NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY, PHILIPPINES

40th Annual Scientific Meeting

The Manila Hotel | July 11-12, 2018

SCIENCE AND **TECHNOLOGY-ENHANCED** TRANSFORMATION FOR SUSTAINABILITY AND RESILIENCY (2018-2030)

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Paper vector
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TABLE OF CONTENTS


1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
THE GLOBAL GOALS
For Sustainable Development
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE AND JUSTICE STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS

Republic of the Philippines

OFFICE OF THE PRESIDENT

Malacañan Palace, Manila

My warmest greetings to the **National Academy of Science and Technology, Philippines (NAST PHL)** as it holds its 40th Annual Scientific Meeting.

Our country's progress is assured when we have a robust crop of competent scientists and practitioners who have a thorough knowledge of the sciences. I am pleased to know that NAST PHL contributes to our national development by ensuring that our policies are in line with the currrent trends in science and technology.

I am confident that this event will spur fruitful discussions surrounding various scientific tools that will enhance our country's resiliency and sustainability. I look forward to seeing the outcomes of this momentous occassion as we continue to find ways on how to innovate and build our capacity towards a more inclusive Philippines.

May you, our talented scientists, inspire and encourage Filipinos so that they too may also engage in pursuits that will benefit their localities. Together, let us work hard as we pursue our shared goal of a brighter future for all.

I wish you a productive and meaningful gathering.

RODRIGO ROA DUTERTE

Republic of the Philippines

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Bicutan, Taguig City

Congratulations to the National Academy of Science and Technology, Philippines (NAST PHL) for successfully organizing the 40th Annual Scientific Meeting with the theme "Science and Technology-Enhanced Transformation for Sustainability and Resiliency (2018-2030)"!

Held annually, the ASM is an opportunity for scientific community - members of the academe, researchers, scientists, and government agencies to address the relevant issues related to science and technology. In line with the initiatives of the Department of Science and Technology (DOST) to support the ten-point economic agenda of President Duterte, NAST PHL has brought the ASM into the regions by conducting Regional Scientific Meetings in Luzon, Visayas, and Mindanao.

While DOST acts as the direction provider, leader, and coordinator of the country's scientific and technological efforts, NAST PHL which is a collegial body that recognizes outstanding achievements in science and technology, engages in projects and programs designed to promote scientific productivity, facilitates collaboration and communication with international linkages and scientific academies, and promotes a strong science culture in the Philippine society.

DOST is one with NAST PHL in establishing the foundation for inclusive growth, a high-trust society, and globally competitive knowledge economy.

I take this opportunity to commend NAST PHL for extending its reach to the regions as well as our hardworking scientists for their noteworthy concerns through their scientific researches and endeavors.

Let me also thank the regional directors of the DOST offices across the country who actively took part in making this ASM possible.

Mabuhay!

FORTUNATO T. DE LA PEÑA
Secretary

Republic of the Philippines

DEPARTMENT OF SCIENCE AND TECHNOLOGY

Bicutan, Taguig City

My warmest greetings to the National Academy of Science and Technology, Philippines (NAST PHL) for successfully organizing the 40th Annual Scientific Meeting!

Building on the experiences and lessons learned from achieving our Millennium Development Goals (MDGs), the Philippines is committed to the bigger challenges brought by the new, universal set of goals, known as the Sustainable Development Goals (SDGs).

In the country, the importance of attaining these goals was adopted in our medium-term development plans, which are based on the 0 -10 Socioeconomic Agenda, the Ambisyon Natin 2040. The theme, "Science and Technology-Enhanced Transformation for Sustainability and Resiliency (2018-2030)", is timely and relevant as there is still a great need for science and technology-based transformation in the country.

With this, I would like to commend NAST PHL for bringing the scientific meetings into the regions to provide a platform where stakeholders, researchers, and development practitioners can share their knowledge and best practices to help achieve greater science productivity and competency. Also, I would like to commend the DOST Regional Offices for their enthusiasm and commitment in making this activity a success.

Let us maximize the next two days to share our views and experiences and learn from each other so we can devise new and innovative strategies to contribute more to nation building.

BRENDA L. NAZARETH-MANZANO
Undersecretary for Regional Operations

Republic of the Philippines
NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY
Bicutan, Taguig City

On behalf of the Officers and Members of the National Academy of Science and Technology, Philippines (NAST PHL), I would like to welcome you all to the NAST 40th Annual Scientific Meeting (ASM) with the theme, **Science and Technology Enhanced Transformation for Sustainability and Resiliency (2018-2030).**

As a yearly tradition, the science community convenes and meets with public and private partners in development, to have a discourse on important and pressing issues facing our country. In this meeting we aim to hear the perspectives of our partners, the challenges they are experiencing, and come up with recommendations to help us efficiently and effectively reach our goals.

Translating scientific knowledge for utilization of the community to achieve sustainability and resiliency requires effort not only from the government but also from all sectors of the society. Synergy is one of the building blocks of development. This is the part where we need our partners the most as we endeavor to help the country in planning and implementing activities in line with the United Nations Sustainable Development Goals (SDGs).

I am hopeful that through this gathering, we will be able to come up with significant policy recommendations that can impact the development and improvement of the Filipinos' quality of life and well-being.

Allow me to thank all of our colleagues and partners from the science community, our distinguished National Scientists and Members of NAST PHL, officials of the Department of Science and Technology, honorable public servants, academic professionals, students, researchers, community development workers, and all the stakeholders for attending this event. Our sincerest thanks to our keynote and plenary speakers.

Again, welcome to the 40th Annual Scientific Meeting and mabuhay tayong lahat!

RHODORA V. AZANZA
President

ABOUT NAST PHL

The National Academy of Science and Technology, Philippines (NAST PHL) an attached organization to the Department of Science and Technology (DOST) was mandated to recognize outstanding achievements in science and technology and to serve as reservoir of competent scientific and technological manpower for the country. By virtue of Executive Order 818, the Academy was formally charged with the function of advisory body to the President and the Cabinet on policies concerning science and technology in the country.

At present, NAST PHL has 66 members called Academicians, 13 of whom were conferred with the Order of National Scientist by the President of the Republic of the Philippines.

NAST PHL members are clustered into six divisions, namely: Agricultural Sciences Division (ASD), Biological Sciences Division (BSD), Engineering Sciences and Technology Division (ESTD), Health Sciences Division (HSD), Mathematical and Physical Sciences Division (MPSD), and Social Sciences Division (SSD).

Collectively, the Academy represents the best of what the Philippines has produced in science and technology.

NATIONAL SCIENTISTS (1978-*present*)

JUAN S. SALCEDO JR.
Nutrition and Public Health (1978)

ALFREDO C. SANTOS
Physical Chemistry (1978)

GREGORIO Y. ZARA
Engineering and Inventions (1978)

FE V. DEL MUNDO
Pediatrics (1980)

EDUARDO A. QUISUMBIING
Plant Taxonomy, Systematics and Morphology (1980)

GEMINIANO T. DE OCAMPO
Ophthalmology (1982)

CASIMIRO DEL ROSARIO
Physics, Astronomy and Meteorology (1982)

GREGORIO T. VELASQUEZ
Phycology (1982)

FRANCISCO M. FRONDA
Animal Husbandry (1983)

FRANCISCO O. SANTOS
Human Nutrition and Agricultural Chemistry (1983)

CARMEN C. VELASQUEZ
Parasitology (1983)

TEODORO A. AGONCILLO
Philippine History (1985)

ENCARNACION A. ALZONA
Philippine History (1985)

HILARIO D.G. LARA
Public Health (1985)

JULIAN A. BANZON
Biophysical Chemistry (1986)

DIOSCORO L. UMALI
Genetics and Plant Breeding (1986)

LUZ OLIVEROS-BELARDO
Phytochemistry (1987)

JOSE ENCARNACION JR.
Economics (1987)

ALFREDO V. LAGMAY
Experimental Psychology (1988)

PAULO C. CAMPOS
Nuclear Medicine (1989)

PEDRO B. ESCURO
Genetics and Plant Breeding (1994)

CLARA Y. LIM-SYLIANCO
Biochemistry and Organic Chemistry (1994)

JOSE R. VELASCO
Plant Physiology (1998)

DOLORES A. RAMIREZ
Biochemical Genetics and Cytogenetics (1998)

GELIA T. CASTILLO
Rural Sociology (1999)

BIENVENIDO O. JULIANO
Organic Chemistry (2000)

CLARE R. BALTAZAR
Systematic Entomology (2001)

BENITO S. VERGARA
Plant Physiology (2001)

ONOFRE D. CORPUZ
Politicial Economics and Government (2004)

RICARDO M. LANTICAN
Plant Breeding (2005)

LOURDES J. CRUZ
Biochemistry (2006)

TEODULO M. TOPACIO JR.
Veterinary Medicine (2009)

MERCEDES B. CONCEPCION
Demography (2010)

ERNESTO O. DOMINGO
Internal Medicine/ Gastroenterology (2010)

PERLA D. SANTOS-OCAMPO
Pediatrics (2010)

RAUL V. FABELLA
Economics (2011)

BIENVENIDO F. NEBRES, SJ
Mathematics (2011)

ANGEL C. ALCALA
Biological Sciences, Humanities [h.c.] (2014)

RAMON C. BARBA
Horticulture (2014)

EDGARDO D. GOMEZ
Marine Biology (2014)

GAVINO C. TRONO JR.
Marine Botany (2014)

ACADEMICIANS

ESTRELLA F. ALABASTRO
Chemical Engineering

ELIEZER A. ALBACEA
Computer Science

PORFIRIO A. M. ALIÑO
Marine Chemical Ecology

RHODORA V. AZANZA
Botany

ARSENIO M. BALISACAN
Economics

JOSE MARIA P. BALMACEDA
Mathematics

ALLAN B. I. BERNARDO
Cognitive Psychology

CHRISTOPHER C. BERNIDO
Theoretical Physics

FILOMENA F. C.AMPOS
Plant Breeding/Cytogenetics

VERONICA F. CHAN
Microbiology/Virology

GISELA P. CONCEPCION
Marine Science

JOSE B. CRUZ JR.
Electrical Engineering

LIBERTADO C. CRUZ
Reproductive Biotechnology

VIRGINIA C. CUEVAS
Botany

ALVIN B. CULABA
Mechanical Engineering

ANTONIO MIGUEL L. DANS
Clinical Epidemiology

ROMULO G. DAVIDE
Nematology-Plant Pathology

FABIAN M. DAYRIT
Chemistry

ERNESTO J. DEL ROSARIO
Chemistry

SALCEDO L. EDUARDO
Veterinary and Medical Parasitology

RAFAEL D. GUERRERO III
Fisheries Management

EMIL Q. JAVIER
Plant Breeding and Genetics

JOSE O. JULIANO
Nuclear Chemistry and Physics

QUINTIN L. KINTANAR
Environmental Medicine

ALFREDO MAHAR F. A. LAGMAY
Geology

RODEL D. LASCO
Forestry

ANGEL L. LAZARO III
Civil Engineering

CEFERINO P. MAALA
Veterinary Medicine

AURA C. MATIAS
Industrial Engineering

MARCO NEMESIO E. MONTAÑO
Biological Chemistry

JAIME C. MONTOYA
Infectious Diseases

APOLINARIO D. NAZAREA
Biophysics

REMIGIO M. OLVEDA
Infectious and Tropical Medicine

CARMENCITA D. PADILLA
Genetics

WILLIAM G. PADOLINA
Phytochemistry

ACADEMICIANS

JURGENNE H. PRIMAVERA
Marine Science

EUFEMIO T. RASCO JR.
Plant Breeding

ASUNCION K. RAYMUNDO
Microbial Genetics/ Plant Pathology

AGNES C. ROLA
Agricultural Economics

CAESAR A. SALOMA
Applied Physics

FORTUNATO B. SEVILLA III
Instrumentation and Analytical Science

FERNANDO P. SIRINGAN
Geology

GUILLERMO Q. TABIOS III
Civil Engineering

MICHAEL L. TAN
Anthropology

RAYMOND GIRARD R. TAN
Mechanical Engineering

EVELYN MAE TECSON-MENDOZA
Biochemistry

WILLIAM T. TORRES
Computer Sciences

THELMA E. TUPASI
Infectious Diseases

FILEMON A. URIARTE JR.
Chemical Engineering

REYNALDO B. VEA
Marine Transportation Systems, Naval Architecture

CESAR L. VILLANOY
Physical Oceanography

RUBEN L. VILLAREAL
Horticulture

EDWARD H.M. WANG
Orthopaedics

CORRESPONDING MEMBERS

ALFONSO A. ALBANO
Physics

JOSEFINO C. COMISO
Physics

JOEL L. CUELLO
Agricultural and Biological Engineering

LIWAYWAY M. ENGLE
Genetics

MANUEL M. GARCIA
Microbiology

CARLITO B. LEBRILLA
Chemistry

EDUARDO R. MENDOZA
Mathematics

AMADOR C. MURIEL
Physics and Astronomy

BALDOMERO M. OLIVERA
Biochemistry

ENRIQUE M. OSTREA JR.
Pediatrics

EDUARDIO A. PADLAN
Biophysics

REYNALDO L. VILLAREAL
Plant Breeding and Plant Pathology

RATIONALE OF THE 40TH ANNUAL SCIENTIFIC MEETING

Theme: "Science and Technology-Enhanced Transformation for Sustainability and Resiliency (2018-2030)"

In line with the nation's sustainability and resiliency goals as recently echoed in the Philippines' "AMBISYON NATIN 2040" (Matatag, Maginhawa at Panatag), and the United Nation's Sustainable Development knowledge platform for 2018-2030, the Biological Science Division (BSD) of the National Academy of Science and Technology (NAST) has proposed the theme "Science and Technology-Enhanced Transformation for Sustainability and Resiliency (2018-2030)".

It can be recalled that the NAST has considered in its 2014 Round Table Discussions (RTDs) and 32nd Annual Scientific Meeting (ASM) Philippine achievements and challenges in relation to the United Nation's Millennium Development Goals (MDGs) set to be achieved by member countries in 2015. The 8 MDGs have been replaced by the UN General Assembly with 17 Sustainable Development Goals (SDGs) hopefully achievable by 2030.

The NAST ASM 2018 through RTDs and regional workshop/conferences considered science-based transformation of knowledge and research into potential goods and services for the Philippines' path towards sustainability and resiliency. Although focusing on the 2018-2030 SDG knowledge platforms, the transformative steps that shall be recommended or initiated shall draw from the challenges or gaps in the country's achievements of the 8 MDGs. The integrative and indivisible nature of the 17 SDGs and 3 pillars of sustainable development i.e., economic, social and environmental (protection) shall be ensured.

OBJECTIVES

1. Insightful review of the Philippine performances and achievements of the MDGs, and initiatives in relation to SDGs (6) Clean Water and Sanitation, (7) Affordable and Clean Energy, (11) Sustainable Cities and Communities, (12) Responsible Consumption and Production, and (15) Life on Land targeted for 2018-2030.
2. Make policy, action plans and other recommendations towards the Philippine's "robust voluntary, effective, participatory and integrated" fulfillment of Philippines of abovementioned SDGs.
3. Emphasize the country's effort and initiatives on SDG (16) Peace, Justice and Strong Intuitions and (17) Partnership for Goals in relation to other SDGs.

PROGRAMME

11 July (DAY 1), WEDNESDAY

8:00	Registration	
	OPENING OF POSTER SESSION & EXHIBITS	
8:30	Ribbon Cutting	DR. FORTUNATO T. DE LA PEÑA Secretary Department of Science and Technology ACADEMICIAN RHODORA V. AZANZA President, NAST Philippines CONGRESSMAN JOEY S. SALCEDA District Representative Albay, 2nd District House of Representatives
	OPENING CEREMONIES	
9:15	Entry of Colors	UP RAYADILLO
9:20	National Anthem	NOVO CONCERTANTE MANILA
9:25	Welcome Remarks	ACADEMICIAN RHODORA V. AZANZA President, NAST Philippines
9:40	Opening Message	DR. FORTUNATO T. DE LA PEÑA Secretary Department of Science and Technology
9:55	Introduction of the Keynote Speaker	ACADEMICIAN RHODORA V. AZANZA President, NAST Philippines
10:00	Keynote Address	CONGRESSMAN JOEY S. SALCEDA District Representative, 2nd District of Albay House of Representatives
10:50	Special Number	NOVO CONCERTANTE MANILA

Master of Ceremonies
ACADEMICIAN FABIAN M. DAYRIT
Vice President, NAST Philippines

11:00 **PLENARY SESSION 1: SUSTAINABLE AND RESILIENT COMMUNITIES FROM THE HIGHLANDS TO THE OCEANS**

Speaker : **ACADEMICIAN JURGENNE H. PRIMAVERA**
Member, Biological Sciences Division
NAST Philippines

OPEN FORUM

Moderator : **ACADEMICIAN ASUNCION K. RAYMUNDO**
Member, Biological Sciences Division
NAST Philippines

Rapporteur : **DR. MUDJEKEEWIS D. SANTOS, OYS 2011**
Scientist II
National Fisheries Research and
Development Institute (NFRDI)

12:00 Lunch and Viewing of Exhibits
MEETINGS:
NAST Member General Assembly

RECOGNITION OF SUPPORT FROM SPONSORS AND DONORS

1:00 **PLENARY SESSION 2: SUSTAINABLE INDUSTRIALIZATION AND INCLUSION**

Speaker : **NATIONAL SCIENTIST RAUL V. FABELLA**
Chair, Social Sciences Division
NAST Philippines

OPEN FORUM

Moderator : **ACADEMICIAN JAIME C. MONTOYA**
Chair, Health Sciences Division
NAST Philippines

Rapporteur : **DR. MARCOS B. VALDEZ JR., OYS 2012**
University Research Fellow
Far Eastern University

2:00 **PLENARY SESSION 3:** **FACTORING IN THE SDG'S IN PHILIPPINE GOVERNMENT PLANNING**

Speakers :

ACADEMICIAN GUILLERMO Q. TABIOS III
Member, Engineering Sciences and Technology Division
NAST Philippines

ASSISTANT SECRETARY **RAFAELITA M. ALDABA**
Industry Development and Trade Policy Group (IDTPG)
Department of Trade and Industry

OPEN FORUM

Moderator :

ACADEMICIAN REYNALDO B. VEA
Chair, Engineering Sciences and Technology Division
NAST Philippines

Rapporteur :

DR. ALLAN N. SORIANO, OYS 2011
Professor
School of Chemical, Biological, and Materials Engineering and Sciences
Mapua University

3:00 **PLENARY SESSION 4:** **UPDATE ON THE 39TH ASM RESOLUTIONS and DEVELOPING OUR COASTAL AND OCEANIC AQUACULTURE FOR FOOD SECURITY AND LIVELIHOOD GENERATION**

Speaker :

ACADEMICIAN RAFAEL D. GUERRERO III
Member, Agricultural Sciences Division
NAST Philippines

OPEN FORUM

Moderator :

ACADEMICIAN EUFEMIO T. RASCO JR.
Chair, Agricultural Sciences Division
NAST Philippines

Rapporteur :

DR. ALETTA CONCEPCION T. YÑIGUEZ, OYS 2017
Assistant Professor, The Marine Science Institute
University of the Philippines Diliman

MEETING :

3:00 Best Scientific Poster Board of Judges

4:00 Resolutions Committee

12 July (DAY 2), THURSDAY

8:00 Registration

8:30 PRESENTATION OF RESEARCH RESULTS OF NAST AWARDEES (FUNDED BY THE DEPARTMENT OF SCIENCE AND TECHNOLOGY)

"DOST Funding Mechanism with focus on Grants-in-Aid Program"	DR. ROWENA CRISTINA L. GUEVARA Undersecretary for Research and Development Department of Science and Technology
BIOLOGICAL SCIENCES DIVISION: "Connectivity of coral reefs and other nearshore habitats: implications for marine resource management in the Philippines"	DR. RENE A. ABESAMIS, OYS 2013 Research Officer Angelo King Center for Research & Environmental Management Silliman University
BIOLOGICAL SCIENCES DIVISION: "Vulnerability assessment to landslides and flooding along the Sta.Rosa-Silang riverine system using LIDAR and GIS-based hydrological modeling technologies"	DR. DAMASA M. MACANDOG, OYS 1997 Institute of Biological Sciences University of the Philippines Los Baños
ENGINEERING SCIENCES AND TECHNOLOGY DIVISION: "Development of an Optimization model for Identifying Efficient Water Re-Use Opportunities in Industrial Parks"	DR. KATHLEEN B. AVISO. OYS 2013 Professor De La Salle University
MATHEMATICAL AND PHYSICAL SCIENCES DIVISION: "Volume holographic reconstruction of Bessel beams using multiple wavelengths"	DR. RAPHAEL A. GUERRERO, OYS 2013 Associate Professor Ateneo de Manila University
SOCIAL SCIENCES DIVISION: "Effects of Media Depictions of Corruption on Political Efficacy and Engagement"	DR. CLARISSA C. DAVID, OYS 2015 College of Mass Communication University of the Philippines Diliman

11:30 OPEN FORUM

Moderator	:	ACADEMICIAN VIRGINIA C. CUEVAS Member, Biological Sciences Division NAST Philippines
Rapporteur	:	DR. MARIBEL L. DIONESIO-SESE, OYS 1995 Immediate Past President Outstanding Young Scientists, Inc.

12:30 LUNCH

Viewing of Posters and Exhibits
MEETINGS:
a) Best Scientific Poster Board of Judges
b) Resolutions Committee

1:30 AWARDING AND CLOSING CEREMONIES

Processional

2:00	Presentation of Resolutions	NATIONAL SCIENTIST EDGARDO D. GOMEZ Member, Biological Sciences Division NAST Philippines
	Response	DR. FORTUNATO T. DE LA PEÑA Secretary Department of Science and Technology MR. EPIMACO V. DENSING III Undersecretary for Operations Department of the Interior and Local Government SECRETARY ROY A. CIMATU Department of Environment and Natural Resources
2:30	Special Number	CEU SINGERS MANILA

3:00 **Presentation of NAST Awards**

BEST SCIENTIFIC POSTER AWARD	ACADEMICIAN SALCEDO L. EDUARDO Chair, Scientific Poster Board of Judges Member, Biological Sciences Division NAST Philippines
2017 GEMINIANO DE OCAMPO VISIONARY AWARD FOR MEDICAL RESEARCH	ACADEMICIAN JAIME C. MONTOYA Secretary, NAST Philippines
OUTSTANDING SCIENTIFIC PAPERS AWARD	NATIONAL SCIENTIST DOLORES A. RAMIREZ Member, Agricultural Sciences Division NAST Philippines
OUTSTANDING BOOKS/ MONOGRAPHS AWARD	NATIONAL SCIENTIST DOLORES A. RAMIREZ Member, Agricultural Sciences Division NAST Philippines
2017 THE WORLD ACADEMY OF SCIENCES (TWAS) PRIZE FOR YOUNG SCIENTIST IN THE PHILIPPINES	NATIONAL SCIENTIST DOLORES A. RAMIREZ Member, TWAS Awards Committee Member, Agricultural Sciences Division NAST Philippines
2017 MAGSAYSAY FUTURE ENGINEERS/TECHNOLOGISTS AWARD	ACADEMICIAN ANGEL L. LAZARO III Chair, Board of Judges, Magsaysay Engineers/Technologists Award Member, Engineering Sciences and Techonology Division NAST Philippines
NAST TALENT SEARCH FOR YOUNG SCIENTIST AWARD	NATIONAL SCIENTIST RAUL V. FABELLA Chair, Board of Judges, Talent Search for Young Scientist Award Chair, Social Sciences Division NAST Philippines
NAST ENVIRONMENTAL SCIENCE AWARD	ACADEMICIAN RHODORA V. AZANZA Chair, Board of Judges, NAST Environmental Science Award Chair, Biological Sciences Division NAST Philippines
OUTSTANDING YOUNG SCIENTISTS AWARD	ACADEMICIAN REYNALDO B. VEA Chair, Engineering Sciences and Techonology Division NAST Philippines

INVESTITURE OF NEW ACADEMICIANS	ACADEMICIAN RHODORA V. AZANZA President, NAST Philippines ACADEMICIAN FABIAN M. DAYRIT Vice President, NAST Philippines
OATH TAKING OF NEW ACADEMICIANS	
Administered by	DR. FORTUNATO T. DE LA PEÑA Secretary Department of Science and Technology
Closing Remarks	ACADEMICIAN FABIAN M. DAYRIT Vice President, NAST Philippines
Exit of Colors	UP RAYADILLO

Master of Ceremonies
ACADEMICIAN JAIME C. MONTOYA
Secretary, NAST Philippines

KEYNOTE SPEAKER

CONGRESSMAN JOEY S. SALCEDA

District Representative Albay, 2nd District
House of Representatives

Representative Joey Sarte Salceda has been voted unopposed to his 1st term as Congressman of the Second Congressional District of Albay. He is currently the Senior Vice Chairperson of the House Committee on Ways and Means, and Vice Chairperson of 3 other committees, namely: Committee on Appropriations, Committee on Economic Affairs and Committee on Local Government.

He was a 3-term Governor of Albay, and unopposed in four of six gubernatorial elections. He was also a 3-term Chairman of Regional Development Council (RDC) of Region V having been nominated alone for the position.

Under his leadership as Governor, the Province of Albay has just been judged by the DILG as the Best Province in Local Governance, ranking no. 1 among the 80 provinces. Its disaster management body, the Albay Public Safety and Emergency Management Office (APSEMO) is a pioneer in Asia, leading the Province of Albay to its Galing Pook Award for Outstanding Governance Program on Disaster Preparedness; and the Gawad Kalasag Hall of Fame Award for Best Disaster Risk Reduction and Management Council for three consecutive years. This year, the Province of Albay was declared by UNESCO as a Biosphere Reserve; was awarded with Manuel L. Quezon Achiever's Award from Department of Health for its implementation of the National Tuberculosis Control Program and for achieving a tuberculosis-free province; and was also awarded with Tourism Star Philippines Award from Department of Tourism for internationally recognized efforts in the growth of its tourism industry.

Congressman Salceda has been a member of the Board of the Green Climate Fund (GCF), the finance arm of the United Nations Framework on Climate Change Convention (UNFCCC). He was its Co-Chairperson (for Developing Countries) – the first Asian to chair the GCF, which was established by the Conference of the Parties to the UNFCCC in December 2011, intended to help developing countries adapt to the impacts of climate change. He was also acknowledged as the First Senior Global Champion on Disaster Risk Reduction and Climate Change Adaptation by the United Nations International Strategy for Disaster Reduction (UN-ISDR).

Congressman Salceda also pioneered the establishment of the Climate Change Academy, the first in the country. He is recognized as the "Green Economist" and the father of the "Albay and Manila Declarations on Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)"; the declarations that paved the way for the enactment of the Republic Act 9723 (The Climate Change Act of 2009) and Republic Act 10121 (The National Disaster Risk Reduction and Management Act). These laws established disaster risk reduction and climate change adaptation as both a national and local priority for building community resilience to climate change impacts and disasters.

PLENARY SESSION 1
CLIMATE RESILIENCE WITH FOCUS ON COASTAL COMMUNITIES

EXECUTIVE SUMMARY
by **Jurgenne H. Primavera, Ph.D.**

Although a child of Mindanao, the Marawi Rebellion of 1972 abruptly ended 10 idyllic years of teaching and raising children at the Mindanao State University. It forced my growing family, like other internal refugees, to seek the peace and quiet of Iloilo in the Visayas, first to do research and extension in shrimp culture at the SEAFDEC Aquaculture Department for 37 years, then to shift to mangroves and the environment with the NGO Zoological Society of London after my retirement in 2007. Therefore the lessons and recommendations shared in this presentation have been distilled from over four decades of R&D work in brackishwater and marine aquaculture, and in mangrove and beach forest conservation and rehabilitation.

Increasing typhoon intensity, if not frequency, and sea level rise are impacts associated with climate change whose mitigation requires the protection of mature mangrove stands through ecoparks (for carbon sequestration) because mangroves capture C at rates 4-5 times higher than terrestrial forests. On the other hand, adaptation requires the rehabilitation of degraded fringing mangroves to maximize storm protection as the Philippines is visited by more than 20 storms yearly. By the turn of the century, more frequent supertyphoons had increased damage and casualties – from a yearly average of only 100 dead+missing as of 2003 and US$380 million as of 2008, to a per typhoon record of ~3,000 dead + missing from 2011 Typhoon Sendong, and PhP1 billion from 2012 Typhoon Pablo. And ~15,000 dead+missing and US$12-15 billion damage from Typhoon Yolanda in 2013.

A 100-m wide greenbelt will reduce energy of wind and swell waves by 13-60% (McIvor et al, 2012), coinciding with a 1986 government regulation which requires a 100-m mangrove width along shorelines in storm surge areas. Where only 50 m are suitable for mangrove planting, the required 100-m band can be completed by supratidal beach forests. Many beach trees can tolerate salt spray, strong winds, low nutrients, and grow up to 200 masl, making them suitable for lowland reforestation as well, including big-scale projects such as the National Greening Program (NGP).

Unfortunately, protocols for NGP and similar programs prescribe the planting of **bakhaw** *Rhizophora* species instead of the naturally dominant **piapi/bungalon** *Avicennia marina* and **pagatpat** *Sonneratia alba,* in the lower intertidal (especially seagrass beds) instead of the upper to middle intertidal zone. This misguided preference for **bakhaw** is Planting by Convenience, not by Ecology because their large propagules are easily sourced and planted (described in Cebuano as *Tusok d Tongki*). A confluence of factors – massive funding, limited coastal planting area and problematic tenure issues of abandoned ponds – has led to the default mode of planting **bakhaw** on seagrass beds – the wrong species in the wrong sites. Success indicators emphasize quotas (e.g., number of hectares and mangroves to be planted) rather than mangrove survival. Hence there is urgent need for the following (Primavera et al., 2012b):

a) prioritize the reversion of abandoned fish/shrimp ponds to mangroves over seafront planting
b) where seafront planting is necessary, plant dominant **piapi/bungalon** and **pagatpat** rather than **bakhaw**, at middle to upper intertidal elevation
c) international and national development agencies should undergo a paradigm shift in defining success as new forest area rather than target area planted

Moreover, a 4:1 mangrove-pond ratio is required for mangrove health and aquaculture sustainability (Saenger et al., 1983). It is the reversion of abandoned ponds (which used to be mangrove forests) that will provide the hectarage needed to restore the present ~1:1 ratio back to 4:1, so we need to redirect the massive application of resources away from socio-politically convenient but ecologically unsuitable seafronts (Primavera et al., 2012a).

SPEAKER

ACADEMICIAN JURGENNE H. PRIMAVERA

Member, Biological Sciences Division
NAST Philippines

Jurgenne Primavera has B.S. Zoology, Ph.D. Marine Science (University of the Philippines Diliman) and M.A. Zoology (Indiana University) degrees. She taught at the Mindanao State University, but a rebellion made her growing family flee to relative peace in Iloilo, central Philippines and a job with the SEAFDEC Aquaculture Department. From her 1980s studies, she rang early warning bells on the perils of unplanned aquaculture. Her research shifted to the mangrove-penaeid shrimp connection and mangrove-friendly aquaculture for which she was conferred a Ph.D. in Science honoris causa by Stockholm University in 2004.

Over almost five decades, Dr. Primavera has added to the body of scientific knowledge and raised the profile of aquaculture, mangroves, beach forests and the Agusan Marsh not only in the country but also worldwide by means of ~140 scientific papers, reviews, manuals, books and other publications (mostly as senior author, and 50% peer-reviewed).

She has also given ~280 keynote lectures, presentations, panel contributions in national and international conferences, seminars, consultations and meetings on aquaculture, fisheries, mangroves, and the environment; organized various conferences/workshops; served as officer/member/trustee of environmental organizations; and undertaken consultancy work for UN-FAO/UNDP, Asian Development Bank and other international agencies.

She was elected to the Swedish Royal Academy on Agriculture and Forestry, Royal Belgian Academy for Overseas Sciences, Phi Kappa Phi, and other honor societies. Among her awards are the Dr. Elvira Tan Memorial Award (PCAMRD) for Best Paper in Aquaculture/Fisheries (1988, 1994, 2000 and 2004); Quadrennial General Assembly Award of the United Church of Christ in the Philippines (2006); and a Pew Fellowship in Marine Conservation (2004). She was named Scientist Emerita of SEAFDEC/AQD upon retirement in 2007, a Time Magazine Hero of the Environment and DOST Men and Women of Science Awardee both in 2008, a University of the Philippines Distinguished Alumni Awardee in Environmental Conservation and Sustainable Development in 2009, and membership to the National Academy of Science and Technology in 2015.

Approaching the end of an active and fruitful career in science, she tends a frontyard nursery of native plants, protects a 20-year old rehabilitated forest in Miagao, Iloilo, and continues to restore another mini-forest in nearby Oton. Presently she is Chief Mangrove Scientific Advisor of the Zoological Society of London. More recently, she led a joint academe-NGO survey team that assessed post-Haiyan mangrove damage and recovery in Eastern Samar and Leyte.

MODERATOR

ACADEMICIAN ASUNCION K. RAYMUNDO

Member, Biological Sciences Division

NAST Philippines

Dr. Asuncion K. Raymundo was elected an Academician to the National Academy of Science and Technology, Philippines (NAST PHL) in 2002 for her significant scientific contributions in the field of microbial genetics research and education in the country.

Dr. Raymundo obtained her B.S. Agriculture *cum laude* (Soil Microbiology) (1966), from the University of the Philippines Los Baños, MS in Plant Pathology (1969) from the University of Hawaii, and Ph.D. in Plant Pathology (1980) from the University of Illinois Urbana (1980). She undertook postdoctoral research in microbial/molecular genetics at Monash University in 1986, Osaka University (1987) and the International Rice Research Institute (1988-1990). She joined UPLB as research instructor in 1966 and worked her way to Professor. She served as Director of the Institute of Biological Sciences (1998- 2006) and Dean of the College of Arts and Sciences (2006-2011) and was appointed as Professor Emeritus on retirement in 2011. Among the awards Dr. Raymundo has received are the following: National Research Council of the Philippines Distinguished Award in Biology; UPLB Outstanding Teacher Award; UPLB Outstanding Researcher Award; PCARRD Pantas Outstanding Researcher Award; and Republica Award given by the Commission of Higher Education.

RAPPORTEUR

DR. MUDJEKEEWIS D. SANTOS, OYS 2011

Scientist II

National Fisheries Research and Development Institute

Dr. Mudjekeewis D. Santos is a Fishery Scientist, recognized nationally and internationally for his work on utilizing genetics and resource assessment to support fisheries management and aquaculture for food security, conservation and climate change adaptation. He is affiliated with the National Fisheries Research and Development Institute, with a rank of Scientist II conferred by the Scientific Career Council. He is likewise a Faculty (part-time) at the Graduate School of the University of Santo Tomas and Ateneo

Dr. Santos obtained his B.S. Biology from the University of the Philippines College Baguio, and his M.S. in Aquatic Biosciences and Ph.D. in Applied Marine Biosciences from the Tokyo University of Marine Science and Technology. He has published more than 80 international and national scientific articles and mentored a number of M.S. and Ph.D. students. He is currently an Editor of the international journal Fisheries Science published by the Japan Society for Fisheries Science, and is the Editor-in-Chief of the recently revived The Philippine Journal of Fisheries. Dr. Santos is a recipient of numerous national and international awards.

PLENARY SESSION 2
SUSTAINABLE INDUSTRIALIZATION AND INCLUSION

EXECUTIVE SUMMARY
Raul V Fabella, Ph.D.

The Philippine economy has a history of boom-and-bust. In the second half of the 20th century we had an economic crisis, mostly a (bop) payments crisis, with a periodicity of about ten years. An unsustainable industrialization path is one where episodes of rapid growth (booms) is followed by episodes of rapid decline (busts). Growth is spasmodic: a succession of boom and bust resulting in a long-term average low economic growth, slow and uneven industrialization and high poverty incidence. Spasmodic growth results from making the Service secor the engine of growth. The Service sector is prone to speculative booms (real estate and stock market booms) followed by busts which comes about because the narrow domestic market cannot absorb the Service sector output (under-consumption crisis). Likewise, the Service sector led growth is likely to incur trade and thus BOP deficits leading to a BOP crisis. Either or both can shorten the duration of economic expansion. By contrast, industrialization path where Tradables (Manufacturing) outpaces the Services sector depending as it does on the vast global market demand and is less likely to be demand constrained; it is also likely to earn enough forex to sustain its purchases from abroad (smaller trade deficit and BOP surplus). Service sector led growth in a low income economy is what we call *development progeria*. East Asian economies, which avoided development progeria, sustained rapid growth for long durations and attained *miracle* status. We investigate the inclusion performance of manufacturing-led growth.

SPEAKER

NATIONAL SCIENTIST RAUL V. FABELLA
Chair, Social Sciences Division
NAST Philippines

National Scientist Raul V. Fabella is the former Dean of the UP School of Economics and Executive Director of the Philippine Center for Economic Development. He has done pioneering works on novel analytic constructs that provide to be useful for problems in economics. His research studies covered the micro-economics phenomena that can be exemplified using Game Theory: teams and partnerships; rent-seeking and lobbying games; the East Asian model; exchange rate value measurement; regulatory games; problem at the boundary between the state and the market such as market and government failures; and economic history outcomes. NS Fabella obtained his undergraduate degree in Philosophy at the Seminario Recoletos (1970) and his master's degree in Economics at the University of the Philippines Diliman (1975).

He then finished his doctorate in Economics at the Yale University (1982). His significant achievements are sterling testimonies for succeeding generations of Filipino scholars and academics in the combat against poverty in all of its dimensions. Dr. Raul V. Fabella was elected to the National Academy of Science and Technology as Academician in 1995 and was conferred the highest rank and order of National Scientist in 2011 by the President of the Republic of the Philippines.

MODERATOR

ACADEMICIAN JAIME C. MONTOYA

Chair, Health Sciences Division

NAST Philippines

Jaime C. Montoya, M.D., M.Sc., Ph.D., CESO III has spent more than twenty years working on infectious diseases and public health. He is highly trained Infectious Disease Specialist with M.Sc. and Diploma in Clinical Tropical Medicine from the London School of Hygiene and Tropical Medicine, M.Sc. in Bioethics from the University of the Philippines and Ph.D. in Medicine from the Juntendo University School of Medicine, Tokyo, Japan. He holds a Doctor of Medicine degree from the University of the Philippines. He is also a public health expert with extensive experience in program implementation of tuberculosis control and control of emerging infections through several years of consultancy work at the Department of Health particularly during the SARS epidemic in 2003.

As an international expert, he successfully formed the ASEAN Network for Drugs, Diagnostic and Vaccines Innovation (ASEAN-NDI) with the help of ASEAN and WHO-TDR. He is a recipient of numerous awards in the fields of medical research, education, medical writing, medical society leadership and community service.

At present, he is the Executive Director of Philippine Council for Health Research and Development – Department of Science and Technology (PCHRD-DOST). He is also a professor at the University of the Philippines (UP) Manila College of Medicine.

RAPPORTEUR

DR. MARCOS B. VALDEZ JR., OYS 2012

University Research Fellow

Far Eastern University

Dr. Marcos B. Valdez, Jr. received his Bachelor of Science in Biology degree in Genetics from the University of the Philippines Los Baños in 1999. He finished his Master of Agricultural Science specializing in avian immunogenetics in 2007 from Nagoya University. In 2010, he finished his Doctor of Agricultural Science from the same university majoring in genetics of avian species.

Dr. Valdez has been instrumental in the establishment of several inbred line of chicken currently maintained to the Avian Bioscience Research Center in Nagoya University. These established inbred lines of chicken are now used as general experimental animals in the fields of biomedicine, transgenic research, immunology, and population studies. He was awarded by the National Academy of Science and Technology as one of the Outstanding Young Scientists of the Philippines in the field of Animal Genetics and Talent Search for Young Scientist of the Philippines in 2012. Currently, he is actively involved in research related to genetics of native animals and conservation of bioresources. He is a University Research Fellow and concurrently the Head of the Department of Biological Sciences of Far Eastern University, Manila.

PLENARY SESSION 3
HOLISTIC APPROACH TO WATER RESOURCES DEVELOPMENT THROUGH GENERATIONS

EXECUTIVE SUMMARY
Guillermo Q. Tabios III, Ph.D.

This presentation discusses holistic approach for sustainable and resilient water resources development in the context of the following items: 1) linking science, policy and management decisions through decision support systems; 2) sustainability science; 3) transdisciplinary approach; and 4) evolutionary resilience. This is followed by showcasing specific studies to relate the above holistic approach to actual water resources planning and management of the following systems: 1) Pasig-Marikina River Basin and West Mangahan Lakeshore Dike flood risk management; 2) New Centennial water supply project for Metro Manila; 3) San Roque Dam sedimentation study; and 4) Banaue Rice Terraces as an archetype of sustainable engineering design. Some discussions on water governance in the Philippines in relation to water resources development are also included.

SPEAKER

ACADEMICIAN GUILLERMO Q. TABIOS III
Member, Engineering Sciences and Technology Division
NAST Philippines

Mr. Tabios III is a Professor at the Institute of Civil Engineering and Research Fellow of the National Hydraulic Research Center at the University of the Philippines (UP) Diliman. He holds B.S. and M.S. degrees in Agricultural Engineering from the University of the Philippines, Los Baños, and Ph.D. in Civil Engineering from Colorado State University. Mr. Tabios teaches and conduct researches in stochastic and computational hydrology and hydraulics, as well as water resources systems engineering. He is an Academician of the National Academy of Science and Technology, a Regular Member of the National Research Council of the Philippines and a Member of the American Geophysical Union and the International Association of Hydro-Environment Engineering and Research.

SPEAKER

MS. RAFAELITA M. ALDABA

Assistant Secretary
Industry Development and Trade Policy Group

Dr. Rafaelita "Fita" M. Aldaba is Assistant Secretary of the Industry Development and Trade Policy Group (IDTPG) of the Department of Trade and Industry (DTI), where she leads the Industry Roadmapping Project (IRP) and the Manufacturing Resurgence Program (MRP). She fulfills a key role in the formulation and implementation of the new Philippine industrial policy and Inclusive Innovation Industrial Strategy (i^3S) (formerly the Comprehensive National Industrial Strategy (CNIS)), including the rollinag out of the Comprehensive Automotive Resurgence Strategy (CARS) Program.

Prior to her appointment, Asec. Aldaba served as Senior Research Fellow and Acting Vice-President of the Philippine Institute for Development Studies (PIDS). She has extensive research experience and authored various publications on development issues in the Philippines and ASEAN. She has also conceptualized and managed research projects with various international organizations, including The World Bank, the Asian Development Bank, the Japan International Cooperation Agency, the Canadian International Development Agency, and the US Agency for International Development.

MODERATOR

ACADEMICIAN REYNALDO B. VEA

Chair, Engineering Sciences and Technology Division
NAST Philippines

Dr. Reynaldo Banzon Vea is currently the President and CEO of the Mapua University, Malayan Colleges Laguna, and Malayan Colleges Mindanao. He is also the President of iPeople, Inc. and is a Director of House of Investments, Maibarara Geothermal, Inc. and Petrogreen, Inc. He is the Chairman of the Engineering Sciences and Technology Division of the National Academy of Science and Technology (NAST) and has just concluded his stint as a Director of the Fulbright Commission of the Philippines. He is the immediate past Chairman of the Science and Technology Committee of the UNESCO National Commission for the Philippines. Dr. Vea was formerly Dean of the College of Engineering of the University of the Philippines (UP), and he once served as the President of the Association for Engineering Education in Southeast Asia and the Pacific (AEESEAP).

Dr. Vea has a PhD in Engineering from the University of California at Berkeley, an MS in Naval Architecture and Marine Engineering from the Massachusetts Institute of Technology, and a B.S. in Mechanical Engineering, *magna cum laude*, from the University of the Philippines.

DR. ALLAN N. SORIANO, OYS 2011

Professor
Mapua University

Dr. Allan N. Soriano is an alumnus of Mapúa University (formerly Mapúa Institute of Technology), where he graduated *Cum Laude* in Bachelor of Science in Chemical Engineering in 2000. He is currently a faculty member of the School of Chemical, Biological, and Materials and Engineering Sciences at Mapúa University. He got his Master's degree in 2004, also in Mapúa. In 2007, he pursued his doctorate at Chung Yuan Christian University (CYCU) in Taiwan and finished it in 2009.

Dr. Soriano's research interests covered the following: (1) carbon dioxide absorption using various absorbents (such as alkanolamines, ionic liquids, and deep eutectic solvents); measurement of properties and development of correlations; (2) property measurement and correlation development of specialty chemicals; and (3) mathematical modeling of chemical and environmental engineering processes and statistical and thermodynamic analysis of industrial systems. To date, he has published more than seventy (70) scientific and technical papers in peer-reviewed journals published in respected international and local journals. His prolific works are not just about quantity but also quality as evident by several international recognitions he received such as the 2010 Prof. Yan-Ping Shi Research Paper Award given by the Institute of Chemical Engineers, Chinese Taipei and the 2012 Malaysia-China Chamber of Commerce Green Award. Locally, he received in 2011 the Outstanding Young Scientist Award; in 2012 the Outstanding Chemical Engineer Award for Research and Development; in 2013 the ChE Board Recognition and Professional Regulation Commission Service Award; and in 2014 the National Research Council of the Philippines Achievement Award. Currently, he is 27th in the ranking of scientists in the Philippines according to Google Scholar Citations with an h-index of 22.

PLENARY SESSION 4
DEVELOPING OUR COASTAL AND OCEANIC AQUACULTURE FOR FOOD SECURITY AND LIVELIHOOD GENERATION

EXECUTIVE SUMMARY
Rafael D. Guerrero III, Ph.D.

We live in a "Blue Planet" that is covered by 71% of oceans. The oceans provide us with minerals and seafood that is the primary source of protein for three billion people. The oceans also serve as the "Lungs of the Earth" by producing about 50% of our oxygen supply and absorbing more than 50% of the man-made carbon dioxide in our planet. They also serve as transport route for 80% of the world's goods and provide many vital ecological services such as climate regulation, ocean energy and tourism. The oceans are "the last and most unexplored frontier on Earth."

The world's fisheries production was 174 million metric tons (mmt) in 2017. In 2014, 54% (93.4 mmt) of the production was from capture (fishing) fisheries and 46% (73.8 mmt) was from aquaculture (farming). The main products from aquaculture were finfish (46%), mollusks (15%), crustaceans (6%), other aquatic animals (7%) and aquatic plants (25%). With overfishing and habitat destruction, 31.4% of the wild fish stocks in the world has been exploited at a "biologically unsustainable level." Aquaculture,"the fastest growing food-producing sector in world," has increased annually by 8.83% and is expected to overtake capture fisheries production by 2020. There are 580 aquatic species and /or species groups that are farmed throughout the world.

The Philippines is an archipelago with more than 7,000 islands, coastline of 18,500 km, 26.6 million hectares of coastal (inshore) waters and 193.4 million hectares of oceanic (offshore) waters. Philippine fisheries production was 4.317 mmt in 2017 with 51.9% coming from aquaculture, 26.2% for municipal fisheries and 21.9% for commercial fisheries. For aquaculture, the major products were seaweeds (62.5%), milkfish (18.6%), Nile tilapia (11.9%), tiger prawn (2.0%), slipper oyster (1.0%) and green mussel (0.08%). The bulk of our aquaculture production (over 70%) comes from coastal aquaculture of seaweeds, oysters and mussels in open coastal waters, and milkfish in coastal fishponds, pens and floating cages.

Fish is the primary source of animal protein in the diet of Filipinos. There is a high poverty incidence of 39.2% among the more than 1.5 million municipal fisherfolk in the country. Thus, coastal aquaculture not only provides fish and other produce for our food security but also livelihood opportunities for poverty alleviation of our coastal communities.

The concept of mariculture parks, similar to industrial and science parks on land, was first introduced in the country by the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (DA/BFAR) in 2001 with the demonstration of milkfish culture in floating cages in the coastal waters of Samal Island, Davao del Norte. In 2006, the Panabo City Mariculture Park (PCMP) was set up in the coastal waters (617 hectares) of Davao del Norte by the BFAR in partnership with the Local Government of Panabo City. In the partnership, the City Government provides the local governance and management for the PCMP while the BFAR provides technical and advisory services. To attract private investors, infrastructure facilities such as mooring (anchoring) system for the floating cages, fish landing, cold storage and support services for processing, transport and marketing were provided. In 2017, there were 405 fish cages in the PCMP that produced 2,505 mt of milkfish, rabbitfish and saline tilapia with a value of more than PhP239.3 million.

Job opportunities for 137 fisherfolk comprised of 69 cage caretakers, 38 women-processors and 30 harvesters were provided.

Coastal aquaculture in the country is limited by the lack of fingerlings (mainly milkfish) for stocking in floating cages and the high cost of commercial feeds (60% of operating costs) for production. The cages can be adversely affected by pollution of coastal waters with poor water mixing. Inshore mariculture can also compete with navigation, tourism and other uses of coastal waters.

While most of the aquaculture production in the world is largely from coastal and inland areas, open ocean aquaculture or farming in oceanic waters is an option for the future. With innovative offshore technologies, the environmental impact of large-scale commercial fishfarming can be avoided with stronger currents in the high seas. However, offshore farms can be more exposed to storms and piracy, and be an obstruction in shipping lanes. The high cost of investment and the lack of tested technologies are the main limitations of offshore mariculture.

There is need for a comprehensive and integrated national program for the development of coastal and oceanic aquaculture in our country. In this respect, a policy for a National Mariculture Program is recommended. For fully harnessing our vast coastal and oceanic resources, the NAST is advocating for the creation of a Department of Fisheries and Oceans.

The two major concerns for R & D in support of the development of coastal and oceanic aquaculture in the Philippines are the need for more hatcheries for the production of fry/fingerlings for culture in ponds, pens and cages, and the development of commercial feeds that are efficient and cost-effective with the use of fish meal substitutes.

SPEAKER

ACADEMICIAN RAFAEL D. GUERRERO III

Member, Agricultural Sciences Division
NAST Philippines

Dr. Rafael D. Guerrero III is an Academician of the National Academy of Science and Technology, Philippines of the Department of Science and Technology (DOST). He has a Ph.D. in Fisheries Management, M.S. in Applied Zoology and B.S. in Zoology. He was formerly Executive Director of the Philippine Council for Aquatic and Marine Research and Development (PCAMRD) of the DOST.

He has published more than 200 technical and popular articles on aquaculture, vermiculture and water resources management, and written four books on fish culture and tilapia farming in the Philippines.

In 2017, he was cited by the Society of Aquaculture Engineers of the Philippines, Inc. and the Philippine Aquaculture Society, Inc. for his "Outstanding Leadership and Devoted Service in the development of the technology of producing all-male tilapia through sex inversion which has been a major factor not only for tilapia farming in the Philippines but also elsewhere." Currently, he is the Aquaculture/Vermiculture Specialist of Aquatic Biosystems, a consultancy and marketing firm based in Bay, Laguna.

MODERATOR

ACADEMICIAN EUFEMIO T. RASCO JR.

Chair, Agricultural Sciences Division
NAST Philippines

Academician Eufemio T. Rasco Jr. was elected to the National Academy of Science and Technology, Philippines as member in 2009. Currently, he serves as the chair of the Agricultural Sciences Division of the Academy.

A graduate of the University of the Philippines Los Baños and Cornell University, he is recognized for his pioneering and outstanding contributions in the field of plant breeding, specifically tropical vegetables and tropical white potato.

Acd. Rasco served as the Director of the Institute of Plant Breeding and Executive Director of the Philippine Rice Research Institute. He also served as Dean of the College of Science and Math at UP Mindanao.

RAPPORTEUR

DR. ALETTA CONCEPCION T. YÑIGUEZ, OYS 2017

Assistant Professor, The Marine Science Institute
University of the Philippines Diliman

Dr. Aletta T. Yñiguez is an Assistant Professor at the Marine Science Institute, University of the Philippines in Diliman specializing in biological oceanography and ecological modeling. She obtained her Ph.D. from the Rosenstiel School of Marine and Atmospheric Science, University of Miami in Florida with the support of a Fulbright and Maytag Scholarships. She uses an arsenal of field, laboratory and modelling approaches to investigate the potential effects of environmental conditions, anthropogenic activities and climate change on the base of the marine food web and how these can impact the fisheries. Beyond research, Dr. Yñiguez advocates education and critical thinking through experiential learning. She has been the Camp Director of the DOST SEI-UPMSI Marine Science and Climate Change Summer Camp for public high school students for nine years. She was a recipient of the 2012 L'Oreal -UNESCO For Women in Science Fellowship and last year was recognized by the National Academy of Science and Technology as an Outstanding Young Scientist.

PRESENTATION OF RESEARCH RESULTS OF NAST AWARDEES

(Funded by the Department of Science and Technology)

DOST FUNDING MECHANISM WITH FOCUS ON GRANTS-IN-AID PROGRAM

SPEAKER

DR. ROWENA CRISTINA L. GUEVARA

Undersecretary for Research and Development
Department of Science and Technology

Dr. Rowena Cristina L. Guevara is the Undersecretary for Research and Development of the Department of Science and Technology (DOST). A well-respected engineer and educator for 30 years, Dr. Guevara is Professor XII at the Electrical and Electronics Engineering Institute of UP Diliman specializing in speech and audio signal processing, time-frequency analysis and synthesis, and artificial intelligence.

Dr. Guevara served as Executive Director of the Philippine Council for Industry, Energy and Emerging Technology R&D (PCIEERD) from July 2012 to 2015. She was the Dean of the UP College of Engineering and was Executive Director of the UP National Engineering Center from 2004 to 2010. Dr. Guevara was the first Dado Banatao Fellow at the University of California Berkeley and she has been the recipient of several awards in engineering and education, including the 2010 Metrobank Outstanding Teachers of the Philippines. Dr. Guevara was the proponent and first program leader of the Engineering Research and Development for Technology (ERDT), a capacity-building program that offers graduate scholarship in all fields of engineering, faculty and infrastructure development, and collaborative R&D for the ERDT Consortium of 7 universities. Dr. Guevara served as Undersecretary for Scientific and Technological Services of the DOST from March 2015 to September 2016. During that time, 6 DOST technology transfer policies, based on RA 10055, were formulated and approved by the Secretary. Today, these policies enable the drive for technology transfer of DOST R&D Institutes, and other agencies that received R&D funding from DOST.

CONNECTIVITY OF CORAL REEFS AND OTHER NEARSHORE HABITATS: IMPLICATIONS FOR MARINE RESOURCE MANAGEMENT IN THE PHILIPPINES

EXECUTIVE SUMMARY

Rene A. Abesamis, Ph.D.

Most marine species that are important to fisheries undergo a larval stage during their life cycle. In fishes that inhabit coral reefs, this larval stage can last from about 1 to 10 weeks in the open sea before settling back to the coral habitat. The larvae of reef fishes can either be dispersed by currents away from the reef where they were spawned or directly settle to the same reef where their parents also live. The larvae of some reef fish species, on the other hand, settle in non-reef habitats (e.g., seagrass, algal beds) adjacent to reefs before migrating to adjacent coral reefs as they mature. In addition, the adults of some reef fishes can undergo daily foraging migrations to nearby seagrass beds, mangroves and other nearshore habitats. However, scientists are only beginning to understand the extent of larval dispersal and adult movement in reef fishes and how populations of reef fish in different places (e.g., within or between villages, municipalities or provinces) are connected to each other. This linking of fish populations through the larval, juvenile or adult stages is referred to as "connectivity".

Larval connectivity is a primary consideration in implementing marine reserve networks (many marine reserves that exchange larvae with each other) for conservation and fisheries management. If fish populations increase in abundance and biomass inside marine reserves, the female fish in these reserves will produce more eggs and larvae than in fishing grounds of the same size. In turn, the larger amounts of larvae produced within marine reserves could subsidise fish populations in surrounding fishing grounds and also other marine reserves. With enough time, this larval connectivity effect may result in fisheries enhancement. Connectivity during the adult stage, referred to here as "habitat connectivity" is also a primary consideration in designing marine reserve networks. Incorporating habitat connectivity will ensure that reef fish species that depend on nearshore non-reef habitats can complete their life cycles, thereby enhancing the protected populations.

In the Philippines, there are now about 1,800 marine reserves that have been established by coastal municipalities. There is growing interest to create marine reserve networks that can enhance the effects of larval and habitat connectivity. However, few studies have investigated if existing marine reserves in the Philippines can link to each other via larval dispersal. It is also not yet clear if marine reserve networks should be implemented at the spatial scale of a single municipality, between two or more municipalities, or at much larger spatial scales (between provinces). This spatial scale will depend on the typical distance of larval dispersal, which has to be measured in scientific field studies. Studies on habitat connectivity are also lacking and only a small proportion of existing marine reserves in the Philippines include critical nearshore non-reef habitats.

Over the past decade, I had been investigating larval connectivity in the Bohol Sea region. Since 2011, we at SUAKCREM have implemented a research program that aims to measure larval dispersal distances in one species of reef fish (Vagabond butterflyfish) by applying a technique called genetic or DNA parentage analysis. Simply put, the method tries to match the DNA of juvenile and adult fish samples that were collected over a large area. A DNA match between a juvenile and its adult parent would indicate that the juvenile, during its larval stage, dispersed from the location of its matching parent to its sampled location. This research is cutting-edge and is technically challenging. SUAKCREM received help from a team of experts from other universities in the Philippines, Australia, Saudi Arabia, Chile and Japan.

To date, the research program has uncovered interesting patterns of larval connectivity that have important implications for implementing marine reserve networks in the Philippines. A major result is that parentage analysis validated the long-standing hope that the small marine reserves managed by coastal communities can exchange larvae with each other, provided that these reserves are sufficiently close to each other (within a few tens of km). Another major finding of this research is that marine reserves can supply fish larvae to surrounding fishing grounds, which could lead to fisheries enhancement if more reserves are established and strictly enforced. The results of the first phase of this research program are now published (Abesamis et al. 2017 Coral Reefs 36:791-801).

With the help of the DOST-National Academy of Science and Technology (Outstanding Young Scientist Grant), I initiated research into habitat connectivity. This research aims to provide baseline ecological information on habitat connectivity at one site in the central Philippines and underscore some implications for designing marine reserve networks in the region.

BIOLOGICAL SCIENCES DIVISION:

DR. RENE A. ABESAMIS

Research Officer
Silliman University-Angelo King Center for Research
and Environmental Management (SUAKCREM)

Rene Abesamis has 20 years research experience on coral reef fish ecology, fisheries and conservation inthe Philippines. A core focus of his research is the ecological effects of marine protected areas, including understanding broader-scale effects through the dispersal of reef fish larvae, juveniles and adults and its implications for marine resource management in the Philippines and other developing coral reef countries. He is primarily a field ecologist but in the past decade had led multi-disciplinary research programs on connectivity in the Philippines involving ecologists, oceanographers, geneticists and conservation planners.

IMPACTS OF LAND USE CHANGE AND AN INTEGRATED ASSESSMENT OF VULNERABILITY TO FLOODING: THE CASE OF STA. ROSA-SILANG SUBWATERSHED

EXECUTIVE SUMMARY

Damasa M. Macandog, Ph.D.

Rapid land use conversion and high population pressure are among the pertinent environmental issues in Silang-Santa Rosa River Subwatershed. Its proximity to Metro Manila and the abundance of quality groundwater had positioned this subwatershed for widespread commercialization and urbanization. Higher economic gains drove land owners in Sta. Rosa City to opt to convert vast farmlands into non-agricultural land uses. However, increased economic activities and income opportunities is compromising the environmental integrity of the subwatershed. Adverse impacts of land use conversion include not only the decline in agricultural production but also increased soil erosion and surface run-off. These pressing issues are especially evident in the uplands of Silang, Cavite, where the headwaters of the subwatershed are located. Existing agroforestry farming systems in the uplands are threatened by issues of increasing soil erosion and surface run-off. This loss in agroforestry systems is also partly caused by ongoing urban sprawl in the uplands.

Consequently, these trends of land use and land cover changes in the Silang-Santa Rosa subwatershed have modified the subwatershed water balance, which is evident through the changes in soil permeability, depletion of water resources, and change in water yield that triggers flooding in the downstream areas of the subwatershed. The drying up of streams and the occurrence of flash floods during typhoons are conflicting water resource issues in the Laguna Lake region that requires assessment, especially of the impacts brought about by human modifications to the environment - one of which is land cover change. Occurrence of landslides and flooding had increased in the Santa Rosa-Silang subwatershed as triggered by extreme weather disturbances including tropical depressions, Southwest monsoon rains, storms and typhoons.
Managing flood hazards, with the aim of maintaining community safety and well-being through the conservation of the environment, is one of the mandates of local governments and authorities. This can be achieved in flood prone areas by reducing vulnerability levels and increasing resilience of the people (Nasiri et al., 2016). Vulnerability assessment involves a holistic analysis of exposure, sensitivity, impacts, adaptive and coping capacities of an area and its people to natural hazards such as typhoons, landslides, earthquakes, and floods.

In this study, GIS- based hydrological models, the Soil and Water Assessment Tool (SWAT and Hydrologic Modeling System (HEC-HMS coupled with HEC-RAS) were used to simulate the quantities of water inflow and outflow in each of the 49 dominant hydrologic response units (HRUs) and precipitation-runoff processes along the Sta. Rosa river system in the entire subwatershed area. Spatial information such as its digital terrain model (DTM) extracted from LIDAR and RS data, land cover map and soil map, together with its 36- year (1980 to 2015) rainfall and temperature data were entered into the models' platforms to generate the surface flow and sediment yield during rain events within the subwatershed. With these outputs, the subwatershed portions and the specific HRUs vulnerable to flooding and erosion were mapped out. Simulation results showed that the low permeability of soil surface increases the occurrence of flashfloods in low- lying areas and along the riverine system. Sloping and open surfaces in the upstream areas are, however, prone to landslides. Vulnerability assessment has shown that the communities along the shoreline and riverine system are most susceptible to flooding and landslides. These results will be useful in the development of area-specific adaptation and mitigation strategies to disasters like landslides and floods.

Community-based and key informant surveys were conducted in three barangays of Sta. Rosa City to produce a community-based vulnerability assessment considering respondents' exposure, sensitivity, impacts and capability to adapt to and cope with floods. This was done by conducting a survey to 50 residents in each of the three lakeshore barangays (Aplaya, Caingin and Sinalhan) of the City and through key informant interviews of city and barangay officials.

Physical and socio-economic analyses were performed to assess the vulnerability to floods of barangays Caingin, Aplaya and Sinalhan. In the physical vulnerability assessment, the extent of damage to the household buildings were analyzed based on structural type, building height, proximity to the Laguna Lake, building age and number of floors. On the other hand, income, livelihood, period of stay, family size, gender, age, education and ownership were the factors used in the analysis of socio-economic vulnerability. Results show that Barangay Sinalhan is most vulnerable to flooding based on structural type, height of ground floor, and distance from the Laguna Lake. The analysis of socio-economic vulnerability also identified barangay Sinalhan as most vulnerable to flooding.

However, the presence and effectiveness of government actions/interventions including the provision of relief goods or financial assistance, health programs, livelihood programs, rescue operations, and others can potentiallylessen the vulnerability of the three barangays to flooding. After identifying, analyzing and assessing the different physical and socio-economic elements at risk during floods, the impacts of floods, the adaptive capacity and coping mechanisms to floods, and the perception of respondents on government intervention and assistance, recommendations on DRRM were presented to the city government and barangay officials. These recommendations were also based on the four aspects of DRRM specified by the NDRRMP 2011 – 2028: (1) Prevention and Mitigation; (2) Preparedness; (3) Response; and (4) Rehabilitation and Recovery.

The possible measures for climate change adaptation and mitigation identified by the LGU officers included development control in high risk areas, maintaining green space and urban greening, strengthening building codes particularly in high-risk areas, green building, afforestation, riverbank rehabilitation, river clean-up and dredging, and harmonization of the Comprehensive Land Use Plans for integrated watershed management. To put these efforts in motion, a Memorandum of Agreement among the Mayors of the four local government units and the General Manager of the Laguna Lake Development Authority (LLDA) was signed to establish the Council for Integrated watershed Management.

BIOLOGICAL SCIENCES DIVISION:

DR. DAMASA M. MACANDOG, OYS 1997

Professor
University of the Philippines Los Baños

Seasoned researcher and academician conducting various researches related to agricultural, biological, agroforestry, ecological, land use change, climate change, natural resource inventory, spatial analysis and biodiversity studies for the past twenty-five years. Has lead and implemented several multidisciplinary internationally-funded projects on sustainable natural resource management and inventory; coordinated international scientific networks and events; and disseminated research information and knowledge to a wider audience through scientific conferences, journals, community forum and various stakeholder consultations.

She has received numerous awards in recognition of her exemplary achievements including the National Academy of Science and Technology (NAST) Outstanding Young Scientist Award in the field of Botany in 1997, 2014 NAST Environmental Science Award, 2015 University of New England Distinguished Alumnus Award, 2015 Philippine-Australian Alumni Association, Inc. (PA3i) Most Oustanding Australian University Alumna Award, UPLB Outstanding Researcher award in 2007, Soil Science Society of the Philippines, Inc. Achievement Award in 2008, University of the Philippines Scientific Productivity award in 2009, and several Professorial Chair awards. She has published fifty papers in scientific journals and book chapters covering a wide range of topics including agricultural pollution, leaf litter decomposition, soil fertility management and best practices in upland farming systems, land use change and spatial analysis, environmental risks and degradation, watershed modelling, bioenergy, greenhouse gas emissions, economic and environmental impacts of land use change.

OPTIMIZING RESOURCE CONSERVATION NETWORKS IN ECO-INDUSTRIAL PARKS, FROM BARRIERS TO PROCESS INTEGRATION

EXECUTIVE SUMMARY

Kathleen B. Aviso, Ph.D.

Co-authors: Lindley R. Bacudio, Michael Francis D. Benjaminb, Ramon Christian P. Eusebioc, Sed Anderson K. Holaysan, Michael Angelo B. Promentillaa, Krista Danielle S. Yud

University of Santo Tomas, Manila Research Center for the Natural and Applied Sciences
Chemical Engineering Department, University of the Philippines Los Banos, Laguna
School of Economics, De La Salle University, Manila, Philippines

The concept of Industrial Symbiosis (IS) initially emerged as a strategy for facilitating the transformation of conventional linear industrial systems into more circular ones. Such a strategy is meant to promote sustainability by supporting mechanisms for recycling and re-use within the industrial cycle thereby encouraging technologies and strategies which lower carbon emissions, lower waste generation or lower resource consumption. The establishment of resource conservation networks or industrial symbiosis network result in more efficient material and energy use. There are two schools of thought regarding IS networks, one supports the natural emergence of the networks while another believes in proper planning. The most popular example of the IS network is demonstrated in Kalundborg Park of Denmark which emerged as a result of the industry's need to adapt to the increasing pressure brought by scarce resources. Since then, several eco-industrial parks have been developed in various parts of the world, most of which requiring long processes of planning. Such initiatives intend to identify potential synergies between candidate component plants and evaluate for their feasibility. Therefore, a systematic design approach is needed to facilitate the successful implementation of these networks and the first step is to properly identify potential barriers (e.g., lack of effective communication, confidentiality issues, support services) to success.

This work presents available methodologies for identifying the barriers to implementing IS in an industrial park and recognizing potential strategies towards reducing water use in eco-industrial parks. Decision Making Trial and Evaluation Laboratory (DEMATEL) approach is introduced to identify the cause and effect relationships which may exist among the different factors which affect IS implementation. The methodology was implemented in an industrial park in Laguna. Results indicate that the most prominent barrier that exists for the case under study is the current lack of awareness on the concept of industrial symbiosis.

Process systems engineering approaches are then discussed to provide some key concepts needed in identifying the potential for establishing resource conservation networks. Mathematical optimization has been found to be powerful in handling multiple objectives and constraints which may arise from the establishment of industrial symbiosis networks.

The challenge then is in bridging the gap between the barriers and the tools available to facilitate the transformation of the industrial system.

ENGINEERING SCIENCES AND TECHNOLOGY DIVISION:

DR. KATHLEEN B. AVISO

Professor
De La Salle University

Kathleen B. Aviso is a Professor at the Chemical Engineering Department of De La Salle University, Manila, Philippines. Her main research interest is the development of decision support tools for environmental decision-making, which have been applied to systems such as eco-industrial parks and low-carbon energy systems. She received her B.S. in Chemical Engineering (*cum laude*) from the University of the Philippines-Diliman in 2000 and her MS in Environmental Engineering and Management (with high distinction and the outstanding thesis award) from De La Salle University in 2006. She also received her Ph.D. degree in Industrial Engineering from De La Salle University in 2010. In 2017, she was included in the Asian Scientist 100, 2017 Edition by the Asian Scientist Magazine.

She received multiple awards during the 2016 Commission on Higher Education (CHED) Republica Awards with five of her co-authored publications recognized as national qualifiers in the fields of social science and engineering, mathematics and information technology. One of these papers was recognized as the National Winner in the engineering, mathematics and information technology category. She was the country representative and among the 10 finalists of the 2016 ASEAN-US Science Prize for Women. She was recognized as one of the Outstanding Young Scientists of 2013 by the Philippine National Academy of Science and Technology, Philippines (NAST PHL) and was the winner of the 2010 NAST Talent Search for Young Scientists for her Ph.D. work on the development of mathematical models for efficient water use in eco-industrial parks.

In 2008, she received the Outstanding Scientific Paper Award from NAST for work done on decision analysis tools in life cycle assessment as part of her master's thesis. She is also one of the recipients of the 2016 Achievement Award from the National Research Council of the Philippines. She now has more than 90 Scopus-indexed publications with an h-index of 19, with 6 publications having 40 or more citations. Part of her Ph.D. work remains the most highly cited article published in 2010 in the IChemE/Elsevier journal *Process Safety and Environmental Protection*. She is currently ranked 43rd among the top scientists in the Philippines based on Google Scholar h-index by Webometrics (www.webometrics.info/en/node/148).

VOLUME HOLOGRAPHIC RECONSTRUCTION OF BESSEL BEAMS USING MULTIPLE WAVELENGTHS

EXECUTIVE SUMMARY

Raphael A. Guerrero, Ph.D.

The project "Volume Holographic Reconstruction of Bessel Beams using Multiple Wavelengths" formally commenced on December 1, 2014 at the photonics laboratory of the Department of Physics, Ateneo de Manila University (AdMU). Research on applications of volume holography was initiated at the Department of Physics in 2004 with the development of holographic techniques employing transparent elastomers . Our group at the Ateneo was later able to demonstrate the volume holographic storage and reconstruction of a special type of non-diffracting beam known as a Bessel beam . Properties of Bessel beams, including non-diffraction and self-reconstruction, have led to the use of these beams in optical micromanipulation, atom trapping and nonlinear optics. With this project, researchers at AdMU were able to develop a holographic method to generate and manipulate modified Bessel beams, potentially allowing an even wider range of applications for these versatile beams. The photonics laboratory of AdMU continues to provide quality training at the undergraduate and graduate levels. Through this project, the support available to students working on volume holography was vastly improved.

Designed to be implemented in one year, the project had the following outputs: a working, research-grade optical system for the generation and holographic reconstruction of Bessel beams at multiple wavelengths was developed. New knowledge regarding the wavelength-dependent properties of Bessel beam propagation was generated. Intensive manpower training at the undergraduate and graduate levels, culminating in one B.S. thesis and one Ph.D. dissertation, was conducted. Researchers also prepared notes on potential applications and possible designs for commercial devices. Publications included an international conference paper and one ISI-indexed journal article.

THE VOLUME HOLOGRAPHIC SYSTEM

Via a grant from the Philippine Council for Advanced Science and Technology Research and Development (PCASTRD) (now PCIEERD, the Philippine Council for Industry, Energy and Emerging Technology Research and Development), a working volume holography system was assembled at the photonics laboratory in the early 2000s. The existing set-up was modified by adding a new wavelength-tunable HeNe laser purchased through this project. With a tunable laser, as compared to the use of separate laser devices, alignment of the beam during holographic reconstruction became more convenient and consistent. The laser emissions at 594 nm, 604 nm and 612 nm added to the range of laser wavelengths available at the photonics laboratory, increasing flexibility to conduct future experiments. In academic year 2015-2016, the volume holography system was employed in the thesis and dissertation work of one B.S. Physics with Applied Computer Systems student and one Ph.D. Physics student.

Figure 1 is a schematic diagram of the optical set-up employed in the project. The laser system used was a Research Electro Optics 5-line (633, 612, 604, 594, 543nm) tunable HeNe laser with a maximum power output of 10.0mW. The 594 nm line was used for recording and both 594 and 633nm lines were used for reconstructions. A plane wave was generated by collimating light (λ = 594nm) from the laser using two lenses (L1, L2; f1 = 10 cm, f2 = 50 cm), reflected using mirrors (M1, M2) and divided with a beam splitter (BS). One beam was used to generate a zeroth-order Bessel beam using Durnin's method [10], where an annular slit, with diameter of ~1.14 mm and slit width of ~0.17 mm, was placed at the back focal plane of another lens (L3; f3 = 50cm). This transformed the plane wavefronts into conical wavefronts of a Bessel beam. The two beams interfered inside an iron doped lithium niobate (LiNbO3:Fe) crystal. The interference angle was measured to be around 7o.

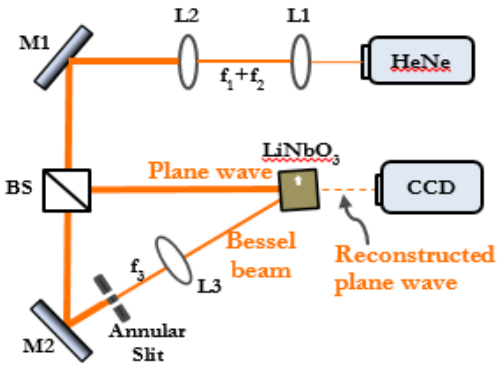


Figure 1. Experimental set-up for volume holography of Bessel beams

MAIN RESULTS

The primary achievement of this project is the implementation of a new volume holographic method for generating self-imaging beams. Through the use of a Bessel readout beam, holography was able to simultaneously reconstruct a modified Bessel beam and a plane wave. This novel method allows the production of periodic 3D intensity voids along a propagation distance of 55 cm. Results from the project were published in the ISI-indexed journal, Optical Engineering in 2015. The new protocol reported here for generating self-imaging beams based on the holographic storage of Bessel beams may be used to create tailored beams for micromanipulation at selectable wavelengths. Recording multiple optical potentials and volumetric lattices is another potential application. In addition, holographic storage with a self-imaging output may allow accessing of data at multiple planes in three dimensions.

Bessel beam reconstructions using a plane wave reference for recording wavelength λ = 594 nm (top) and readout wavelength λ'= 633 nm (bottom) are shown in Fig. 2. Images in the first column are theoretical simulations of the Bessel beam transverse profile for the two wavelengths which is ideally the same at all propagation distances. The Bessel beam profile of a central intensity maximum surrounded by concentric rings is maintained at propagation distances of 10 cm and 40 cm.

Two student researchers of the photonics laboratory made use of the volume holography system in their thesis and dissertation work. Carlex Randolph Jose II, a B.S. Physics with Applied Computer Systems student, successfully defended his thesis on "Volume holographic storage of Bessel beams at multiple wavelengths" in May, 2016. A Ph.D. Physics student, Jonathan Manigo, defended his dissertation on "Volume holographic generation of optical bottle beams" in April, 2016. Mr. Manigo became the third graduate of AdMU's Ph.D. Physics program.

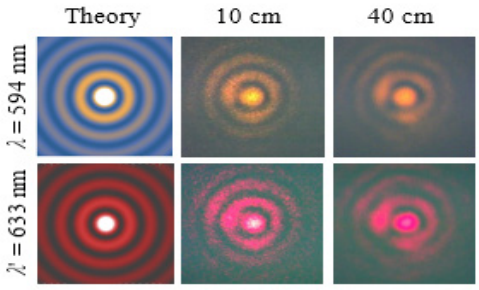


Figure 2. Bessel beams reconstructed using two readout wavelengths:
594 nm (yellow) and 633 nm (red).

MATHEMATICAL AND PHYSICAL DIVISION:

DR. RAPHAEL A. GUERRERO

Professor
Ateneo de Manila University

Raphael A. Guerrero is the Chair of the Department of Physics of the Ateneo de Manila University, where he holds the rank of Associate Professor. He is the coordinator of the department's Photonics Laboratory, supervising research on volume holography, fluorescent materials, soft lithography and elastomeric optics. Dr. Guerrero obtained his Ph.D. in Physics from the University of the Philippines Diliman in 2005. He received his B.S. and M.S. degrees in Physics from the same university. Scholarships for his higher education were provided by the Science Education Institute (SEI) and the Philippine Council for Advanced Science and Technology Research and Development (PCASTRD). His doctoral dissertation discussed a pattern recognition system based on photorefractive volume holography. Work on this dissertation would lead to the first ISI-indexed paper on volume holography from the Philippines. Through grants provided by the Department of Science and Technology, Dr. Guerrero was able to establish a world-class optics research facility in the Photonics Laboratory of the Ateneo de Manila University. Papers from Dr. Guerrero's lab have appeared in the ISI-indexed journals Optics Communications, Applied Optics, Optics and Photonics News, Materials Science and Engineering C, Optical Engineering and Advances in Materials Science and Engineering. He has presented papers at international conferences in the United States, Italy, Egypt, Japan, China, Taiwan and Nepal.

Dr. Guerrero serves on the Photonics Technical Panel of the Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) was a member of Technical Committee for Physics of the Commission on Higher Education (CHED). He is a member of the Samahang Pisika ng Pilipinas (he was president of the SPP for the years 2011 and 2012), the National Research Council of the Philippines (NRCP), the Optical Society of America (OSA) and the International Society for Optical Engineering (SPIE). Dr. Guerrero received the Loyola Schools Outstanding Scholarly Work Award in 2006 and has been a recipient of the Rev. Francis J. Heyden, S.J. Professorial Chair in Physics since 2010. He was the winner of the NAST Talent Search for Young Scientists in 2008. Dr. Guerrero received two awards from NAST in 2013: Outstanding Young Scientist in Physics and the TWAS Prize for Young Scientist in the Philippines.

SAME NEWS, DIFFERENT FORMATS: AFFECTIVE PROCESSES AS MEDIATORS AND TYPE OF ISSUE AS MODERATOR OF FRAMING EFFECTS

EXECUTIVE SUMMARY

Clarissa C. David, Ph.D.

Co-authors: Jose Antonio R. Clemente, Ma. Rosel S. San Pascual, and Maria Jeriesa P. Osorio (University of the Philippines Diliman)

Following the Cognitive Mediation Model (Nabi, 1999), this study examines the role that the affective processes of empathy and emotion play in mediating the relationship between exposure to a particular news and story format on consequent opinion formation. Using a 3 X 2 experimental design to test the main and interaction effects of news story format (narrative, non-narrative, hybrid format) and type of policy issue (crime vs. economic policy) on subsequent approval of government policies, results reveal that the effects of news story format and policy issue on approval of policies were mediated by affective processes, i.e., a news story format and a policy issue that elicit empathy evoke stronger positive and negative emotions, and that depending on the policy issue, different affective mechanisms lead to increased or decreased approval of government policy.

SOCIAL SCIENCES DIVISION:

DR. CLARISSA C. DAVID

Professor
University of the Philippines Diliman

Clarissa C. David is Professor at the College of Mass Communication, attached to the Graduate Studies Department where she teaches graduate level classes in quantitative research methods, public opinion, and political communication. Dr. David is a graduate of the MA Communication and PhD Communication programs of the Annenberg School of Communication at the University of Pennsylvania.

Professor David's academic research interests revolve around news media effects, framing, political knowledge, political engagement, political attitudes, and public opinion. In her research studies in the areas of politics and elections, she investigates public opinion and its relationship with news and other forms of media content. In addition to academic research she conducts policy-oriented research and communication strategy consulting in the areas of public education, health, and governance in the Philippines.

MODERATOR

ACADEMICIAN VIRGINIA C. CUEVAS

Member, Biological Sciences Division

NAST Philippines

Dr. Cuevas obtained her bachelor and master degree in Botany from UP Diliman in 1961 and 1977, respectively. She attained her Ph.D. Botany from UP Los Banos in 1987. For her significantly important contributions to the advancement of agriculture and natural resources in the Philippines, Dr. Virginia C. Cuevas was named as one of the Academicians for 2016 by the National Academy of Science and Technology, Philippines (NAST PHL).

Dr. Cuevas has developed rapid composting technology using Trichoderma, a microorganism that acts as an activator in hastening the decomposition of farm wastes into compost that serves as an organic fertilizer and also developed Trichoderma Microbial Inoculant (TMI) that enhances crop growth and controls various fungal diseases. She was the recipient of various awards including two international bodies, UN-ESCAP Clean Technology Award (1995), and Best Scientific Poster Award from the Association of Asian Societies Academy of Sciences. She was also awarded by different institution in the country, among them were NAST's Outstanding Young Scientist Award (1989), the NRCP's Achievement Award in Biology (2005), DOST's Pantas Award (1990), Rizal Pro Patria Outstanding Agricultural Scientist Award (1992), Civil Service Commission's Lingkod Bayan Award (1992), UP Distinguished Alumni Award in Science and Technology (2009), Ten Outstanding Women in the Nation's Service (1992) and Philippine

RAPPORTEUR

DR. MARIBEL D. SESE, OYS 1995

Immediate Past President

Outstanding Young Scientists, Inc.

Dr. Maribel L. Dionisio-Sese obtained her B. S. Botany (*cum laude*) and M. S. Botany degrees from the University of the Philippines Los Baños (UPLB), and her Doctor of Science in Botany degree from The University of Tokyo, Japan. She received post-doctoral and visiting research fellowships in Japan and the Alexander von Humboldt Research Fellowship at the Phillips Universität Marburg in Germany. Dr. Dionisio-Sese is a specialist in the field of plant and algal physiology and biochemistry, photobiology, and stress physiology. In recognition of her scientific achievements, she is a recipient of various national, academic and professional awards including the Philippines' National Academy of Science and Technology Outstanding Young Scientist for Plant Physiology, the UPLB-College of Arts and Sciences Distinguished Alumna Award for Basic Research and Instruction, and the Scientist I recognition by the UP System. She is the current Director of the UPLB-Interactive Learning Center and holds the rank of Professor 12 at the Institute of Biological Sciences, College of Arts and Sciences, University of the Philippines Los Baños.

2018 NAST PHL AWARDS

The sculptural trophy for the NAST Awards shows fuid lines and curves, subtly forming the word NAST. The upward movement of the line shows modernity, great strides in science and excellence. The contours and holes symbolize how our outstanding scientists discover and explore the world of science from different perspectives.

MEMBERSHIP TO THE ACADEMY

MUDJEKEEWIS D. SANTOS

Ph.D. (Applied Marine Biosciences)

This award is given in recognition of his significant work in fish science, fishery management and marine biodiversity in the Philippines. Dr. Santos introduced the use of the DNA barcoding protocol in the Philippines to understand fish population structures, identify fish species and by-products for traceability and labeling purposes, and for monitoring of trade in endangered, protected and regulated aquatic species. He also initiated the National Fisheries Research and Development Institute-Genetic Fingerprinting Laboratory (NFRDI-GFL), which has become the leading laboratory in the country in utilizing genetics in fisheries management and regulation. He contributed to the understanding of fish immunology through his work on the genetics and molecular mechanisms of white blood cell formation in fishes.

Dr. Santos led and implemented the National Stock Assessment Program, which provided the scientific basis for seasonal fishing closures in the country as one of the management strategies to sustain the population of commercially important pelagic fish stocks, such as sardines, mackerels and roundscads.

Dr. Santos provided additional evidence to support the hypothesis that the Philippines is the center of marine biodiversity in the world through the discovery of new fish species. Recently, he and the NFRDI team identified possible effects of climate change in fisheries resources and developed a vulnerability assessment tool specific to the fisheries sector to guide climate change adaptation strategies for the country.

ARNEL A. SALVADOR

Ph.D. (Physics)

In recognition of his significant contributions and pioneering work in experimental condensed matter and applied solid state physics, specifically the fabrication of optoelectronic devices using Groups III-V semiconductors that are grown via molecular beam epitaxy techniques and which can be applied in semiconductor lasers and photodetectors for optical communication, terahertz emitter and detectors for spectroscopic identification of chemicals and imaging.

Dr. Salvador has produced pioneering results in his field as manifested in numerous highly cited peer-reviewed technical publications. He established an advanced and globally competitive academe-based semiconductor research laboratory dedicated to training and mentoring highly-skilled and competent undergraduate and graduate scientists. He also established and set up international collaborations that allowed his students to also work in research laboratories abroad; a testament to his resolve to improve the level of S&T in the Philippines.

GLENN B. GREGORIO

Ph.D. (Genetics)

This award is given in recognition of his exemplary contributions in the fields of plant breeding and genetics, in particular for his in-depth studies of salinity tolerance in rice and breeding and genetics of high iron and zinc rice for human health.

The rapid screening techniques he developed led to the identification of salt tolerance genes and breeding of the highly tolerant rice variety FL478. This variety has become the standard tolerant check in rice varietal evaluation. His team developed numerous elite salt-tolerant breeding materials that have been released as commercial varieties in the Philippines and introduced to other countries in Asia and Africa. His success led to a Philippine Department of Agriculture-supported project "Accelerating the Development and Adoption of Next-Generation (Next-Gen) Rice Varieties for the Major Rice Ecosystems of the Philippines" and Bill & Melinda Gates Foundation-supported project "Stress-tolerant Rice for Poor Farmers" in Africa and South Asia.

Dr. Gregorio also led a high-profile project to develop rice varieties with enhanced iron and zinc in the rice grain which paved the way to the development of the Bill & Melinda Gates Foundation project "Breeding for Biofortified Crops."

VICTOR B. AMOROSO

Ph.D. (Botany)

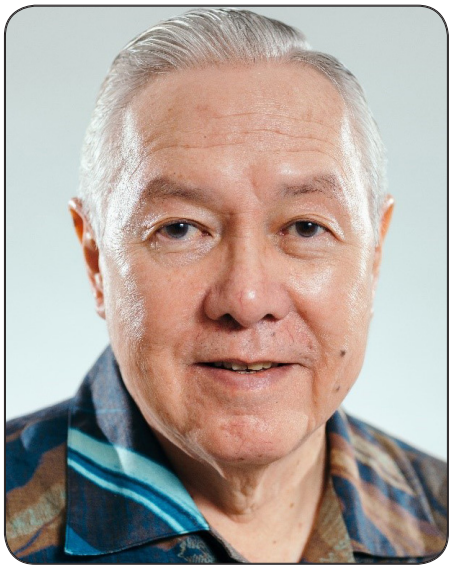
In recognition of his significant research contributions in the field of botany that enriched the scientific knowledge and advancement of biodiversity research through discoveries of new plant species. Dr. Amoroso has discovered 18 new species of vascular plants including a rare species of pygmy pitcher plant in addition to three species as new records in the Philippines.

His researches on ferns led to the advancement of knowledge and development of economic ferns and lycophytes in the Philippines including their potential as functional foods and as source of nutraceuticals and medicine based on indigenous and scientific knowledge. He developed a protocol for large scale propagation of economically important ferns which was adopted in Bukidnon and Twin Lakes Balinsasayao People's Organization in Negros Oriental augmenting the income of farmers in the localities.

He has established a Fern Spore Bank, Fern Garden and a globally recognized Herbarium. His researches in biodiversity of Mt. Hamiguitan Range Wildlife Sanctuary have led to its inscription as a UNESCO World Heritage Site and an ASEAN Heritage Park.

MAHAR K. MANGAHAS

Ph.D. (Economics)



In recognition of his pioneering work in public opinion research in the Philippines and in South East Asia. He has developed and continuously advocated the use of the "Self-Rated Poverty" which is an important tool for poverty monitoring in the country. He essentially forced the initially skeptical economics profession into favorably recognizing a concept and a data-based evidence-based instrument of policy making which has the advantage of timeliness of recommendation from up-to-date survey data.

Based on this, Dr. Mangahas founded Social Weather Stations (SWS) that has been doing public opinion research since 1985, which gauges the pulse of the nation, and which has become increasingly influential and indispensable in Philippine political life and policy. SWS has been serving the country and policymakers as an independent and timely source of pertinent and credible data on Philippine social, economic and political landscape.

CORRESPONDING MEMBERSHIP

RIGOBERTO C. ADVINCULA

Ph.D. (Chemistry)

In recognition of his significant contributions to polymer chemistry and materials. He has constantly engaged in cutting edge research in materials and phenomena, applying the best analytical tools to probe and discover new paradigms in basic research and application. Dr. Advincula has invented new materials and a novel approach for combining electrochemistry, surface plasmon resonance spectroscopy and atomic force microscopy techniques in a single set.

He has engaged in training the best minds among his Filipino students, helping shape their careers in the sciences and engineering. He is also fully engaged in helping the Philippines through collaborative research, mentoring, and helping industries. He has mentored 16 Filipino graduate students in his laboratory in the USA and provided short-term training to Filipino students.

OUSTANDING YOUNG SCIENTISTS

ANGEL B. ENCARNACION

Ph.D. (Marine Science)
Bureau of Fisheries and Aquatic Resources
Department of Agriculture

In recognition of his outstanding contributions in the field of fisheries science particularly on fisheries postharvest and resource management. His research interests include development of technologies to promote production of safe and quality fish and fishery products, and exploitation of underutilized resources by value adding to increase production profits. The novel application of his research on the utilization of edible extracts to control melanosis and lipid oxidation in farmed crustaceans and fish is a response to key issues on food security, particularly on food quality and safety, and waste utilization. As a resource manager and planner, he is also involved in fisheries stock assessment studies as source of information for policy making to better manage and develop the country's fisheries and aquatic resources.

NONILLON M. ASPE

Ph.D. (Natural History Sciences)
Western Philippines University

For his outstanding contribution in the biodiversity and systematics of Philippine earthworms that resulted in discovering around 50 new earthworm species out of 200 species currently recorded in the country. His works on the morphological and molecular characterization of Philippine earthworms helped develop the biology of these organisms, which are crucial to their effective conservation and protection in the face of natural habitat destruction and invasion of exotic species. The conservation of native earthworm species is vital to ensure the existence of these species as bequest to the future generation. Dr. Aspe's works also assess the potential of native species in vermiculture, vermicomposting, soil bioremediation, extraction of natural products, and their conservation and sustainable utilization.

DIXON T. GEVAÑA

Ph.D. (Forest Environmental Science)
University of the Philippines Los Baños

In recognition of his pioneering research on mangrove blue carbon and tree biomass modelling which could further help place mangrove conservation in the country's environmental priorities. He developed community-based stand management designs and strategies to best manage mangrove plantations in view of their capacity to mitigate climate change and improve local economic development. His notable researches on estimating ridge-to-coast forest carbon stocks likewise emphasizes the importance of landscape management approach to sustain the linked vital ecosystem function of carbon sequestration.

RINLEE BUTCH M. CERVERA

Ph.D. (Mechanical, Electrical & Materials Engineering)
University of the Philippines Diliman

In recognition of his outstanding contributions in the field of energy storage and conversion devices, which is important for the development of a green and sustainable energy system in our country. He has fostered a research laboratory on advanced materials for energy equipped with basic and analytical capabilities to enhance research on energy related applications such as those for Lithium-based batteries, solid oxide fuel cells and electrolytic cells applications. Dr. Cervera has also founded the "Institute of Materials Engineers of the Philippines" (IMEP), the first and only professional organization of materials engineers in the Philippines, which brought collaborative opportunities among local and international materials scientists and engineers.

JEY-R S. VENTURA

Ph.D. (Environmental Engineering and Biotechnology)
University of the Philippines Los Baños

In recognition of his significant contribution in the field of science and technology specifically for developing a technology that enhanced sludge reduction and nutrient removal of domestic wastewater. His fascination with bioenergy production has led to the development of a recombinant strain for improved yield of biobutanol production; his life cycle analysis of microalgae bioenergy routes, which not only deal with the assessment of energy and CO2 reduction capacity of microalgae but also include assessment of four bioenergy routes of microalgae system, is important since microalgae are being tapped as a potential alternative renewable energy source in the country.

MARIO A. TAN

Ph.D. (Pharmaceutical Sciences)
University of Santo Tomas

In recognition of his significant contributions in the advancement of chemical studies on the endemic and indigenous Philippine plants both in the field of natural products and total synthesis. His studies on indigenous and endemic Pandanus plants have demonstrated the rich potentials of this plant family as a source of therapeutics. He isolated and elucidated the structure of novel alkaloids with pharmacological activities, some of which were isolated for the first time from a Pandan species.

Dr. Tan designed reaction pathways for his work on the total synthesis of the plant metabolites with complex structures using commercially available precursor compounds. His synthesis routes could facilitate the development of drugs from the compounds that he has isolated. His work represents an important aspect in the development of Philippine medicinal chemistry.

2017 TWAS PRIZE FOR YOUNG SCIENTIST IN THE PHILIPPINES

NATHANIEL P. HERMOSA II

Ph.D. (Physics)
National Institute of Physics
University of the Philippines Diliman

In recognition of his significant contributions to the understanding of fundamental properties of light and light-matter interactions and the development of novel techniques based on light that significantly advanced the state of knowledge of this field in the country. He has written several publications on light's orbital angular momentum, specifically on its effect on the beam's reflection, on the use of these beams for free space communication, and on detecting seemingly inaccessible information.

2018 NAST ENVIRONMENTAL SCIENCE AWARD

WILFREDO ROEHL Y. LICUANAN

Ph.D. (Biology)
De La Salle University

For his scientific contributions on the assessment and monitoring of vulnerability of coral reefs and other coastal ecosystems that provide critical guideposts for marine conservation; for developing sustainable community-based programs to build public understanding of the value of coastal ecosystems; and for his outstanding researches on coral diversity and phylogeny, climate change sensitivities and resilience to thermal stress.

Dr. Licuanan has developed a practical application that can be used in the field in assessing coral reefs, useful for environmental NGOs, national government agencies and local government units. His notable scientific work published in Science in 2008 which discusses the risk posed by climate change to the world's coral reefs, is a highly influential scientific contribution that has been cited by researchers around the world.

NAST TALENT SEARCH FOR YOUNG SCIENTISTS

WINNERS

FIRST PLACE

CHITO P. FELICIANO

Ph.D. (Materials Science)
Philippine Nuclear Research Institute
Department of Science and Technology

In recognition of his outstanding scientific and technological research entitled: **"Long-Term Bioavailability of Redox Nanoparticles Effectively Reduces Organ Dysfunctions and Death in Whole-Body Irradiated Mice"**

SECOND PLACE

RALPH JOHN L. DE LA CRUZ

Ph.D. (Mathematics)
University of the Philippines Diliman

In recognition of his outstanding scientific and technological research entitled: **"Skew Phi Polar Decompositions"**

THIRD PLACE

JOHN FREDERICK D. TAPIA

Ph.D. (Chemical Engineering)
De La Salle University

In recognition of his outstanding scientific and technological research entitled: **"Optimal CO2 Allocation and Scheduling in Enhanced Oil Recovery (EOR) Operations"**

LORI SHAYNE A. BUSA

Ph.D. (Chemical Sciences and Engineering)
Nueva Vizcaya State University

In recognition of her outstanding scientific and technological research entitled: **"A Competitive Immunoassay System for Microfluidic Paper-Based Analytic Detection of Small Size Molecules"**

2017 MAGSAYSAY FUTURE ENGINEERS/TECHNOLOGISTS AWARD

WINNERS

FIRST PLACE

JANNE PAULINE S. NGO
De La Salle University

In recognition of her outstanding scientific and technological research entitled:**"Chemical Treatment of Waste Abaca for Natural Fiber-Reinforced Geopolymer Composite"**

SECOND PLACE

NEIL KARLO Z. OLEGARIO
University of the Philippines Los Baños

In recognition of his outstanding scientific and technological research entitled: **"Optimization of Bacteriocin Production by Pediococcus acidilactici Lindner in Rice Bran Extract-Based Medium"**

THIRD PLACE

JOSHUA IAN C. BAUTISTA
Mapua Institute of Technology

In recognition of his outstanding scientific and technological research entitled: **"Color Vision Deficiency Compensation for Visual Processing Disorder using Hardy- Rand-Rittler Test and Color Transformation"**

SPECIAL CITATIONS

KYLE DARRYL T. AGUILAR
De La Salle University

In recognition of his outstanding scientific and technological research entitled: **"Bilevel Fuzzy Optimization Model of an Algae-based Eco-Industrial Park under Cooperative Game Theory"**

DARVY P. ONG
University of the Philippines

In recognition of his outstanding scientific and technological research entitled: **"Brainsmart: Ambient Assisted Living Smartphone Application Prototype for Parkinson's Disease Patients"**

2017 GEMINIANO DE OCAMPO VISIONARY AWARD FOR MEDICAL RESEARCH

LOURDES L. IGNACIO, M.D.

University of the Philippines Manila

In recognition of her outstanding contributions towards the advancement of the mental health services in the Philippines as well as other Asian countries. Her pioneering studies proved the possibility to undertake mental health care at the primary level and led to better accessibility of Filipinos through training and capacity building program of health staff in the rural health units. Dr. Ignacio's publications served as important references for the development of community mental health services and psychosocial interventions programs in the aftermath disasters.

OUTSTANDING BOOKS

- **"Systemic Pesticides: A Worldwide Assessment"** (by Jean-Marc Bonmatin, Francisco Sanchez-Bayo, and Jose Isagani Janairo) De La Salle University Publishing House, 2017
- **"Bamboo: The Grass of Hope"** (by Aida C. Baja-Lapis, Armando M. Palijon, Florentino O. Tesoro, and Felizardo D. Virtucio) Philippine Bamboo Foundation, Inc., 2016
- **"Fisheries Resources and Ecological Assessment of Manila Bay 2012-2015"** (by Mudjekeewis D. Santos, Elsa F. Furio, Grace DV. Lopez, Francisco SB. Torres Jr., Valeriano M. Borja, Eunice DC Bognot and Norvida C. Gatdula) Published by the National Fisheries Research and Development Institute, Department of Agriculture, 2017

OUTSTANDING SCIENTIFIC PAPERS

- **"Larvae Identification and Development of the Only Freshwater Sardinella, Sardinella Tawilis Endemic to Taal Lake Philippines"** (by Maria Theresa M. Mutia, Katreena P. Sarmiento, Myla C. Muyot, Michael John R. Mendiola, Benjie D. Tordecilla and Mudjekeewis D. Santos) Philippine Journal of Science 146(3):257-265, 2017

- **"Mutations in the Alpha-D-Galactosidase Gene Suggest Molecular Basis of the Mutant "Makapuno" Coconut (Cocos Nucifera L.) Phenomenon"** (by Reggie Y. dela Cruz and Von Jason D. Bugayong) The Philippine Agricultural Scientist 99(4):321-325, 2016

- **"An Egg Yolk Immunoglobulin (Rvp6-Igy) Specific for a Constructed Rotavirus Vp6 Antigen (Rvp6) Inhibited Rotavirus Replication in Vitro"** (by Marilen P. Balolong, Ju Kyoung Oh, Jung Woo Kim, Yong Tae Jung, Nina G. Gloriani and Dae-Kyung Kang) Philippine Journal of Science 145(1):71-77, 2016

- **"Mathematical and Anthropological Analysis of Northern Luzon Funeral Textile"** (by Ma. Louise Antonette N. De Las Peñas and Analyn V. Salvador-Amores) Philippine Journal of Science 145(1): 89-103, 2016

- **"Geohazards, Tropical Cyclones and Disaster Risk Management in the Philippines: Adaptation in a Changing Climate Regime"** (by Decibel V. Faustino-Eslava, Carla B. Dimalanta, Graciano P. Yumul Jr., Nathaniel T. Servando, and Nathaniel A. Cruz) Journal of Environmental Science and Management 16(1):84-97, 2013

- **"Making Social Health Insurance and Micro-Savings Programs Work for the Informal Sector in the Philippines"** (by Mitzie Irene P. Conchada and Marites M. Tiongco) DLSU Business and Economics Review 27(1):107-123, 2017

- **"Market Competition in the Downstream Oil Industry: Is There Evidence of Price Asymmetry?"**(by Ma. Joy Abrenica, Rolando Danao andMa. Nimfa Mendoza) The Philippine Review of Economics LI (2):1-20, 2014

CERTIFICATE OF RECOGNITION FOR MANUAL ON MANGROVE

- **"Manual on Community-based Mangrove Rehabilitation Mangrove Manual Series No. 1"** (by Jurgenne H. Primavera, Josephine P. Savaris, Basilio E. Bayojo, Jofel D. Conching, David J. Curnick, Rodney L. Golbeque, Armi May T. Guzman, Junriz Q. Henderin, Rosalie V. Joven, Rona Joy A. Loma and Heather J. Koldewey) Published by the Zoological Society of London, 2012. ISBN 978-971-95370-1-4

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REPORT ON THE 39TH ANNUAL SCIENTIFIC MEETING

With over a thousand attendees, the National Academy of Science and Technology, Philippines (NAST PHL) successfully held its 39th Annual Scientific Meeting (ASM) on July 12-13 at the Manila Hotel, with the theme, "Attaining Sustainable Development Goals: Philippine Fisheries and Other Aquatic Resources 20/20".

Academician Fabian M. Dayrit, acting president of NAST PHL, opened the event by emphasizing the country's need to improve utilization of water resources for national development. He also gave updates regarding NAST's recent efforts to solve this pertinent science and technology concern, particularly the conduct of Regional Scientific Meetings (RSM) held in Mindanao, Visayas and Luzon. These RSMs highlighted the significance of fisheries and aquatic resources in the food, transport, and pharmaceutical industry, to name a few.

DOST Secretary Fortunato De la Peña graced the event as keynote speaker highlighting the relevant sustainable development goals (SDGs), linking DOST with the Department of Agriculture (DA) and Department of Environment and Natural Resources to fill the gaps in policy-making and to meet the demands of the nation.

The series of plenary sessions was opened by Dr. Ronald Mendoza of the Ateneo De Manila University, as he talked about the Philippines' Blue Economy, citing it as necessary in pushing forward our national interest.

Academician Rodel D. Lasco of NAST PHL presented the case of Laguna de Bay as an example for sustainable development, citing multi-sectoral usage and conservation factors for the largest inland water-resource of the country.

His presentation was followed by Dr. Evelyn Grace T. De Jesus-Ayson of SEAFDEC who discussed sustainable mariculture. She cited the success of the Panabo Mariculture Park as a benchmark that can be followed by other viable water resources with its harmonious cooperation between LGUs and the private sector.

The first day ended with Dr. Kent Carpenter recounting the grueling victory of the country in last year's territorial dispute for the West Philippine Sea at the International Court of Justice, the Hague in November 2015. He cited the role of scientists in ecosystems protection and naval security.

The second day opens with Academician Gisela P. Concepcion highlighting the potential of marine microbiome research in providing promise of new drug compounds.

Academician Marco Nemesio E. Montaño discussed the importance of marine science and technology in the sardine and seaweed industries. According to him, seaweeds should be further studied for bioenergy, pharmaceuticals, food, agriculture and horticulture, paper and other products.

National Scientist Angel C. Alcala of NAST PHL reported on the success of the Apo Island and Sumilon Island No-Take Marine Reserves, proving that sustainability through conservation is the best way to provide livelihood for all.

The series of plenary talks was concluded by Mr. Philip Ong of Santeh Feeds, Inc. As a proponent of the private sector, he shared the success stories and opportunities, as well as the research mishaps, in the aquaculture industry --- from the wrong administration of vaccine in tilapia fingerlings to the viability of vanamei shrimps and mangrove crabs for aquaculture.

Academician Rodel D. Lasco presented the resolutions to DOST Secretary Fortunato De la Peña and Department of Agriculture Undersecretary for Fisheries and BFAR National Director Commodore Eduardo Gongona. Secretary De la Peña responded by committing the DOST towards the Blue Economy and all of its relevant resolutions, while Undersecretary Gongona responded by encouraging better marketing and commercialization of the numerous researches done by our scientists.The 39th ASM was hosted by the NAST Agricultural Sciences Division, chaired by Academician Eufemio T. Rasco, Jr.

The Annual Scientific Meeting serves as the leading convention between the experts, the industry and policymaking agencies, to translate research into future social programs and commercial products. Recommendations gathered from this activity are then forwarded to the concerned sectors of the Philippine government.

LUNINGNING E. SAMARITA-DOMINGO
Director IV, NAST PHL

NAST 39th ANNUAL SCIENTIFIC MEETING RESOLUTIONS PRESENTED TO DOST AND DA

Resolutions summarizing the recommendations of the National Academy of Science and Technology, Philippines (NAST PHL) were presented during the second day of the NAST 39th Annual Scientific Meeting on July 13, 2017.

The Department of Science and Technology Secretary Fortunato De la Peña regards the Annual Scientific Meeting (ASM) as a success after Academician Rodel T. Lasco presented the Resolutions. As a recurring topic throughout the two-day event, Sec. De la Peña commits towards the Blue Economy and all other related resolutions, whether a new, dedicated agency for oceanic resources is established or not. He also beckons the rest of the Departments to follow suit and direct their efforts towards such. Sec. De la Peña also noted the importance of partnering with various LGUs in implementing research and development, which was also mentioned as a constant example throughout by the many plenary speakers. Lastly, he highlighted the importance of the maritime industry, encourages continuous discussion and research to give recommendations for the Blue Economy. He suggested adding the agenda of strengthening the shipbuilding industry in the recommendations.

Sec. De la Peña's response was followed by Department of Agriculture Undersecretary Retired Commodore Eduardo Gongona, as the representative of Secretary Emmanuel Piñol. He emphasized on "taking care of what we have, develop it and make it a country with an economy that we can be proud of." Usec. Gongona is supportive of the creation of a new agency, but advised that the timing of its suggestion is very important. He noted of the billions of pesos' loss due to foreign poaching, dynamite fishing, among other malpractices and threats. Usec. Gongona encourages better marketing and commercialization of the numerous researches done by our scientists. This in turn would address food sufficiency, among other matters of national security.

The Academy expressed its hope that the result of this year's ASM will be favourably considered by the present administration as a guide to assist the concerned departments and agencies in preparing and implementing the roadmap to improve the country's oceans, fisheries and aquatic resources.

39th Annual Scientific Meeting Resolutions

Theme: ATTAINING SUSTAINABLE DEVELOPMENT GOALS:
PHILIPPINE FISHERIES AND OTHER AQUATIC RESOURCES 20/20
39th Annual Scientific Meeting
12-13 July 2017, Manila Hotel

RESOLUTIONS

WHEREAS, the Philippine territory consists of 80% water and 20% land, which is owing to its archipelagic geography;

WHEREAS, the ocean is a source of food, pharmaceutical and industrial raw materials, including phycocolloids (from seaweeds), bioactive natural compounds, minerals and other high value products;

WHEREAS, in the development of the "Blue Economy" (ocean-based) in the country, the living marine resources are major contributors;

WHEREAS, these vast aquatic and marine natural resources remain largely untapped;

WHEREAS, harnessing aquatic and marine resources will help us meet our sustainable development goals (SDGs);

WHEREAS, Philippine aquatic resources have become overexploited, a victim of the so-called "tragedy of the commons", and needs restoration and protection;

WHEREAS, there are several agencies involved in the administration and management of the country's ocean and aquatic resources resulting in fragmented and ineffective implementation of policies and programs;

WHEREAS, other ASEAN countries of comparable or even lesser marine and aquatic resources have placed governance of fisheries and oceans at the Ministry (Department) level;

WHEREAS, there is a paramount need for a no-nonsense enforcement of the laws and rules governing the exploitation of our aquatic resources;

WHEREAS, the consequence of over exploitation of resources and poor implementation of policies and programs, fisher folk communities are still among the poorest in the country.

NOW, THEREFORE, the National Academy of Science and Technology (NAST), Philippines on its 39th Annual Scientific Meeting recommend the following actions to be addressed accordingly by the appropriate offices and agencies:

<u>For the Office of the President and Senate of the Philippines/ House of Representatives:</u>

- Initiate the creation of a new department that will deal with fisheries, the oceans and other aquatic resources (e.g. Department of Fisheries and Oceans). The new department will spearhead the development of the Blue Economy in the Philippines. The primary function of the new department is to develop and manage resources in the oceans and other aquatic ecosystems.

- Consider the following concerns in the creation of the new department: equitable distribution of benefits; separating the development and regulatory functions; including both living and non-living resources (e.g. minerals, energy; market development) creating R and D arm;

- Wherever appropriate, increase the budget for fisheries and ocean resources including that of more inclusive research of aquatic issues;

- Specifically, the following issues need to be urgently addressed by the executive branch and later by the new department:

1. Human Resources
    a. Develop competencies that empower fisher folk and other stakeholders (e.g. seafarers, ship/ boat builders) in the use of appropriate practices that are at once productive and sustainable;
    b. Develop tertiary level human resources who will staff the new department and related government agencies.

2. Information and Educational Campaign
    a. Intensify information, education, and communication campaign on the blue economy and aquatic and ocean resources;

3. Technologies
    a. Develop, introduce and promote sustainable fisheries and aquatic resources technologies, including technologies for mineral resources;

4. Regulation
    a. Strengthen the enforcement of fishery and environmental laws and regulations;
    b. Promote the protection, conservation, and sustainable and equitable utilization of ocean and aquatic resources;

5. Environmental conservation and management
    a. Rehabilitate aquatic habitats (e.g. mangroves, sea grasses, coral reefs, wetlands) and once restored, protect these from future collapses associated with "tragedy of commons";
    b. Strengthen environmental monitoring in the fisheries and aquatic sector using the state-of-the-art technologies;

6. Maritime, communication, and R/D infrastructure
    a. Prepare a master development plan covering fish ports, telecommunication facilities, and other infrastructure in coordination with relevant agencies;
    b. Upgrade existing fish ports and navigation equipment and other infrastructure facilities

7. Business development
    a. Create business models that will ensure sustainable livelihoods and equitable distribution of costs and benefits;
    b. Promote and support the development of enterprises including SMEs in the blue economy and related sectors.

For the Department of Agriculture
- Support and Facilitate the creation of the new department on oceans, fisheries and aquatic resources

For the Department of Science and Technology (DOST)
- Create a research agency focusing on oceans and its resources; including the sea bed;
- Continue to develop and disseminate new and affordable technologies for conservation, restoration, and sustainable utilization of ocean and aquatic resources;
- Coordinate the effective implementation of the national R&D agenda for the fisheries and aquatic sector, including the harnessing of renewable energy from the ocean and desalination of seawater for domestic use;
- Intensify S&T human resources development for the fisheries and aquatic sector;

For the Department of Education (DepEd)
- Develop curricular materials that promote awareness and better appreciation of the importance of fisheries and aquatic resources;
- Align K to 12 curriculum to include awareness and competence in ocean and aquatic resources

For the Department of Health (DOH)
- Coordinate the environmental biologic monitoring of fisheries and aquatic resources and impact in human health;
- Provision of expanded health care services to fisher folk communities

For the National Economic and Development Authority (NEDA)

- Ensure that government programs on fisheries and the oceans are science-based and rooted on sustainable marine ecosystem management

For the Local Government Units (LGUs)

- Strengthen the fisheries extension services to serve as the link between researchers and fisher folk communities in their choice of appropriate technology.

For the Department of Environment and Natural Resources

- Ensure that environmental concerns are tempered by the needs of socio-economic development;
- Expand marine protected areas (MPAs) to at least 20-30% of total area;

For Commission on Higher Education (CHED)

- Consider creating a "virtual" university for Marine and Archipelagic Studies which will integrate and coordinate the initiatives of HEIs on oceans, fisheries and blue economy concerns.

For the Department of Foreign Affairs

- Ensure the protection of national territorial integrity

For the Department of Trade and Industry (DTI)

- Encourage and support the establishment of industries in the blue economy guaranteeing inclusive growth
- Expand the market for products of the blue economy

UPDATE ON THE 39th ASM RESOLUTION FOR THE CREATION OF THE DEPARTMENT OF FISHERIES AND AQUATIC RESOURCES

In the First Regular Session of the 17th Congress in 2016, there were 10 bills filed by various representatives of the Lower House of Congress, led by Rep. Gloria Macapagal Arroyo (author of House Bill No. 428), for the creation of a Department of Fisheries and Aquatic Resources or a similar entity. Such bills have been referred to appropriate Committees of the House of Representatives and are pending up to this date. Similar Senate bills have been filed by Senators Francisco Pangilinan and Loren Legarda and are also pending in the Senate of the Philippines. The creation of a Department of Fisheries and Aquatic Resources has not been given priority by President Rodrigo Duterte for action by Congress. In his speech at the Closing Ceremony of the 39th ASM, Undersecretary for Fisheries and National Director of the Bureau of Fisheries and Aquatic Resources of the Department of Agriculture said : "We support the creation of a Department of Fisheries and Aquatic Resources but it is a long shot."

With the given situation, the NAST Commitee (chaired by Acd. Rafael D. Guerrero III) tasked with pushing the initiative for the creation of the Department of Fisheries and Aquatic Resources decided to shift its focus and efforts on assessing the current status and potentials of mariculture (marine aquaculture) in the country considering its vast marine resources consisting of 26.6 million hectares of coastal water and 193.4 million hectares of oceanic waters.

The Committee (Academicians Porfirio Aliño, Rafael Guerrero III and Eufemio Rasco, Jr.) visited the Panabo Mariculture Park in Davao del Norte on January 11, 2018 (with support of the NAST) to gather information and assess its programs and accomplishments. A report of such assessment will be made by the Committee at the 40th ASM on July 11, 2018 through a presentation entitled "The Panabo Mariculture Park: A Model for Sustainable Aquaculture?".

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Clerk III

NAST MEMBERS *1978-2017*

Year of Entry	Name	Field of Specialization	Remarks
1978	Paulo C. Campos, M.D.	Nuclear Medicine	Proclaimed N.S. 1989
	Alfredo V. Lagmay, Ph.D.	Experimental Psychology	Proclaimed N.S. 1988
	Cecilio F. Lopez, Dr. phil.	Philippine Linguistics and Oriental Studies	
	Tito A. Mijares, Ph.D.	Statistics	
	Juan S. Salcedo, Jr., M.D., D.Sc. (*honoris causa*)	Nutrition and Public Health	Proclaimed N.S. 1978
	Alfredo C. Santos, Dr. phil.	Physical Chemistry	Proclaimed N.S. 1978
	Dioscoro L. Umali, Ph.D.	Genetics and Plant Breeding	Proclaimed N.S. 1986
	Carmen C. Velasquez, Ph.D.	Parasitology	Proclaimed N.S. 1983
	Gregorio T. Velasquez, Ph.D.	Phycology	Proclaimed N.S. 1982
	Gregorio Y. Zara, D. Sc.	Engineering and Inventions	Proclaimed N.S. 1978
1979	Encarnacion A. Alzona, Ph.D.	Philippine History	Proclaimed N.S. 1985
	Teodoro A. Agoncillo, Litt.D. (*honoris causa*)	Philippine History	Proclaimed N.S. 1985 (Posthoumous)
	José Encarnación, Jr., Ph.D.	Economics	Proclaimed N.S. 1987
	Pedro B. Escuro, Ph.D.	Genetics and Plant Breeding	Proclaimed N.S. 1994
	Raymundo A. Favila, Ph.D.	Mathematics	
	Francisco M. Fronda, Ph.D.	Animal Husbandry	Proclaimed N.S. 1983
	Bienvenido O. Juliano, Ph.D.	Organic Chemistry	Proclaimed N.S. 2000
	Melecio S. Magno, Ph.D.	Physics	
	Fe del Mundo, M.D., M.A.	Pediatrics	Proclaimed N.S. 1980
	Geminiano T. de Ocampo, M.D.	Opthalmology	Proclaimed N.S. 1982
	Eduardo A. Quisumbing, Ph.D.	Plant Taxonomy, Systematics and Morphology	Proclaimed N.S. 1980
	Jose N. Rodriguez, M.D.	Leprology	
	Casimiro del Rosario, Ph.D.	Physics, Astronomy and Metrology	Proclaimed N.S. 1982
1980	Luz Oliveros-Belardo, Ph.D.	Pharmaceutical Chemistry	Proclaimed N.S. 1987
1980	Magdalena C. Cantoria, Ph.D.	Botany	
	Emerita V. de Guzman, Ph.D.	Plant Physiology	
	Conrado S. Dayrit, M.D.	Pharmacology, Cardiology	
	Francisco O. Santos, Ph.D.	Human Nutrition and Agricultural Chemistry	Proclaimed N.S. 1983 (Posthumous)
	Joventino D. Soriano, Ph.D.	Cytogenetics and Mutation Research	

Year of Entry	Name	Field of Specialization	Remarks
1980	Clara Y. Lim-Sylianco, Ph.D.	Biochemistry and Organic Chemistry	Proclaimed N.S. 1994
1981	Clare R. Baltazar, Ph.D.	Systematic Entomology	Proclaimed N.S. 2001
	Julian A. Banzon, Ph.D.	Biophysical Chemistry	Proclaimed N.S. 1986
	Amando M. Dalisay, Ph.D.	Economics	
	Benjamin D. Cabrera, M.D., M.P.H.	Medical Parasitology and Public Health	
1982	Emil Q. Javier, Ph.D.	Plant Breeding and Genetics	
1983	Gelia T. Castillo, Ph.D.	Rural Sociology	Proclaimed N.S. 1999
	Jose O. Juliano, Ph.D.	Nuclear Chemistry and Physics	
	Hilario D. G. Lara, M.D., Dr. P.H.	Public Health	Proclaimed N.S. 1985
	Bienvenido F. Nebres, S.J., Ph.D.	Mathematics	Proclaimed N.S. 2011
	Faustino T. Orillo, Ph.D.	Mycology	
	Jose R. Velasco, Ph.D.	Plant Physiology	Proclaimed N.S. 1998
1985	Quintin L. Kintanar, M.D., Ph.D.	Environmental Medicine	
	Quirino O. Navarro, Ph.D.	Nuclear Chemistry	
	Gregorio F. Zaide, Ph.D.	History	
1987	Solita F. Camara-Besa, M.D., M.S.	Biochemistry	
	Filomena F. Campos, Ph.D.	Plant Breeding/ Cytogenetics	
	Lourdes J. Cruz, Ph.D.	Biochemistry	Proclaimed N.S. 2006
	Edito G. Garcia, M.D.	Medical Parasitology	
	Carmen Ll. Intengan, Ph.D.	Nutrition	
	Dolores A. Ramirez, Ph.D.	Biochemical Genetics	Proclaimed N.S. 1998
	Benito S. Vergara, Ph.D.	Plant Physiology	Proclaimed N.S. 2001
	Prescillano M. Zamora, Ph.D.	Plant Anatomy- Morphology	
1988	Ricardo M. Lantican, Ph.D.	Plant Breeding	Proclaimed N.S. 2005
1990	Leopoldo S. Castillo, Ph.D.	Animal Science	
	Apolinario D. Nazarea, Ph.D.	Biophysics	
	Ruben L. Villareal, Ph.D.	Horticulture	
1992	Mercedes B. Concepcion, Ph.D.	Demography	Proclaimed N.S. 2010
	Ernesto O. Domingo, M.D.	Internal Medicine/ Gastroenterology	Proclaimed N.S. 2010
	Rafael D. Guerrero III, Ph.D.	Fisheries Management	
	Evelyn Mae T. Mendoza, Ph.D.	Biochemistry	
1993	Ramon F. Abarquez, Jr., M.D.	Cardiology	
	Salcedo L. Eduardo, Ph.D.	Veterinary and Medical Parasitology	
	Edgardo D. Gomez, Ph.D.	Marine Biology	Proclaimed N.S. 2014
	Teodulo M. Topacio, Jr., Ph.D.	Veterinary Medicine	Proclaimed N.S. 2009

Year of Entry	Name	Field of Specialization	Remarks
1994	Perla D. Santos Ocampo, M.D.	Pediatrics	Proclaimed N.S. 2010
1995	Ledivina V. Cariño, Ph.D.	Sociology	
	Raul V. Fabella, Ph.D.	Economics	Proclaimed N.S. 2011
	William G. Padolina, Ph.D.	Phytochemistry	
1996	Veronica F. Chan, Ph.D.	Microbiology	
1998	Andrew Gonzalez, F.S.C, Ph.D.	Linguistics	
1999	Onofre D. Corpuz, Ph.D.	Political Economics and Government	Proclaimed N.S. 2004
2000	Filemon A. Uriarte, Jr., Ph.D.	Chemical Engineering	
	Norman E. Borlaug, Ph.D.	Agronomy/ Plant Breeding	Honorary Member (1970 Nobel Peace Prize Laureate)
	Ceferino L. Follosco, Ph.D. (*honoris causa*)	Mechanical, Electrical, & Agricultural Eng'g.	
	Angel L. Lazaro III, Ph.D.	Civil Engineering	
	William T. Torres, Ph.D.	Computer Science	
	Reynaldo B. Vea, Ph.D.	Marine Trans. System, Naval Architecture	
2002	Romulo G. Davide, Ph.D	Nematology-Plant Pathology	
	Asuncion K. Raymundo, Ph.D.	Microbial Genetics/Antimicrobials (Antibiotic) Bacterial Taxonomy	
2003	Amador C. Muriel, Ph.D.	Physics and Astronomy	Corresponding Member
	Eduardo A. Padlan, Ph.D.	Biophysics	Corresponding Member
2004	Angel C. Alcala, Ph.D.	Biological Sciences, Humanities (*honoris causa*)	Proclaimed N.S. 2014
	Ramon C. Barba, Ph.D.	Horticulture	Proclaimed N.S. 2014
	Baldomero M. Olivera, Ph.D.	Biochemistry	Corresponding Member
2005	Caesar A. Saloma, Ph.D.	Applied Physics	
2006	Eliezer A. Albacea, Ph.D.	Computer Science	
	Reynaldo L. Villareal, Ph.D.	Genetics	Corresponding Member
2007	Allan Benedict I. Bernardo, Ph.D.	Cognitive Psychology	
	Christopher C. Bernido, Ph.D. Leonardo Q. Liongson, Ph.D.	Theoretical Physics Water Resources Administration/ Hydrology	
	Liwayway M. Engle, Ph.D.	Genetics	Corresponding Member
2008	Libertado C. Cruz, Ph.D.	Reproductive Biotechnology	
	Gisela P. Concepcion, Ph.D.	Marine Natural Products, Biochemistry & Biological Sciences (Chemistry)	
	Gavino C. Trono, Jr., Ph.D.	Marine Botany, Seaweed Biodiversity, Taxonomy, Ecology and Culture	Proclaimed N.S. 2014
	Jose Maria P. Balmaceda, Ph.D.	Mathematics	
	Alvin B. Culaba, Ph.D.	Mechanical Engineering	

Year of Entry	Name	Field of Specialization	Remarks
	Jaime C. Montoya, M.D., M.Sc.	Infectious Diseases	
	Carmencita D. Padilla, M.D., MHPSS	Genetics	
	Arsenio M. Balisacan, Ph.D.	Economics	
2009	Rhodora V. Azanza, Ph.D.	Botany	
	Fabian M. Dayrit, Ph.D.	Chemistry	
	Rodel D. Lasco, Ph. D.	Forestry	
	Eufemio T. Rasco Jr., Ph.D.	Plant Breeding	
	Manuel M. Garcia, Ph.D.	Microbiology	Corresponding Member
2010	Marco Nemesio E. Montaño, Ph.D.	Biological Chemistry	
	Fernando P. Siringan, Ph.D.	Geology	
	Guillermo Q. Tabios III, Ph.D.	Civil Engineering	
	Antonio Miguel L. Dans, M.D.	Clinical Epidemiology	
2011	Ernesto J. del Rosario, Ph.D.	Chemistry	
	Aura C. Matias, Ph.D.	Industrial Engineering	
	Agnes C. Rola, Ph.D.	Agricultural Economics	
	Eduardo R. Mendoza, Ph.D.	Mathematics	Corresponding Member
2012	Jose B. Cruz Jr., Ph.D.	Electrical Engineering	
	Michael L. Tan, Ph.D.	Anthropology	
	Alfonso M. Albano, Ph.D.	Physics	Corresponding Member
2014	Porfirio Alexander M. Aliño, Ph.D.	Marine Chemical Ecology	
	Remigio M. Olveda, M.D.	Infectious and Tropical Medicine	
2015	Ceferino P. Maala, Ph.D.	Veterinary Medicine	
	Jurgenne H. Primavera, Ph.D.	Marine Science	
	Estrella F. Alabastro, Ph.D.	Chemical Engineering	
	Fortunato B. Sevilla III, Ph.D.	Instrumentation and Analytical Science	
	Edward H.M. Wang, M.D.	Orthopedics	
2016	Virginia C. Cuevas, Ph.D.	Botany	
	Alfredo Mahar Francisco A. Lagmay, Ph.D.	Geology	
	Enrique M. Ostrea Jr., M.D.	Pediatrics	Corresponding Member
	Joel L. Cuello, Ph.D.	Agricultural and Biological Engineering	Corresponding Member
2017	Josefino C. Comiso, Ph.D.	Physics	Corresponding Member
	Raymond Girard R. Tan, Ph.D	Mechanical Engineering	
	Cesar L. Villanoy, Ph.D	Physical Oceanography	
	Carlito B. Lebrilla, Ph.D	Chemistry	Corresponding Member

Legend: N.S. - National Scientist

OUTSTANDING YOUNG SCIENTISTS *1980-2017*

Year	Name	Field of Specialization
1980	Ernesto J. del Rosario Jr., Ph.D. (Elected Academician, 2011)	Chemistry
	Salcedo L. Eduardo, Ph.D. (Elected Academician, 1993)	Veterinary and Medical Parasitology
	Rafael D. Guerrero III, Ph.D. (Elected Academician, 1992)	Fisheries Management
	Rufino H. Ibarra, Ph.D.	Physics
	Florian M. Orejana-Ward, Ph.D.	Fish Processing and Quality Control
	Ely Anthony R. Ouano, Ph.D.	Environmental Engineering
	Ernesto M. Pernia, Ph.D.	Economic Demography
	Alberto Romualdez, Jr., M.D.	Medicine
	Thelma E. Tupasi-Ramos, M.D. (Elected Academician, 2006)	Infectious Diseases
	Victoria A. Vicente- Beckett, Ph.D.	Chemistry
1981	Romeo M. Bautista, Ph.D.	Economics
	Paciente A. Cordero, Jr., Ph.D.	Marine Biology
	Lourdes J. Cruz, Ph.D. (Elected Academician, 1987; Proclaimed National Scientist, 2005)	Biochemistry
	Severino V. Gervacio, Ph.D.	Mathematics
	Esperanza A. Icasas-Cabral, M.D.	Cardiology
	Ernesto P. Lozada, Ph.D.	Agricultural Engineering
	Manolito G. Natera, Ph.D.	Physics
1982	Carmelo A. Alfiler, M.D.	Pediatric Medicine
	Rodolfo P. Cabangbang, Ph.D.	Agronomy
	Virgilio G. Enriquez, Ph.D.	Psychology
	Alejandro N. Herrin, Ph.D.	Demographic Economics
	Jose G. Marasigan, Ph.D.	Mathematics
	William G. Padolina, Ph.D. (Elected Academician, 1995)	Phytochemistry
	Percy A. Sajise, Ph.D.	Ecology
	Benito L. Tanhehco, M.D.	Biomedical Engineering
1983	Ponciano S.M. Halos, Ph.D.	Plant Pathology
	Remigio M. Olveda, M.D. (Elected Academician, 2014)	Parasitic Diseases

Year	Name	Field of Specialization
1983	Vicente B. Paqueo, Ph.D.	Human Resource Economics
	Luzvisminda U. Rivero, Ph.D.	Chemistry
1984	William T. Chua, M.D.	Cardiovascular Medicine
	Reynaldo E. dela Cruz, Ph.D.	Forestry
	Evelyn Mae T. Mendoza, Ph.D. (Elected Academician, 1992)	Biochemistry
	Roger R. Posadas, Ph.D.	Physics
	Eufemio T. Rasco Jr., Ph.D. (Elected Academician, 2009)	Plant Breeding
	Filemon A. Uriarte, Jr., Ph.D. (Elected Academician, 2000)	Chemical Engineering
1985	William D. Dar, Ph.D.	Agriculture
	Alumanda M. dela Rosa, Ph.D.	Radiation Chemistry
	Ann Inez N. Gironella, Ph.D.	Statistics
	Jose A. Magpantay, Ph.D.	Physics
	Corazon M. Raymundo, D.Sc.	Population Science
	Mediadora C. Saniel, M.D.	Epidemiology
	Amaryllis T. Torres, Ph.D.	Psychology
1986	Regalado G. Zamora, Ph.D.	Animal Science
	Edwin A. Benigno, Ph.D.	Entomology
	Ida F. Dalmacio, Ph.D.	Food Microbiology
	Ma. Concepcion C. Lizada, Ph.D.	Biochemistry
	Ernesto S. Luis, Ph.D.	Food Chemistry
	Manolo G. Mena, Ph.D.	Metallurgy
	Glorina N. Pocsidio, Ph.D.	Zoology
	Danilo M. Yanga, Ph.D.	Physics
1987	Ruperto P. Alonzo, M.A	Economics
	Dante B. Canlas, Ph.D.	Economics
	Rene P. Felix, Ph.D.	Mathematics
	Miguel D. Fortes, Ph.D.	Marine Plant Ecology
	Ruben M. Gapasin, Ph.D.	Plant Pathology
	Wilfredo I. Jose, Ph.D.	Chemical Engineering
	Felino P. Lansigan, Ph.D.	Statistics
	Reynaldo C. Mabesa, Ph.D.	Food Science
	Manuel F. Montes, Ph.D.	Economics
	Linda S. Posadas, Ph.D.	Physics
1988	Francisco M. Basuel, Ph.D.	Animal Science
	Ma. Cynthia Rose B. Bautista, Ph.D.	Sociology
	Manuel M. Lantin, Ph.D.	Plant Breeding
	Rolando E. Ramos, Ph.D..	Mathematics

Year	Name	Field of Specialization
1988	Polly W. Sy, Ph.D.	Mathematics
	Benito C. Tan, Ph.D.	Botany
1989	Efren C. Abaya, Ph.D.	Electrical Engineering
	Candida B. Adalla, Ph.D.	Entomology
	Christopher C. Bernido, Ph.D. (Elected Academician, 2007)	Physics
	Virginia C. Cuevas, Ph.D. (Elected Academician, 2016)	Botany
	Mary Ann D. Lansang, M.D.	Clinical Epidemiology
	Alfenitta Fermina B. Zamora, M.S.	Agronomy
	Ambrosio Raul R. Alfiler, MS	Entomology
1990	Adelina A. Barrion, Ph.D.	Insects Genetics
	Manuel M. Dayrit, M.D.	Epidemiology and MPH
	Emmanuel M. Lagare, Ph.D.	Mathematics
	Rodel G. Maghirang M.S.	Vegetable Breeding
	Roberto N. Padua, Ph.D.	Theoretical Statistics
	Lilian F. Pateña, M.S.	Plant Tissue Culture
	Manuela Fe H. Tarroja, Ph.D.	Physics
	Wilfred U. Tiu, Ph.D.	Parasitology/ Immunology
1991	Victor B. Amoroso, Ph.D.	Botany
	Alberto T. Barrion, M.S.	Entomology
	Ma. Cecilia Gastardo-Conaco, Ph.D.	Psychology
	Emerenciana E. Ballelos-Duran, Ph.D.	Biophysics
	Edwino S. Fernando, M.S.	Plant Taxonomy
	Ma. Socorro H. Gochoco-Bautista	Economics
	Joseph Anthony Y. Lim, Ph.D.	Economics
	Florentino C. Sumera, Ph.D.	Chemistry
	Violeta N. Villegas, Ph.D.	Fruit Breeding and Genetics
1992	Arsenio M. Balisacan, Ph.D. (Elected Academician, 2008)	Economics
	Rhodora A. del Rosario, M.D.	Health Science
	Portia G. Lapitan, M.S.	Forest Biology
	Luz R. Nochefranca, Ph.D.	Mathematics
	Valentino C. Perdido, M.S.	Crop Science
	Caesar A. Saloma, Ph.D. (Elected Academician, 2005)	Applied Physics
	Irene M. Villaseñor, Ph.D.	Chemistry
	Ma. Helena T. Yap, Ph.D.	Marine Biology
1993	Josephine U. Agravante, Ph.D.	Postharvest Horticulture
	Ma. Alicia M. Aguinaldo, Ph.D.	Chemistry

Year	Name	Field of Specialization
1993	Porfirio Alexander M. Aliño, Ph.D. (Elected Academician, 2014)	Marine Biology
	Angelina M. Bacala, Ph.D.	Physics
	Severino S. Capitan, Ph.D.	Animal Physiology/ Nutrition
	Emmanuel S. de Dios, Ph.D.	Economics
	Gerardo C. Janairo, D. Nat. Sci.	Chemistry
	Shirley R. Tiong-Palisoc, Ph.D.	Physics
	Graciano P. Yumul, Jr., D. Sc.	Geology
1994	Teresita H. Borromeo, M.S.	Plant Breeding
	Cherrie L. Bunag-Pascual, Ph.D.	Chemistry
	Sergio S. Cao, Ph.D.	Mathematics
	Elda B. Esguerra, Ph.D.	Postharvest Horticulture
	Gil S. Jacinto, Ph.D.	Marine Chemistry
	Marie Antonette Juinio-Menez, Ph.D.	Marine Biology
	Terencio D. Lacuesta, Ph. D.	Physics
	Manuel L. Logroño, Ph.D.	Plant Breeding and Genetics
	Desiree I. Menancio-Hautea, Ph.D.	Plant Genetics and Molecular Biology
	Cecilia P. Reyes, Ph.D.	Entomology
1995	Abundio A. Balgos, M.D.	Pulmonary and Internal Medicine
	Jose Maria P. Balmaceda, Ph.D. (Elected Academician, 2008)	Mathematics
	Allan Benedict I. Bernardo, Ph.D. (Elected Academician, 2007)	Cognitive Psychology
	Armando C. Crisostomo, M.D.	Colon and Rectal Surgery
	Maribel L. Dionisio-Sese, D.Sc.	Biophysics
	Zenaida N. Ganga, Ph.D.	Plant Breeding
	Randy A. Hautea, Ph.D.	Plant Breeding
	Antonio C. Laurena, Ph.D.	Agricultural Chemistry
	Merlyn S. Mendioro, Ph.D.	Genetics
	Fidelina B Natividad-Carlos, Ph.D.	Economics
1996	Antonio L. Acedo, Ph.D.	Horticulture
	Jezie A. Acorda, Ph.D.	Veterinary Medicine
	Eliezer A. Albacea, Ph.D. (Elected Academician, 2006)	Computer Science
	Carmelita A. Belda-Baillie, Ph.D.	Zoology
	Jose E. Hernandez, Ph.D.	Plant Breeding and Genetics

Year	Name	Field of Specialization
1996	Eduardo C. Lim, M.D.	Immunology
	Jose M. Oclarit, Ph.D.	Applied Biochemistry
	Jossie M. Rogacion, M.D.	Pediatrics Nutrition and Gastroenterology
	Roland V. Sarmago, Ph.D.	Physics
	Tessa T. Torres-Edejer, M.D.	Clinical Economics
1997	Rhodora R. Aldemita, Ph.D.	Botany
	Orville L. Bondoc, Ph.D.	Animal Breeding/ Genetics
	Leonorina G. Cada, Ph.D.	Chemistry
	Antonio Miguel L. Dans, M.D., M.S.(Elected Academician, 2010)	Clinical Epidemiology
	Ricardo T. Jose, Ph.D.	History/Area Study
	Rodel D. Lasco, Ph.D. (Elected Academician, 2009)	Forestry
	Damasa M. Magcale-Macandog, Ph.D.	Botany
	Blessilda P. Raposa, Ph.D.	Mathematics
	Cesar L. Villanoy, Ph.D.	Physical Oceanography
	Edward H.M. Wang, Ph.D. (Elected Academician, 2015)	Orthopedics
1998	Vermando M. Aquino, Ph.D.	Plant Pathology
	Philbert S. Bonilla, Ph.D.	Plant Physiology
	Mark J. Encarnación, Dr. techn.	Technical Mathematics
	Mario R. Festin, M.D.	Obstetrics and Gynecology
	Ma. Emma Concepcion D. Liwag	Psychology
	Ronald R. Matias, Ph.D.	Zoology
	Jaime C. Montoya, M.D. (Elected Academician, 2008)	Microbiology
	Felix P. Muga II, Ph.D.	Mathematics
	Edilberto D. Redoña, Ph.D.	Genetics
	Ma. Jamela R. Revilleza, Ph.D.	Biochemistry
1999	Vicente Y. Belizario, Jr., M.D.	Tropical Medicine/ Hygiene
	Merdelyn T. Caasi-Lit, Ph.D.	Plant Science/ Entomology
	Sergio R. Canoy, Jr., Ph.D.	Mathematics
	Cesar G. Demayo, Ph.D.	Entomology/Genetics
	Danilo B. Largo, Ph.D.	Aquatic Environmental Science
	Bernadette D.L. Libranda-Ramirez, Ph.D.	Immunology
	Eric R. Punzalan, Ph.D.	Chemistry
	Leocadio S. Sebastian, Ph.D.	Plant Breeding
2000	Rafael C. Bundoc, M.D.	Orthopedics

Year	Name	Field of Specialization
2000	Arnel N. del Barrio, Ph.D.	Ruminant Nutrition
	Ireneo L. Lit, Jr., M.S.	Entomology
	Pablito M. Magdalita, Ph.D.	Plant Breeding
	Francisco A. Magno, Ph.D.	Political Science
	Roberto M. Malaluan, Dr. Eng.	Chemical Engineering
	Perry S. Ong, Ph.D.	Behavioral Ecology Evolutionary Biology
	Ishmael D. Ordoñez, Ph.D.	Chemistry
	Ricardo Jose D.L.T. Quintos II, M.D.	Vascular Surgery
	Jose Ramon T. Villarin, S.J., Ph.D.	Atmospheric Physics
2001	Lemnuel V. Aragones, Ph.D.	Marine Biology
	Conrado H. Balatero, Ph.D.	Plant Breeding
	Edward F. Barroga, Ph.D.	Veterinary Oncology
	Christina A. Binag, Ph.D.	Chemistry
	Dindo M. Campilan, Ph.D.	Communication and Innovation Studies
	Albert A. Gapud, Ph.D.	Physics
	Ma. Antonia E. Habana, M.D., M.S.	Epidemiology
	Patricio P. Palmes, M.D.	Internal Medicine
	Simeona V. Siar, Ph.D.	Plant Breeding
	John Paul C. Vergara, Ph.D.	Computer Science and Applications
2002	Renato A. Avenido, Ph.D.	Agricultural Sciences
	Peter S. Guzman, Ph.D.	Plant Breeding
	Gabriel O. Romero, Ph.D.	Genetics
	Rea Victoria P. Anunciado, Ph.D.	Animal Genetics/ Physiology
	Noli N. Reyes, Ph.D.	Mathematics
	Raymund C. Sison, Ph.D.	Computer Science
	Arnel A. Salvador, Ph.D.	Physics
	Eva Maria C. Cutiongco, M.D.	Genetics
	Maria Lourdes de Leon-Matsuda, M.D.	Surgery
	Queena N. Lee-Chua, Ph.D.	Psychology
2003	Nathaniel C. Bantayan, Ph.D.	Forestry Engineering
	William L. delos Santos, Ph.D.	Agronomy and Soils
	Ma. Corazon A. de Ungria, Ph.D.	Molecular Biology
	Evelyn Grace T. de Jesus-Ayson	Zoology
	Agnes T. Paras, Ph.D.	Mathematics
	Carla B. Dimalanta, Ph.D.	Geology
	Mary Ann A. Endoma, Ph.D.	Chemistry
	Jesus N. Sarol, M.D.	Epidemiology

Year	Name	Field of Specialization
2004	Rio John T. Ducusin, Ph.D.	Veterinary Science
	Cynthia P. Saloma, Ph.D.	Physiology
	Wenresti G. Gallardo, Ph.D.	Marine Science
	Jean O. Loyola, Ph.D.	Mathematics
	Erwin P. Enriquez, Ph.D.	Physical Chemistry
	Raymond Girard R. Tan, Ph.D. (Elected Academician 2017)	Mechanical Engineering
	Marie Carmela M. Lapitan, M.D.	Urology
	Jonna DLP. Estudillo, Ph.D.	Economics
	Ma. Joy V. Abrenica, Ph.D.	Economics
2005	John Donnie A. Ramos, Ph.D.	Molecular Biology/ Immunology
	Julie F. Barcelona, Ph.D.	Botany
	Ricardo CH. Del Rosario, Ph.D.	Mathematics
	Mario Juan A. Aurelio, Ph.D.	Structural Geology and Tectonics
	Luis Francisco G. Sarmenta, Ph.D.	Electrical Engineering and Computer Science
	Felix Eduardo R. Punzalan, M.D.	Cardiology
	Ronaldo B. Mactal, Ph.D.	History
	Ma. Regina M. Hechanova, Ph.D.	Industrial/ Organizational Psychology
2006	Ma. Genaleen Q. Diaz, Ph.D.	Genetics
	Grecebio Jonathan D. Alejandro, Ph.D.	Botany
	Arturo O. Lluisma, Ph.D.	Biology
	Jose Ernie C. Lope, Ph.D.	Mathematics
	Vincent Ricardo M. Daria, Dr. of Engineering	Applied Physics
	Maricor N. Soriano, Ph.D.	Applied Physics
	Lenora C. Fernandez, M.D.	Respiratory Health and Emergency Care
	Jericho Thaddeus P. Luna, M.D.	Obstetrics and Gynecology
	Windell L. Rivera, Ph.D..	Medical Science
	Rollin P. Tabuena, M.D.	Pulmonary Medicine
2007	Willie P. Abasolo, Ph.D.	Agriculture
	Christian Joseph R. Cumagun, Ph.D.	Agriculture
	Arnold V. Hallare, Dr rer nat	Ecotoxicology
	Ephrime B. Metillo, Ph.D.	Zoology
	Drexel H. Camacho, Ph.D.	Chemistry
	Laura T. David, Ph.D.	Physical Oceanography
	Joseph Auresenia, Ph.D.	Chemical Engineering
	Paulito P. Palmes, D. Eng.	Information and Computer Science

Year	Name	Field of Specialization
2007	Eduardo C. Ayuste Jr., MD	Clinical Surgery
	Czarina A. Saloma-Akpedonu, Ph.D.	Sociology
2008	Constancio A. Asis Jr., Ph.D.	Agriculture
	Hayde F. Galvez, Ph.D.	Agriculture
	Antonio A. Alfonso, Ph.D.	Plant Biology
	Arvin D. Diesmos, Ph.D.	Wildlife Ecology and Environmental Sciences
	Carlo Mar Y. Blanca, Ph.D.	Physics
	Roberto B. Corcino, Ph.D.	Mathematics
	Jaderick P. Pabico, Ph.D.	Computer Science
	Dennis S. Mapa, Ph.D.	Economics
	Edsel L. Beja Jr., Ph.D.	Economics
2009	Antonio G. Lalusin, Ph.D.	Plant Breeding
	Ronald D. Villanueva, Ph.D.	Marine Science
	Lucille C. Villegas, Ph.D.	Microbiology
	Julius M. Basilla, Ph.D.	Mathematics
	Melito A. Baccay, Dr. of Engineering	Civil Engineering
	Ma. Stephanie Fay S. Cagayan, M.D.	OB-Gyne and Trophoblastic Diseases
	Leoncio L. Kaw, M.D.	Surgery
	Lawrence G. Dacuycuy, Ph.D.	Economics
	Stella Luz A. Quimbo, Ph.D.	Economics
2010	Von Mark V. Cruz, Ph.D.	Plant Breeding
	Roel R. Suralta, Ph.D.	Agricultural Sciences
	Gayvelline C. Calacal, MS	Molecular Biology
	Rachel June Rabago-Gotanco, M.Sc.	Molecular Biology and Biotechnology
	Eric A. Galapon, Ph.D.	Physics
	Fredegusto Guido P. David, Ph.D.	Biomedical Engineering
	Alvin R. Caparanga, Ph.D.	Environmental Engineering
	Allan A. Sioson, Ph.D.	Computer Science and Applications
	Maria Pura R. Solon, M.D., MS	Tropical Medicine and International Health
	Edsel Maurice T. Salvaña, M.D., DTM&H	Tropical Medicine
	Mary Janet M. Arnado, Ph.D.	Sociology
2011	Nathaniel C. Añasco, Ph.D.	Fisheries Science
	Claro N. Mingala, Ph.D.	Infectious Diseases
	Mudjekeewis D. Santos, Ph.D.	Applied Marine Biosciences
	Waren N. Baticados, Ph.D.	Veterinary Science
	Juan Carlos T. Gonzalez, M.Sc	Zoology

Year	Name	Field of Specialization
2011	Regina C. So, Ph.D.	Organic Chemistry
	Christopher P. Monterola, Ph.D.	Physics
	Joseph M. Pasia, Ph.D.	Social and Economic Sciences (Applied Mathematics)
	Allan N. Soriano, Ph.D.	Chemical Engineering
	Jose Bienvenido Manuel M. Biona, Ph.D.	Mechanical Engineering
	Carlo P. Magno, Ph.D.	Philosophy in Educational Psychology
2012	Michelle Grace V. Paraso, Ph.D.	Environmental Science
	Dindo Agustin A. Tabanao, Ph.D.	Applied Plant Sciences
	Wilfredo A. Dumale Jr., Ph.D.	Biological and Environmental Engineering
	Thomas Edison E. Dela Cruz, Dr. Rer. Nat.	Mycology
	Marcos B. Valdez Jr., D. Agr. Sc.	Animal Genetics
	Leslie Michell M. Dalmacio, Ph.D.	Molecular Biology and Biotechnology
	Gemma Teresa T. Narisma, Ph.D.	Atmospheric Science
	Bernard John V. Tongol, Ph.D.	Engineering (Applied Chemistry)
	Derrick Ethelbhert C. Yu, Ph.D.	Chemistry
	Ronald U. Mendoza, Ph.D.	Economics
2013	Edwin A. Combalicer, Ph.D.	Forest Environmental Sciences
	Alma O. Canama, M.Sc.	Genetics
	Rene A. Abesamis, Ph.D.	Marine Biology
	Salvador Eugenio DC. Caoili, Ph.D.	Molecular Biology and Biotechnology
	Raphael A. Guerrero, Ph.D.	Physics
	Kathleen B. Aviso, Ph.D.	Industrial Engineering
	Michael Angelo B. Promentialla, Ph.D.	Socio-Environmental Egnineering
	Alonzo A. Gabriel, Ph.D.	Food Microbiology and Hygiene
	Liane P. Alampay, Ph.D.	Psychology
2014	Glenn S. Banaguas, M.Sc.	Environmental Management
	Rommel C. Sulabo, Ph.D.	Animal Science
	Ian Kendrich C. Fontanilla, Ph.D.	Genetics
	Karl Marx A. Quiazon, Ph.D.	Aquatic Biosciences
	May T. Lim, Ph.D.	Physics
	Richard S. Lemence, Ph.D.	Mathematics

Year	Name	Field of Specialization
2014	Jessie Pascual P. Bitog, Ph.D.	Agricultural and Rural System Engineering
	Rhoda B. Leron, Ph.D.	Chemical Engineering
	Paolo Antonio S. Silva, M.D.	Ophthalmology
	John Mark S. Velasco, M.D.	Public Health
	Geoffrey M. Ducanes, Ph.D.	Economics
	Analyn V. Salvador-Amores, Ph.D.	Social and Cultural Anthropology
2015	Dennis V. Umali, Ph.D.	Veterinary Science
	Aimee Lymm Barrion-Dupo, Ph.D.	Entomology
	Joey D. Ocon, M.Sc.	Chemical Engineering
	Rex Ferdinand M. Traifalgar, Ph.D.	Fisheries Science
	Enrico C. Paringit, D.Eng.	Geology
	Allan Patrick G. Macabeo, D.Nat.Sci.	Organic Chemistry
2016	Tonette P. Laude, Ph.D.	Plant Science
	Ian A. Navarrete, Ph.D.	Soil Sciences
	Richard N. Muallil, Ph.D.	Marine Science
	Glenn L. Sia Su, Ph.D.	Environmental Science
	Mary Donnabelle L. Balena, Ph.D.	Materials Science Engineering
	Aristotle T. Ubando, Ph.D.	Mechanical Engineering
	Manuel Joseph C. Loquias, Dr.	Mathematics
	Aaron Joseph L. Villaraza, Ph.D.	Chemistry
	Majah-Leah V. Ravago, Ph.D.	Economics
2017	Phillip A. Alviola, M.S.	Wildlife studies
	Aletta Concepcion T. Yñiguez, Ph.D.	Marine Biology and Fisheries
	Lanndon A. Ocampo, Ph.D.	Industrial Engineering
	Mario Antonio L. Jiz II, Ph.D.	Medical Science
	Nathaniel P. Hermosa II, Ph.D.	Physics
	Jeffrey S. Perez, M.S.	Engineering
	Jayeel S. Cornelio, Ph.D.	Sociology
	Krista Danielle S. Yu, Ph.D.	Economics

NOTES for PLENARY SESSION 1

SUSTAINABLE AND RESILIENT COMMUNITIES
FROM THE HIGHLANDS TO THE OCEANS

NOTES for PLENARY SESSION 1

SUSTAINABLE AND RESILIENT COMMUNITIES
FROM THE HIGHLANDS TO THE OCEANS

NOTES for PLENARY SESSION 2

SUSTAINABLE INDUSTRIALIZATION AND INCLUSION

NOTES for PLENARY SESSION 2

SUSTAINABLE INDUSTRIALIZATION AND INCLUSION

NOTES for PLENARY SESSION 3

FACTORING IN THE SDG'S IN PHILIPPINE GOVERNMENT PLANNING

NOTES for PLENARY SESSION 3

FACTORING IN THE SDG'S IN PHILIPPINE GOVERNMENT PLANNING

NOTES for PLENARY SESSION 4

UPDATE ON THE 39TH ASM RESOLUTIONS and DEVELOPING OUR COASTAL AND OCEANIC AQUACULTURE FOR FOOD SECURITY AND LIVELIHOOD GENERATION

NOTES for PLENARY SESSION 4

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DEVELOPING OUR COASTAL AND OCEANIC AQUACULTURE
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