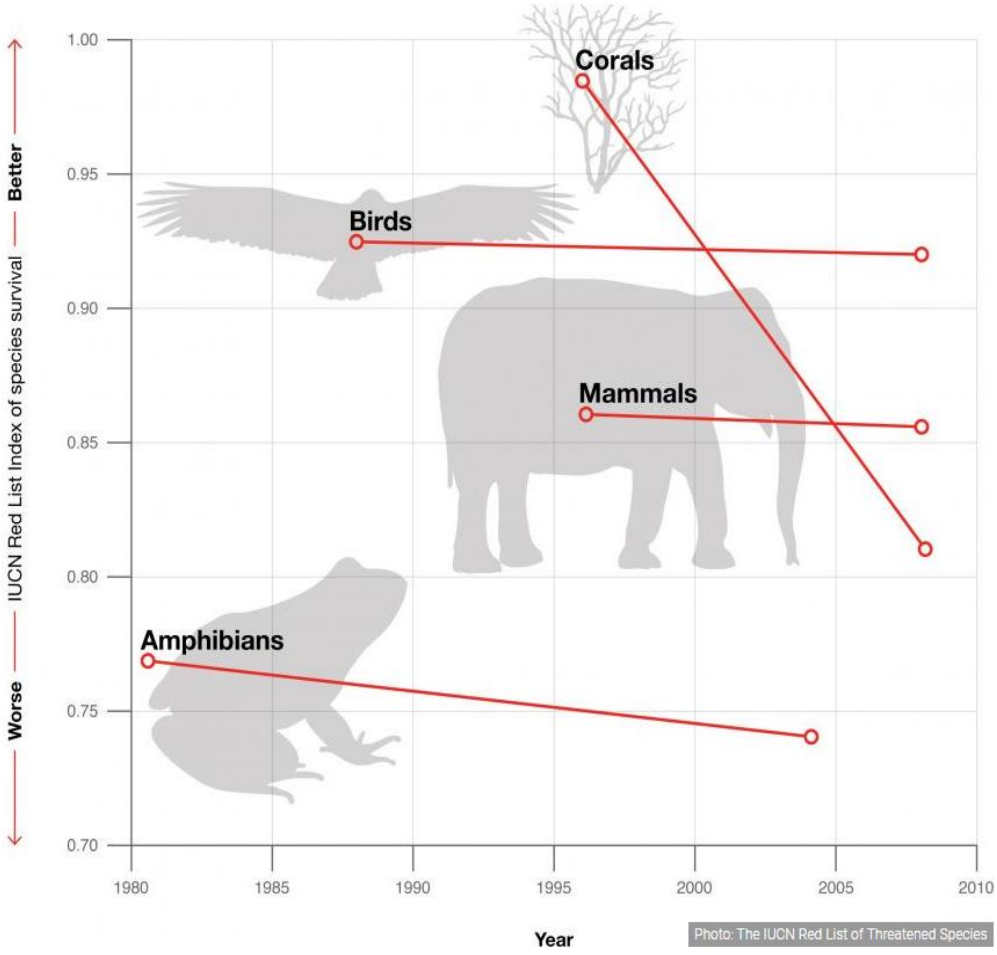

Fig. 4. The IUCN Red List Index of species survival

The program also provided information on appropriate mangrove reforestation practices such as the proper selection of species and planting materials. Similarly, the findings of the study may also provide inputs for species-specific management regulations for sharks and fishes for ornamental trade and improvement in the network design of MPAs.

Conclusion, Policy Insights and Recommendations

Science and Technology, especially the conduct of scientific researches addressing specific policy issues, has been shown in this paper to play a critical role in the whole policy-making process. In the case of sardines, results of studies funded by DOST/PCAARRD provided scientific basis for the period of the closed fishing season. In sea cucumber, the DOST/PCAARRD funded research projects on this commodity provided the strong empirical basis for regulating catch size. Scientific researches funded by DOST/PCAARRD on tuna yielded equally crucial policy significance which enabled better scientific information to support conservation measures and management strategies. Finally, in corals, DOST-funded projects on this commodity can even influence policy at an international level when the project was able to update the Red List of Threatened Species in the International Union for Conservation of Nature (IUCN). The corals project was also able to provide a new benchmark for the assessment of coral reef environment.

A well-informed policy-making process necessitates a complete set of empirical information relevant to a given issue. Such information can only come from scientific researches hence, the need for the S&T sector to play a very active part in supporting the policy-making process. In the case of fisheries, there is a need to continue supporting R&D projects that will input directly or indirectly to the major policy concerns of the sector. We can take advantage of the increasing investment in R&D to expand even more our support to these kinds of projects. Institutional capacity (both technical and manpower) to do fishery research should also be improved especially in the light of seeming disinterest among the youth (as shown in declining enrollment in AANR courses) in fishery courses. Finally, the utilization of research results should be enhanced among policy makers. This can be done by improving all the means by which outputs are disseminated (i.e. multi-media) as well as strengthening the linkage between the researchers and policy-makers.

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