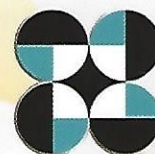




40 Years of Excellence

National Academy of Science and Technology  
Philippines  
1976 - 2016  
IN PURSUIT OF EXCELLENCE

Republic of the Philippines  
Department of Science and Technology  
National Academy of Science and Technology



# 38<sup>th</sup> ANNUAL SCIENTIFIC MEETING

“Looking Back and  
Looking Forward”

July 13-14, 2016 | The Manila Hotel

# ABOUT NAST PHL

## VISION, MISSION, and MANDATE

The National Academy of Science and Technology, Philippines, founded in 1976, continues to stand today with a firm resolve to faithfully pursue:

### Its *VISION for the country*:

A PROGRESSIVE PHILIPPINES ANCHORED ON SCIENCE

### Its *VISION for NAST*:

NAST, as an academy of recognized experts, serves as principal adviser to the nation on science, technology, and innovation contributing to national development

### Its *MISSION*:

1. To recognize scientists for their exemplary science and technology achievements, and to identify and support emerging scientific talent.
2. To encourage Academy members to continue their own scholarly pursuits.
3. To provide independent advice on the utilization of science, technology, and innovation.
4. To promote a strong science culture in Philippine society.
5. To link with national academies of science and technology in other countries.

### Its *MANDATE*:

1. To recognize outstanding achievements in science and technology as well as provide meaningful incentives to those engaged in scientific and technological researches (P.D. 1003-A, 1976).
2. To advise the President and the Cabinet on matters related to science and technology (E.O. 818, 1982).
3. To engage in projects and programs designed to recognize outstanding achievements in science and promote scientific productivity (E.O. 818, 1982).
4. To embark on programs traditionally expected of an academy of science (E.O. 818, 1982).
5. To manage, operate, and maintain the Philippine Science Heritage Center (PSHC) (R.A. 9107, 2001).



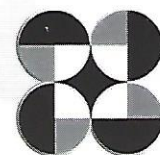


40 *Years of Excellence*

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Department of Science and Technology

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In celebration of the



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Republic of the Philippines  
**OFFICE OF THE PRESIDENT**  
Malacañan Palace, Manila

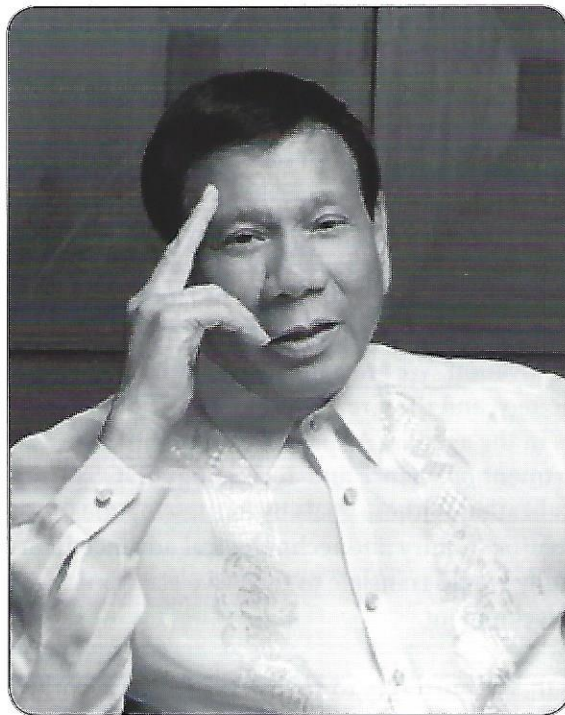
I would like to extend my sincerest felicitations to the National Academy of Science and Technology, Philippines as you hold your 38<sup>th</sup> Annual Scientific Meeting.

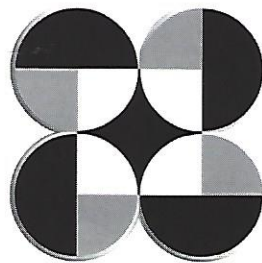
Over the years, the Philippines has been faced with various challenges – from poverty, poor health and nutrition, climate change, inequality, injustice among others, that impede our growth and development as a nation. With your support, we aim to fully utilize the capacity of science and technology to address national issues and drive us towards inclusive and sustained growth and development. May you, the nation's leading scientists, always strive to heed the call of service to build a progressive Philippines.

Let us start anew as we embark on another chapter of seizing endless opportunities by integrating our learning and experiences in efficient nation-building, towards increased productivity, improved quality of life, and sustained development.

I wish everyone a productive and meaningful gathering.

**RODRIGO R. DUTERTE**  
President





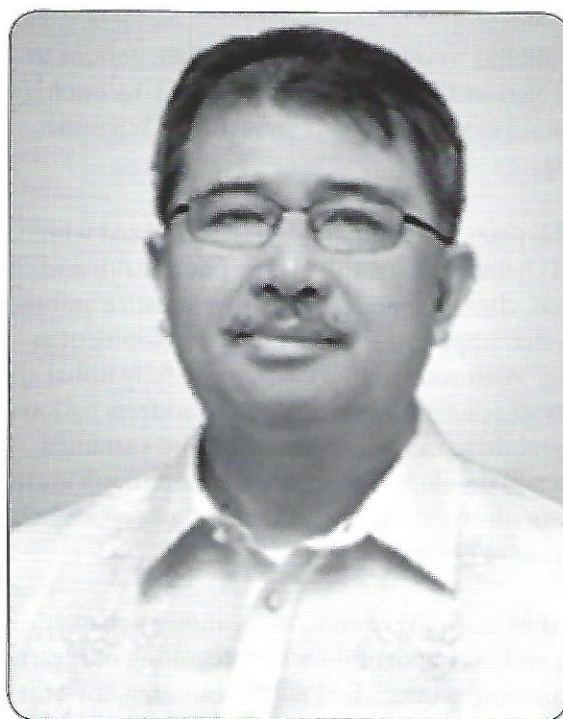
Republic of the Philippines  
**DEPARTMENT OF SCIENCE AND TECHNOLOGY**  
Bicutan, Taguig City

Congratulations to the National Academy of Science and Technology, Philippines (NAST PHL) for successfully organizing the 38<sup>th</sup> Annual Scientific Meeting (ASM) with the theme “Looking Back and Looking Forward”.

At the dawn of the New Administration, we review the achievements of the past and plan for concrete strategies on how to fulfill President Duterte’s ten-point economic agenda through science, technology, and innovation. We are happy to note that “Science, technology, and the Creative Arts” is one of the ten points in the agenda. As part of our initiatives, we at the Department of Science and Technology (DOST), aim for the realization of these goals by harnessing the products of scientific inquiry and technological advancements that hopefully would translate to inclusive economic growth and development.

I take this opportunity to commend our hardworking scientists for their noteworthy contributions in pursuing the challenging tasks of addressing pertinent societal concerns through their scientific researches. Let me also congratulate this year’s NAST Awardees who demonstrated excellence in their respective fields to contribute new knowledge and to help improve the quality of life of Filipinos. Your diligence and commitment inspires our younger generations to do great things in the name of science and technology.

Mabuhay!



  
**FORTUNATO T. DE LA PEÑA**  
Secretary





Republic of the Philippines  
Department of Science and Technology  
**NATIONAL ACADEMY OF SCIENCE AND TECHNOLOGY**  
Bicutan, Taguig City

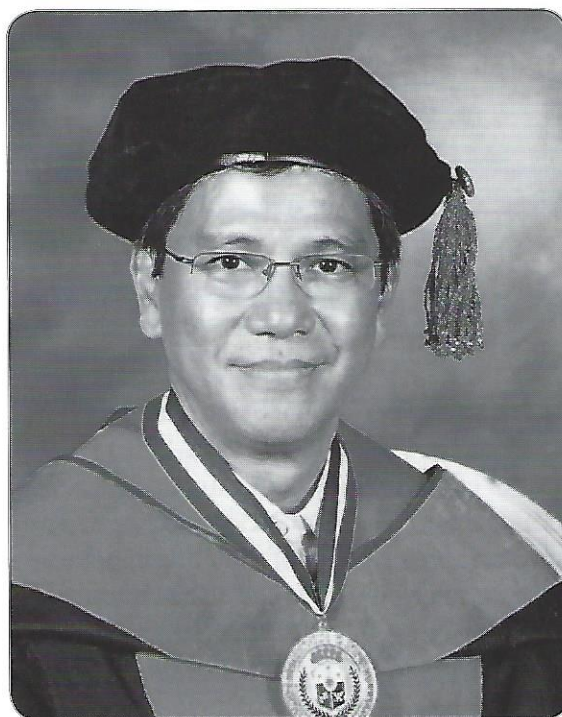
On behalf of the Officers and Members of the National Academy of Science and Technology, Philippines (NAST PHL), I am pleased to welcome all of you to the NAST PHL 38<sup>th</sup> Annual Scientific Meeting (ASM).

This is a special year as NAST PHL is celebrating its 40<sup>th</sup> anniversary. NAST PHL was established in 1976 and now has the dual function as the highest advisory body to the President of the Philippines in matters related to S&T, and as the highest recognition body of the country in science and technology.

Held annually since 1978, the ASM is the premier meeting of scientists from all over the country to present technical papers and discuss important issues related to science and technology. The outcomes of the fora that the Academy held during the year are presented and discussed. Consistent with the Academy's mandate as the country's highest advisory body on S&T, various recommendations and policies that address the concerns and needs of the Filipino people will be submitted to the new administration of Pres. Rodrigo R. Duterte.

During the second day, the Academy will recognize outstanding individuals who have made important contributions to science and technology and conduct the investiture of new Academy members.

Allow me to thank our sponsors and organizers for their continued support during the year, including the successful conduct of this 38<sup>th</sup> Annual Scientific Meeting.



Finally, I would like to thank the DOST and the entire scientific community for their constant commitment to support the Academy in the attainment of its goals.

Mabuhay tayong lahat!

  
**FABIAN M. DAYRIT**  
Acting President

# ABOUT THE NAST PHL



**T**he National Academy of Science and Technology, Philippines (NAST PHL) is the symbol of the nation's commitment to science. The proposal for its creation originated from several scientists of the University of the Philippines and was endorsed by the National Science Development Board (the predecessor agency of the Department of Science and Technology) to the President of the Philippines.

On October 6, 1976, the National Academy of Science was created by the Presidential Decree 1003. A subsequent amendment established instead the National Academy of Science and Technology and expanded the base of its membership. Thus, P.D. 1003-A signed on December 16, 1976, is the enabling legislation which started the Academy.

The science community then submitted nominations of the most eminent among them to be members of the Academy. The President of the Philippines named ten scientists from a wide range of disciplines to be the first Academicians in 1978. Henceforth, nominations have continued to come from the science community but the election of Academicians is the prerogative of the members of the Academy alone, following their strict rules of review and selection. Every member is distinguished, known nationally and internationally in his or her own right.

The Academy is composed of six divisions: Agricultural Sciences, Biological Sciences, Engineering Sciences and Technology, Mathematical and Physical Sciences, Health, and Social Sciences.

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



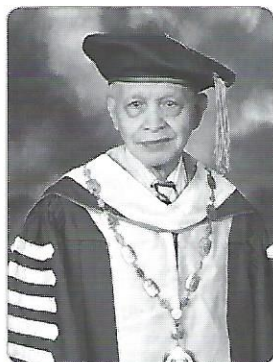
# NATIONAL SCIENTISTS



**ANGEL C. ALCALA**  
*Biological Sciences*



**CLARE R. BALTAZAR**  
*Systematic Entomology*



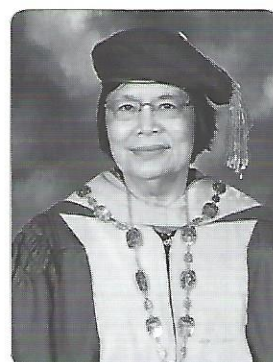
**RAMON C. BARBA**  
*Horticulture*



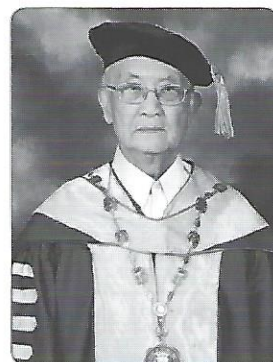
**GELIA T. CASTILLO**  
*Rural Sociology*



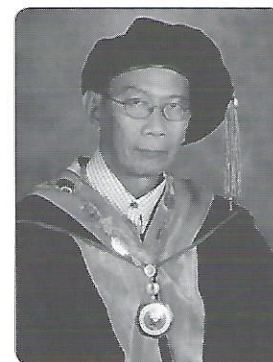
**MERCEDES B. CONCEPCION**  
*Demography*



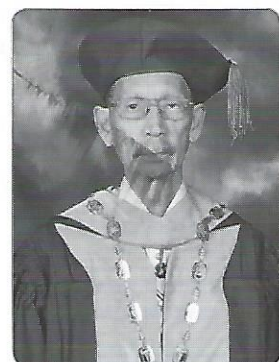
**LOURDES J. CRUZ**  
*Biochemistry*



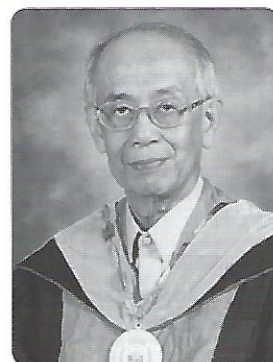
**ERNESTO O. DOMINGO**  
*Internal Medicine/Gastroenterology*



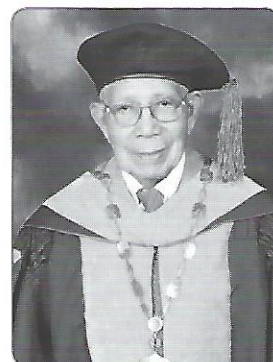
**RAUL V. FABELLA**  
*Economics*



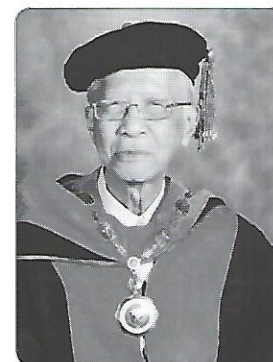
**EDGARDO D. GOMEZ**  
*Marine Biology*



**BIENVENIDO O. JULIANO**  
*Organic Chemistry*



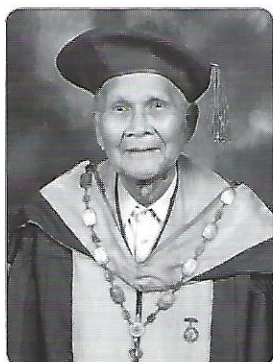
**RICARDO M. LANTICAN**  
*Plant Breeding*



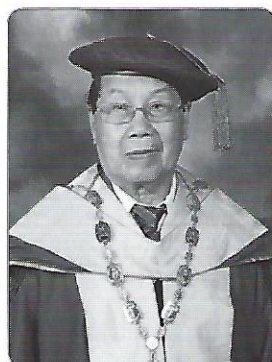
**BIENVENIDO F. NEBRES, S.J.**  
*Mathematics*



**DOLORES A. RAMIREZ**  
*Biochemical Genetics*



**TEODULO M. TOPACIO, JR.**  
*Veterinary Medicine*



**GAVINO C. TRONO, JR.**  
*Marine Science*



# ACADEMICIANS



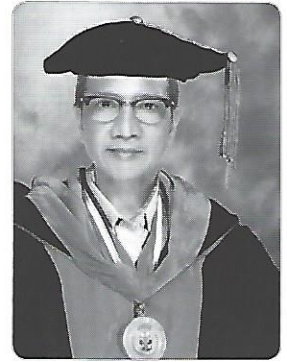
**RAMON F. ABARQUEZ, JR.**  
*Cardiology*



**ESTRELLA F. ALABASTRO**  
*Chemical Engineering*



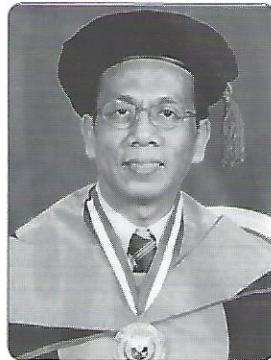
**ELIEZER A. ALBACEA**  
*Computer Science*



**PORFIRIO ALEXANDER M. ALIÑO**  
*Marine Chemical Ecology*



**RHODORA V. AZANZA**  
*Botany*



**ARSENIO M. BALISACAN**  
*Economics*



**JOSE MARIA P. BALMACEDA**  
*Mathematics*



**ALLAN BENEDICT I. BERNARDO**  
*Cognitive Psychology*



**CHRISTOPHER C. BERNIDO**  
*Theoretical Physics*



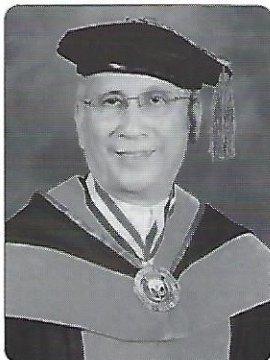
**FILOMENA F. CAMPOS**  
*Plant Breeding / Cytogenetics*



**VERONICA F. CHAN**  
*Microbiology/ Virology*



**GISELA P. CONCEPCION**  
*Marine Science*



**JOSE B. CRUZ, JR.**  
*Electrical Engineering*



**LIBERTADO C. CRUZ**  
*Reproductive Biotechnology*



**ALVIN B. CULABA**  
*Mechanical Engineering*



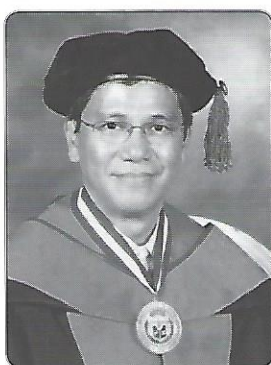
**ANTONIO MIGUEL L. DANS**  
*Clinical Epidemiology*



# ACADEMICIANS



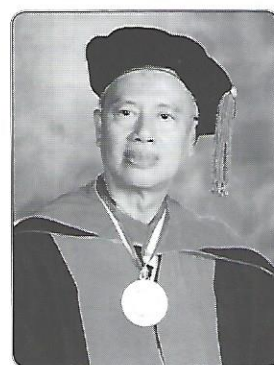
**ROMULO G. DAVIDE**  
*Nematology-Plant Pathology*



**FABIAN M. DAYRIT**  
*Chemistry*



**ERNESTO J. DEL ROSARIO**  
*Chemistry*



**SALCEDO L. EDUARDO**  
*Veterinary and Medical  
Parasitology*



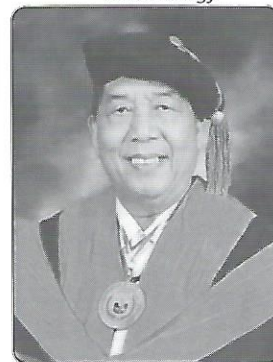
**RAFAEL D. GUERRERO III**  
*Fisheries Management*



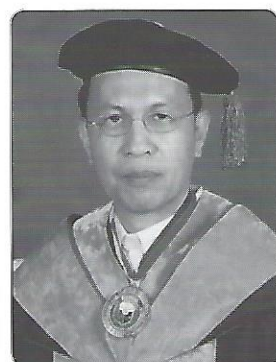
**EMIL Q. JAVIER**  
*Plant Breeding and Genetics*



**JOSE O. JULIANO**  
*Nuclear Chemistry and Physics*



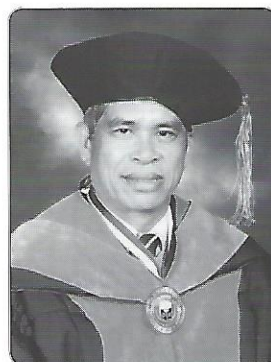
**QUINTIN L. KINTANAR**  
*Environmental Medicine*



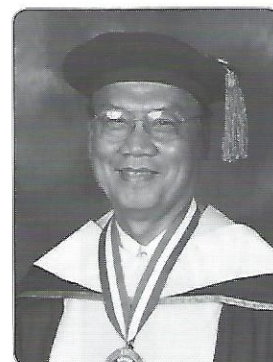
**RODELL D. LASCO**  
*Forestry*



**ANGEL L. LAZARO III**  
*Civil Engineering*



**LEONARDO Q. LIONGSON**  
*Water Resources  
Administration and Hydrology*



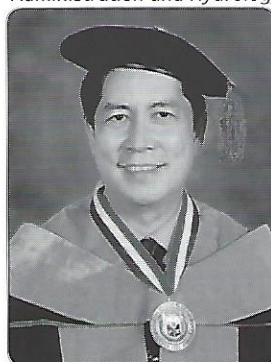
**CEFERINO P. MAALA**  
*Veterinary Medicine*



**AURA C. MATIAS**  
*Industrial Engineering*



**MARCO NEMESIO E. MONTAÑON**  
*Biological Chemistry*



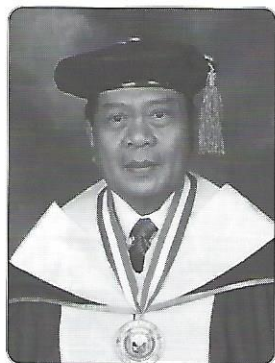
**JAIME C. MONTOYA**  
*Infectious Diseases*



**APOLINARIO D. NAZAREA**  
*Biophysics*



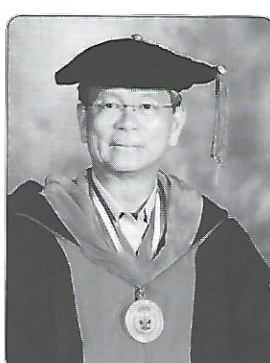
# ACADEMICIANS



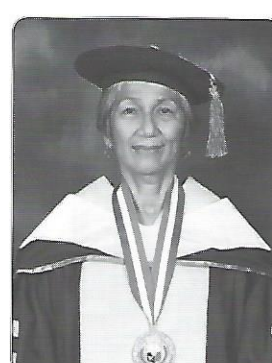
**REMIGIO M. OLVEDA**  
*Infectious and Tropical Medicine*



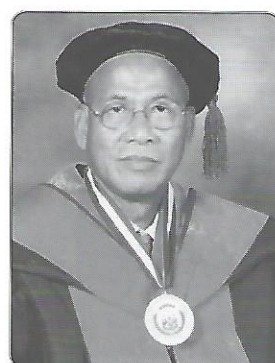
**CARMENCITA D. PADILLA**  
*Genetics*



**WILLIAM G. PADOLINA**  
*Phytochemistry*



**JURGENNE H. PRIMAVERA**  
*Marine Science*



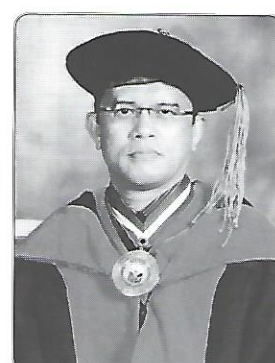
**EUFEMIO T. RASCO, JR.**  
*Plant Breeding*



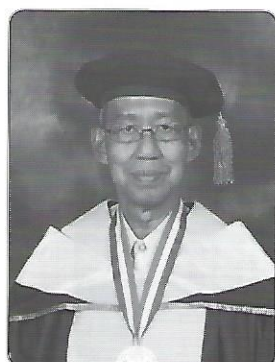
**ASUNCION K. RAYMUNDO**  
*Microbial Genetics/ Plant Pathology*



**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*



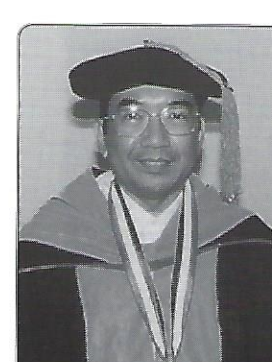
**EVELYN MAE TECSON- MENDOZA**  
*Biochemistry*



**WILLIAM T. TORRES**  
*Computer Sciences*



**THELMA E. TUPASI**  
*Infectious Diseases*



**FILEMON A. URIARTE, JR.**  
*Chemical Engineering*



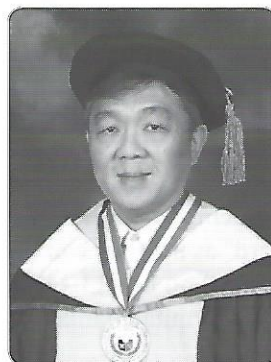
## ACADEMICIANS



**REYNALDO B. VEA**  
*Marine Transportation  
Systems, Naval Architecture*

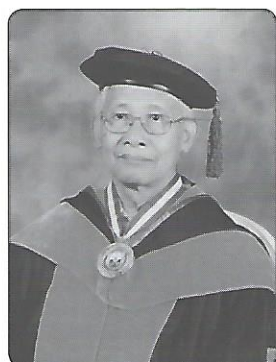


**RUBEN L. VILLAREAL**  
*Horticulture*



**EDWARD H.M. WANG**  
*Orthopaedics*

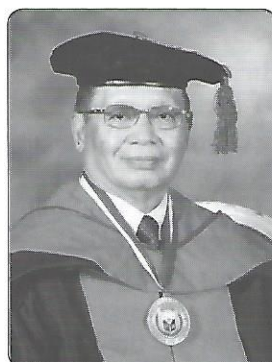
## CORRESPONDING MEMBERS



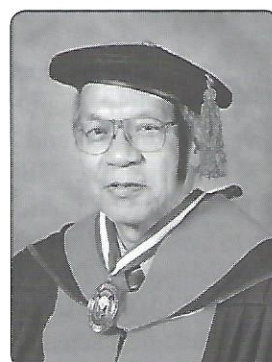
**ALFONSO L. ALBANO**  
*Physics*



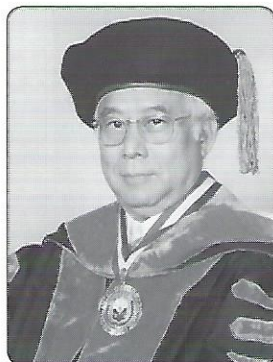
**LIWAYWAY M. ENGLE**  
*Genetics*



**MANUEL M. GARCIA**  
*Microbiology*



**EDUARDO R. MENDOZA**  
*Mathematics*



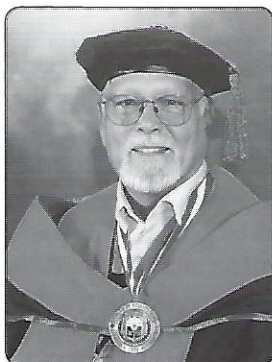
**AMADOR C. MURIEL**  
*Physics and Astronomy*



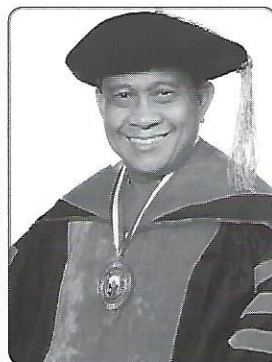
**BALDOMERO M. OLIVERA**  
*Biochemistry*



**EDUARDO A. PADLAN**  
*Biophysics*



**KELVIN S. RODOLFO**  
*Marine Geology*



**REYNALDO L. VILLAREAL**  
*Plant Breeding and Plant  
Pathology*



# RATIONALE OF THE 38<sup>th</sup> ANNUAL SCIENTIFIC MEETING

## “Looking Back and Looking Forward”

This year, the Academy has chosen “Looking Back and Looking Forward” as the theme of the 38<sup>th</sup> Annual Scientific Meeting (ASM) on July 13-14, 2016 at the Manila Hotel, Bonifacio Drive, Ermita, Manila.

This annual activity of the Academy serves as the leading forum for the presentation of scientific and policy research that aims to review the past achievements and outline the needed reforms and activities for the newly elected government officials. Policy recommendations on appropriate interventions as agreed upon during the plenary sessions will be submitted to the Philippine government and the private sector.

Various policy fora were conducted in preparation for the ASM by the six divisions of NAST PHL. These were Linking Poverty Reduction and Agricultural Development (February 2016); Farm Integration, Intensification, and Diversification in the Philippines (March 2016); and From Monocrops to Systems: What is an Appropriate RDDDD (Research, Development, Demonstration and Deployment) Approach? (April 2016) by the Agricultural Sciences Division. The Biological Sciences Division had the Research Findings on the Effects of Climate Change on the Philippine Marine Resources (April 2016) and Multidisciplinary Approach to Community-based Conservation and Management Programs (June 2016) as their ASM inputs.

On the other hand, the Engineering Sciences and Technology Division conducted five fora for the ASM. These were Past, Present, and Future of ICT Infrastructure in the Philippines (December 2015); Energy Storage Technologies (March 2016); Water Infrastructure (March 2016); Philippine Transportation: Looking Back and Looking Forward (June 2016); and Human Resource Development: Looking Back and Looking Forward (June 2016). The Mathematical and Physical Sciences Division had the forum on the Challenges and Opportunities in the Implementation of K-12 STEM Curriculum (June 2016); while the Health Sciences Division organized Reconfiguring Primary Health Care Within the Context of Kalusugan Pangkalahatan/ Universal Health Care (June 2016). Finally, the host division, Social Sciences Division, had a forum on Behavioral Economics and Public Policy: An Overview (September 2015).





# PROGRAMME

---

## 13 JULY (DAY 1)

7:00 REGISTRATION

8:00 OPENING OF SCIENTIFIC  
POSTERS SESSION  
& EXHIBITS

Ribbon Cutting

**HONORABLE FORTUNATO T. DE LA PEÑA**  
Secretary, Department of Science and Technology

**ACADEMICIAN FABIAN M. DAYRIT**  
Acting President, NAST Philippines

**DR. MOHAMED JAMAL DEEN**  
President of the Academy of Science, Royal Society of Canada

8:30 OPENING CEREMONIES

Entry of Colors

**UP RAYADILLO**

National Anthem

**UP SINGING AMBASSADORS**

Welcome Remarks

**ACADEMICIAN FABIAN M. DAYRIT**

Opening Message

**HONORABLE FORTUNATO T. DE LA PEÑA**

Video Presentation

**SIR VENKATRAMAN RAMAKRISHNAN**  
President, Royal Society of London

Introduction of the  
Keynote Speaker

**ACADEMICIAN FABIAN M. DAYRIT**

Keynote Address

**DR. MOHAMED JAMAL DEEN**

Special Number

**UP SINGING AMBASSADORS**

Master of Ceremonies

**ACADEMICIAN JAIME C. MONTOYA**  
Secretary and Chair, Health Sciences Division, NAST Philippines

## PLENARY SESSIONS

### 10:30 PLENARY SESSION 1

#### FROM SCRIBES TO SEERS: DOING SOCIAL SCIENCE IN THE PHILIPPINES

Speaker

**ACADEMICIAN MICHAEL L. TAN**  
Chancellor, University of the Philippines Diliman and  
Member, Social Sciences Division  
NAST Philippines

Discussant

**AMARYLLIS T. TORRES, Ph.D., OYS 1985**  
Professor Emeritus, University of the Philippines and  
Executive Director, Philippine Social Science Council

#### OPEN FORUM

Moderator

**ACADEMICIAN AGNES C. ROLA**  
Professor, College of Public Affairs and Development,  
University of the Philippines Los Baños and  
Member, Social Sciences Division  
NAST Philippines

Rapporteur

**CLARISSA C. DAVID, Ph.D., OYS 2015**  
Professor, College of Mass Communication  
University of the Philippines Diliman

### 12:00 Lunch and Viewing of Posters and Exhibits

#### MEETINGS:

- a) Best Scientific Poster  
Board of Judges

*Kamagong Conference Room*

- b) Resolutions Committee

*Ipil Conference Room*

#### BOOK LAUNCHING

**“Rice Self-Sufficiency under the Lens of Provincial Analysis:  
A New Way of Looking at the National Rice Security”**  
*Fiesta Pavillion*

#### RECOGNITION OF SUPPORT FROM SPONSORS AND DONORS

### 1:00 PLENARY SESSION 2

#### AGRICULTURAL SCIENCES

#### Looking Back and Looking Forward: What to Do with Agriculture

Speaker

**ACADEMICIAN EMIL Q. JAVIER**  
Member, Biological Sciences Division  
NAST Philippines

#### OPEN FORUM

Moderator

**CORRESPONDING MEMBER REYNALDO L. VILLAREAL**  
Agricultural Sciences Division  
NAST Philippines

Rapporteur

**GLENN B. GREGORIO, Ph.D., OYS 2004**  
Plant Breeder and Geneticist  
East-West Seed Philippines



2:00	<b>PLENARY SESSION 3</b>	<b>BIOLOGICAL SCIENCES</b> <b>Climate Change Impacts on Food Security from Marine Resources</b>
	Speaker	<b>LAURA T. DAVID, Ph.D., OYS 2007</b> Professor VII The Marine Science Institute University of the Philippines Diliman
	<b>OPEN FORUM</b>	
	Moderator	<b>ACADEMICIAN RHODORA V. AZANZA</b> Assistant Vice-President for Academic Affairs and Director Office of International Linkages University of the Philippines and Chair, Biological Sciences Division NAST Philippines
	Rapporteur	<b>ARNOLD V. HALLARE, Ph.D., OYS 2007</b> Professor 9, Department of Biology and Director, National Graduate Office for the Health Sciences University of the Philippines Manila
3:00	<b>PLENARY SESSION 4</b>	<b>MATHEMATICAL AND PHYSICAL SCIENCES</b> <b>Human Capital in Science Education</b>
		<i>Developing S&amp;T PhD Programs and Research: The UP-Ateneo-De La Salle Consortium and ESEP Experience</i>
	Speaker 1	<b>NATIONAL SCIENTIST BIENVENIDO F. NEBRES, S.J.</b> Rector, Jesuit Residence, Ateneo de Manila University and Member, Mathematical and Physical Sciences Division NAST Philippines
		<i>Lessons from the Past, Projections for the Future: Smarter Science Learning and Research</i>
	Speaker 2	<b>MARIA VICTORIA C. BERNIDO, Ph.D.</b> Directress Central Visayan Institute Foundation Jagna, Bohol
	<b>OPEN FORUM</b>	
	Moderator	<b>ACADEMICIAN FABIAN M. DAYRIT</b> Professor, Department of Chemistry Ateneo de Manila University, Acting President, and Chair, Mathematical and Physical Sciences Division NAST Philippines
	Rapporteur	<b>QUEENA N. LEE-CHUA, Ph.D., OYS 2002</b> Professor Mathematics and Psychology Departments Ateneo de Manila University

4:00    PLENARY SESSION 5                    **ENGINEERING SCIENCES AND TECHNOLOGY**  
**Philippine Infrastructure: Looking Back and Looking Forward**

Speaker                                    **PRIMITIVO C. CAL, Ph.D.**  
Executive Director, Planning and Development  
Research Foundation, Inc. (PLANADES)

OPEN FORUM  
Moderator                                **ACADEMICIAN REYNALDO B. VEA**  
President and CEO  
Mapua Institute of Technology and Malayan Colleges Laguna and  
Chair, Engineering Sciences and Technology Division  
NAST Philippines

Rapporteur                                **ENRICO C. PARINGIT, D. Eng., OYS 2015**  
Associate Professor, Department of Geodetic Engineering  
College of Engineering  
University of the Philippines Diliman

14 JULY (DAY 2)

8:00    REGISTRATION

9:00    PLENARY SESSION 6                    **HEALTH SCIENCES**  
**Universal Health Care in the Philippines**

Speaker                                    **NATIONAL SCIENTIST ERNESTO O. DOMINGO**  
University Professor Emeritus, UP College of Medicine and  
Member, Health Sciences Division  
NAST Philippines

OPEN FORUM  
Moderator                                **ACADEMICIAN EDWARD H.M. WANG**  
Professor 12 and University Scientist 3, UP College of Medicine,  
Head, UP- Musculoskeletal Tumor Unit, Philippine General Hospital, and  
Member, Health Sciences Division  
NAST Philippines

Rapporteur                                **RAUL V. DESTURA, M.D, FPSMID, OYS 2008**  
Clinical and Research Associate Professor  
College of Medicine, University of the Philippines Manila

**TECHNICAL SESSION 1 | *Overseas Filipino Workers: Household Welfare Impact***

Speaker  
**GEOFFREY M. DUCANES, Ph.D.,**  
**OYS 2014**  
Assistant Professor  
School of Economics  
University of the Philippines Diliman

Moderator  
**ACADEMICIAN ARSENIO M.**  
**BALISACAN**  
Chairman  
Philippine Competition Commission  
and Member, Social Sciences Division  
NAST Philippines

Rapporteur  
**LAWRENCE G. DACUYCUI, Ph.D.,**  
**OYS 2009**  
Professor, School of Economics  
De La Salle University



## TECHNICAL SESSION 2 | *Filipino 2040 Energy: Power Security and Competitiveness*

Speaker	Moderator	Rapporteur
<b>MAJAH-LEAH V. RAVAGO, Ph.D.</b>	<b>NATIONAL SCIENTIST RAUL V. FABELLA</b>	<b>RONALD U. MENDOZA, Ph.D., OYS 2012</b>
Assistant Professor	Chair, Social Sciences Division	Dean, School of Government
School of Economics	NAST Philippines	Ateneo De Manila University
University of the Philippines Diliman		

12:00 Lunch

Viewing of Posters and Exhibits

### MEETINGS:

- |  |                                 |
|--|---------------------------------|
| a) Best Scientific Poster<br>Board of Judges | <i>Kamagong Conference Room</i> |
| b) Resolutions Committee                     | <i>Ipil Conference Room</i>     |

1:30 AWARDING AND CLOSING CEREMONIES

Processional

Presentation of Resolutions	<b>ACADEMICIAN MICHAEL L. TAN</b> Chair, 38 <sup>th</sup> ASM Resolutions Committee, NAST Philippines
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Response	<b>HONORABLE FORTUNATO T. DE LA PEÑA</b> Secretary, Department of Science and Technology
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**HONORABLE ERNESTO M. PERNIA**  
Secretary and Director General  
National Economic and Development Authority

Presentation of NAST Awards	<ul style="list-style-type: none"><li>• BEST SCIENTIFIC POSTERS</li><li>• OUTSTANDING SCIENTIFIC PAPERS</li><li>• OUTSTANDING BOOKS/MONOGRAPHS</li><li>• NAST ENVIRONMENTAL SCIENCE AWARD</li><li>• NAST TALENT SEARCH FOR YOUNG SCIENTISTS</li><li>• OUTSTANDING YOUNG SCIENTISTS</li></ul>
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Special Number	UP SINGING AMBASSADORS
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INVESTITURE OF NEW ACADEMICIANS	<b>ACADEMICIAN FABIAN M. DAYRIT</b> Acting President, NAST Philippines
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### OATH TAKING OF NEW ACADEMICIANS

Administered by	<b>HONORABLE FORTUNATO T. DELA PEÑA</b>
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Closing Remarks

Exit of Colors	UP RAYADILLO
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Master of Ceremonies  
**ACADEMICIAN JAIME C. MONTOYA**  
Secretary and Chair, Health Sciences Division, NAST Philippines

# KEYNOTE SPEAKER

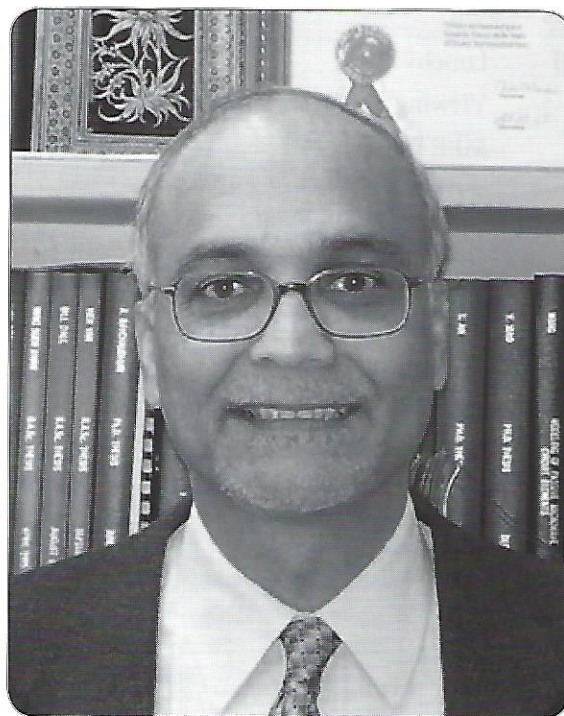
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## **DR. MOHAMED JAMAL DEEN**

President of the Academy of Science  
Royal Society of Canada

**D**r. M. Jamal Deen was born in Georgetown, Guyana, South America. He completed a B.Sc. degree in Physics and Mathematics at the University of Guyana (1978), a M.S. degree (1982) and a Ph.D. degree (1985) in Electrical Engineering and Applied Physics at Case Western Reserve University (CWRU), Cleveland, Ohio, U.S.A. His Ph.D. dissertation was on the design and modeling of a new CARS spectrometer for dynamic temperature measurements and combustion optimization in rocket and jet engines and was sponsored by NASA, Cleveland, USA. He received the Dr. Eng. (*honoris causa*) degree from the University of Waterloo, ON, Canada (2011), the Doctor degree (*honoris causa*) from the Universidad de Granada, Granada, Spain (2012) and the Doctor degree (*honoris causa*) from the Universitat Rovira I Virgili (URV), Tarragona, Spain (2014) for his exceptional scholarly achievements and service contributions, and exemplary professionalism.

Dr. Deen has published extensively in microelectronics/nanoelectronics and optoelectronics. Dr. Deen's research record includes more than 500 peer-reviewed articles (about 20% are invited), two textbooks on Silicon Photonics—Fundamentals and Devices, Fiber Optic Communications – Fundamentals and Applications, 20 authored/edited books and conference proceedings, 16 invited book chapters, six awarded patents that have been used in industry, and 13 best paper/poster/presentation awards. He has given one hundred and forty-eight invited/keynote/plenary conference presentations. He has also served as a consultant to the semiconductor industry in Canada, the USA and Japan. His research interests include nanoelectronics, optoelectronics, nanotechnology, and their emerging applications in health and environmental sciences.



Dr. Deen has been elected by his peers as Fellow/Member of ten national academies and professional societies: Fellow of The Royal Society of Canada (FRSC) - The Academies of Arts, Humanities and Sciences of Canada; Fellow of the Canadian Academy of Engineering (FCAE), Member (Academician) - European Academy of Sciences and Arts (MEASA); Foreign Fellow of the Indian National Academy of Engineering (FINAE-Foreign); Foreign Fellow of the National Academy of Sciences India (FNASI-Foreign); Fellow of The Institute of Electrical and Electronic Engineers (FIEEE); Fellow of The American Physical Society (FAPS); Fellow of The Electrochemical Society (FECS); Fellow of The American Association for the Advancement of Science (FAAAS); Fellow of The Engineering Institute of Canada (FEIC); and an Honorary Member of the World Innovation Foundation (HonMWIF) – the foundation's highest honor.



# GUEST SPEAKER

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## **HON. FORTUNATO T. DE LA PEÑA**

Secretary

Department of Science and Technology

**B**efore being appointed as the DOST Secretary, Hon. Fortunato T. de la Peña served as the Undersecretary for Scientific and Technological Services of DOST (2001-2014) and Director of Technology Application and Promotion Institute (TAPI), DOST (1989-1991).

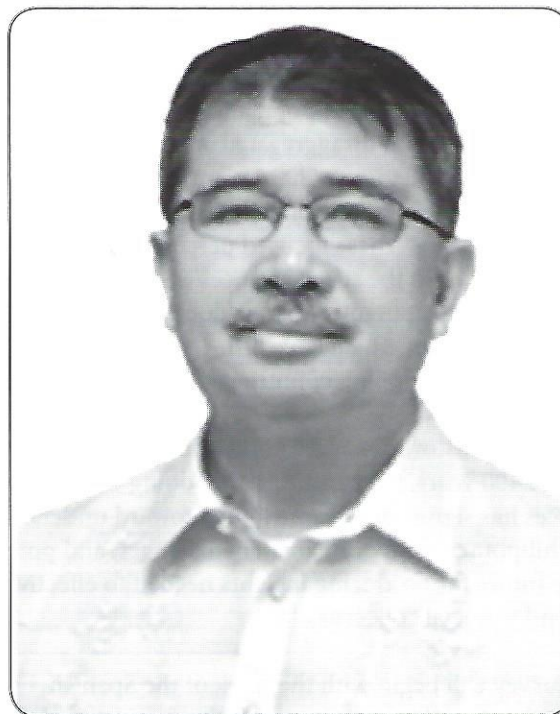
Hon. de la Peña is currently a Professorial Lecturer in Industrial Engineering at the University of the Philippines (UP). In 1973, he joined the UP College of Engineering as faculty in Industrial Engineering and became a full Professor in 1988.

He is President of the Philippine Association for the Advancement of Science and Technology (PhilAAST) since 2011 and was President of the National Research Council of the Philippines (NRCP) (2002-2007). He also became President of the Philippine Institute of Chemical Engineers (1989-1990) and Association of Management & Industrial Engineers of the Philippines (AMIEP) (1986-1988).

In recognition of his committed and dedicated service, he was awarded the *Dangal ng Bayan Award* in 2005. It is the highest award in the Philippine Civil Service conferred by the Civil Service Commission. In the same year, he was conferred the Outstanding Career Executive Officer (CEO) Award by The Career Executive Service Board.

He was cited as Outstanding Professional of the Year in the field of Chemical Engineering by the Philippine Professional Regulation Commission in 1999 and as Most Outstanding Chemical Engineer by the Philippine Institute of Chemical Engineers in 1998.

He was awarded the Distinguished Alumni Award for Public Service by the UP Alumni Association in 2012. He was named one of the 100 Outstanding Alumni Engineers of the University of the Philippines for the Century (1910-2009) in 2010.



In 1994, he received the Gawad Chancellor Award for Outstanding Administrator from the University of the Philippines Diliman.

He was awarded the Most Distinguished Alumnus by the UP Alumni Engineers in 2003 and was distinguished by the Provincial Government of Bulacan, his hometown, with the Dangal ng Lipi Award in 1997.

In 2015, he conferred the degree of Doctor of Philosophy (*honoris causa*) by the Rizal Technological University.

# PLENARY SESSION I

## SOCIAL SCIENCES

### FROM SCRIBES TO SEERS: DOING SOCIAL SCIENCE IN THE PHILIPPINES

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#### Executive Summary

by Michael L. Tan, Ph.D.

This paper will begin with popular perceptions of the social sciences, often disaggregated and with particular stereotypes, e.g. history as “heroes and dates”, geography as “maps”, psychology as “behavior” and anthropology as “(exotic) tribes”. These focused perceptions lead to misconceptions of the social sciences as mainly descriptive, almost dilettante, pursuits that produce studies that are “nice to know” but which have little impact on society, especially for developing countries.

Through an historical survey, this paper will show how, in the past 400 years, the practice – the “doing” -- of social sciences has significantly contributed toward understanding the Philippines, with even greater challenges, and potential, in the future for producing insights needed to effectively respond to social concerns.

The survey will begin with the work of the Spanish chronicles, mainly missionaries, with often detailed accounts of what they saw in the Philippines, accompanied by commentaries that were often tinged by racial and religious biases but which were, and still are, useful for understanding our past.

The review will move into a discussion of the emergence of social sciences in Europe in the context of the Enlightenment, and its impact on the thinking of social reformers. In the Philippines this would be exemplified by Jose Rizal and Isabelo de los Reyes with their unrelenting search for a Filipino identity and nationhood.

The American colonial period will be described in terms of its more formal definition, and application, of the social sciences for governance, including social engineering with its long term impact on many aspects of our public life.

In the postcolonial period, Filipino social scientists have followed international trends of separating the social sciences from the natural sciences, as well as arts and humanities, with academic institutions developing discipline-based silos of research. Despite the fragmentation, there have been common themes in the disciplines, particularly in a search for the “indigenous”, taking up in a sense the agenda of Rizal and de los Reyes in the late 19<sup>th</sup> century.

Applied social sciences have also become important to better inform development efforts. These applied social sciences have allowed greater convergence, and the adoption of inter- and transdisciplinary research. This review will use examples from the National Academy of Science and Technology’s fora, to show how these approaches can be amplified, with challenges for social scientists and their partners in the natural sciences, engineering, agriculture and medicine, to find ways to move from old roles of chronicling and describing, toward that of public intellectuals, in a sense modern seers and prophets, who can help the nation navigate perilous places, and times.

#### Speaker



**ACADEMICIAN MICHAEL L. TAN**  
Chancellor  
University of the Philippines Diliman  
and Member, Social Sciences Division  
NAST Philippines

Dr. Michael Lim Tan is a medical anthropologist (Ph.D., University of Amsterdam 1996) and a veterinarian (DVM, University of the Philippines 1977). He worked for many years with community-based health programs in the NGO sector before joining the academe. He has taught at UP since 1985 and is currently a faculty member of the College of Social Sciences and Philosophy and Clinical Professor with the UP College of Medicine.

In 2014 he was appointed Chancellor of UP Diliman. He is an Academician at the National Academy of Science and Technology (NAST) under the the Social Sciences Division.



## Discussant



**AMARYLLIS T. TORRES, Ph.D.,  
OYS 1985**  
Professor Emeritus  
University of the Philippines and  
Executive Director  
Philippine Social Science Council

Amaryllis Tiglao-Torres was appointed the Executive Director of the Philippine Social Science Council in February 2013. Concurrently, she is Professor Emeritus of the College of Social Work and Community Development, University of the Philippines and serves as Professorial Lecturer in its Doctor of Social Development and Master's in Community Development Programs.

She retired from the University of the Philippines as Professor of Community Development. She was Dean of the College of Social Work and Community Development from 2007-2010 and Vice-Chancellor for Academic Affairs of UP Diliman from 1993-1996. She was Chairperson of the Department of Community Development from 1982-1984, and served as Director of UP Diliman's Office of Research Coordination from 1987-1990, and then again in 1993.

Dr. Torres obtained her baccalaureate, master's and doctoral degrees in psychology from the University of the Philippines. She taught psychology early in her career, but applied her social science training to community development, gender studies, and social development for most of her professional life. Amar Torres has completed researches and publications relevant to the disciplines of Community Development, Child Labor, Gender and Women's Studies, Philippine Psychology, and Social Psychology.

## Moderator



**ACADEMICIAN AGNES C. ROLA**  
Professor, College of Public Affairs and  
Development,  
University of the Philippines  
Los Baños and  
Member, Social Sciences Division  
NAST Philippines

Agnes Casiple-Rola is Professor at the College of Public Affairs and Development, UPLB where she teaches methods courses to graduate students. She obtained her Ph.D. in Agricultural Economics from the University of Wisconsin-Madison, USA, M.S. in Agricultural Economics from the University of the Philippines Los Baños and B.S. in Statistics from the University of the Philippines Diliman. She has a summer program

certificate in Environmental Leadership from the University of California-Berkeley. Her research revolves around the economics, policy and institutional aspects of sustainable agriculture and natural resources management. Her current research interests are in the topics of water governance for development, water security under climate risks, environment and food security interaction amid climate change, and the policy support to organic agriculture. She has produced more than 100 scholarly outputs and holds several national research related awards. She is member of the editorial board of the International Journal of Agricultural Sustainability and currently serves on the Board of Trustees of the International Center for Tropical Agriculture (CIAT), a CGIAR center. She is a member of the Social Sciences Division, National Academy of Science and Technology (NAST) Philippines.

## Rapporteur



**CLARISSA C. DAVID, Ph.D.,  
OYS 2015**  
Professor  
College of Mass Communication  
University of the Philippines Diliman

Clarissa is a Professor in the College of Mass Communication at the University of the Philippines (Ph.D., Annenberg School for Communication, University of Pennsylvania). She conducts research in public opinion, political communication, public interventions, and communicating policy.

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. Her work has been published in some of the leading journals in communication, and her recent book "The RH Wars: Framing the Population and Health Debate" received NAST Outstanding Book Award.

In 2015 Clarissa was named one of the country's Outstanding Young Scientists by the NAST and an E. Angara Fellow for Policy Research by the University of the Philippines.

# PLENARY SESSION 2

## AGRICULTURAL SCIENCES

### Looking Back and Looking Forward: What to Do with Agriculture

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#### Executive Summary

by Emil Q. Javier, Ph.D.

Our slow progress in the attainment of our national economic and social development goals trace their roots to a large extent to the relative lack of productivity in agriculture. Pervasive poverty, underemployment, high food prices and malnutrition be attributed to the failure of the agriculture sector to contribute significantly to the growth of our economy. The 1.7% rate of growth of agriculture, not even matching population growth during the last five years (2011-2015), is symptomatic of this malaise.

Compared with our neighbors in the ASEAN against whom we usually benchmark ourselves, we are making the least progress in providing a better life for our people. While they have significantly brought their poverty rates down, poverty among Filipinos has persisted at a painfully embarrassing rate of 26 percent. And most of that poverty is found in the countryside, among farmers and fisherfolk.

And yet the ingredients to make agriculture move forward, to make it more productive, competitive, sustainable and economically rewarding to our millions of small farmers and fisherfolk are largely in place. Our moderate tropical environment and rainfall with irrigation make year-round growing possible. Our vast fisheries resources, carefully managed, should provide a sustainable supply of affordable, quality animal proteins in our diets. We have a fairly educated workforce and a modest but working higher education and scientific research infrastructure in agriculture. We have an established and increasingly competitive food and beverage manufacturing subsector. Progressive legislations are in place with the Agriculture and Fisheries Modernization Act (AFMA) of 1997 and the Fisheries Code of 1998, and a palpable improving political will to support agriculture as manifested by the expanding congressional appropriations for the Department of Agriculture (DA).

What should we do with agriculture in 2016 and beyond to get it moving forward? Beyond generalities, what specifically do we want to see done by government and those with stake in agriculture to help farmers and fisherfolk attain a better standard of living for themselves, and ultimately for all of us, now and in the future?

There is no single magic bullet that will cure all the ills of Philippine agriculture. We need to come together, marshal

and direct our resources along four major platforms of reform, namely:

- Reform of the bureaucracy of the Department of Agriculture (DA),
- Meaningful participation of stakeholders in the governance of agriculture,
- Continuing investments in rural institutions and infrastructure, and
- Closure on a few important but contentious issues.



## Speaker



**ACADEMICIAN EMIL Q. JAVIER**  
Member, Biological Sciences Division  
NAST Philippines

Academician Emil Q. Javier has served as a presidential cabinet member and chair of the National Science Development Board or NSDB, (now Department of Science and Technology or DOST). He was also the first Director of the Institute of Plant Breeding of the University of the Philippines Los Baños (UPLB) and was the 16<sup>th</sup> President of the University of the Philippines System (UP) between 1993 and 1999.

Acad. Javier's works are focused on developing practical methods of improved crop production, using modest, indigenous inputs, aware of the small farmer's limited resources. In 1972, a national pasture development program was launched, premised on the minimum or no tillage establishment of adapted legumes on native pastures with application of phosphorous, based on his experiment of introducing legume into native Imperata pastures with minimum or no tillage.

Acad. Javier attended his undergraduate degree in B.S. Agriculture (*cum laude*) at the University of the Philippines College of Agriculture (1960). He finished his Master of Science in Agronomy from the University of Illinois (1964) and his Ph.D. in Plant Breeding from Cornell University (1969).

He was recipient of SEARCA Professional Chair in forage and pasture technology in 1974 to 1975, Ten Outstanding Young Men (TOYM) award in Agriculture in 1975, Rizal Pro Patria award in agriculture in 1975, and the UP Alumni Association Professional Achievement award in agriculture in 1980.

## Moderator



**CORRESPONDING MEMBER**  
**REYNALDO L. VILLAREAL**  
Member, Agricultural Sciences Division  
NAST Philippines

Corresponding Member Reynaldo L. Villareal is an Adjunct Professor of Plant Breeding and International Programs at Cornell University, USA since 1991.

In the span of his career as a rice and wheat breeder, he had significantly contributed to international agricultural development through his active involvement in "Gene Stewardship," which includes responsible management of rice and wheat genetic resources and varietal development. He was closely involved in the rice and wheat development and improvement programs at the International Rice Research Institute (IRRI) and Centro Internacional de Mejoramiento de Maize y Trigo (CIMMYT), respectively, which has led to the release of more than 140 rice and more than 150 bread wheat varieties worldwide. The improved germplasms for these two major crops are now cultivated on some 50 million hectares around the world; they provide parental materials for the development of locally adapted varieties. In the Philippines, 34 rice varieties had been released from this genetic pool during the period 1973-2001.

Global recognition has been given to his research group on exploiting the wild relatives of wheat for genetic diversity, identifying dwarfing genes for better crosses, utilizing durum-based man-made bread wheat in breeding, and using wheat-rye chromosome translocations for yield increase. At least 98 novel germplasms had been identified from this work, most of which had been registered with the Crop Science Society of America. From his research work, he had written/co-written more than 110 papers in prestigious scientific journals and technical publications.

For 28 years, he coordinated and conducted national and regional agricultural training and research activities at IRRI and CIMMYT that has strengthened the capacity of many countries in rice and wheat production. He continues to serve as Consultant on rice and wheat, training, research, and production problems in Southeast Asia.



## 37<sup>th</sup> ASM IN PHOTOS



## Rapporteur



**GLENN B. GREGORIO, Ph.D.,**  
**OYS 2004**  
 Plant Breeder and Geneticist  
 East-West Seed Philippines

Glenn B. Gregorio obtained his Ph.D. in Genetics and M.Sc. in Plant Breeding at the University of the Philippines Los Baños (UPLB). His career was developed at the International Rice Research Institute (IRRI) as researcher from 1986-1998 where he served as Post-Doctoral Fellow and assumed various research positions like International Research Fellow, Scientist, Senior Scientist, and Deputy Division Head of IRRI's Plant Breeding Genetics and Biotechnology Division. At IRRI, he worked on Rice Breeding for tolerance to saline-prone and problem soils, Coordinator - Varietal development pipeline-cross cutting R&D. He is Adjunct Professor at the University of the Philippines Los Baños and Central Mindanao University (CMU). He recently joined the East-West seed (EWS) company as Crop breeding Manager for corn.

His awards include among others: Ten Outstanding Youth Scientists of the Philippines (TOYS 1980), William Dar 2014 Crop Science Achievement Award in Research Management (2014). Medal award as "Having Great Contribution to the cause of Agriculture and Rural Development of Vietnam" (2012), Central Mindanao University Centennial Most Distinguished Alumnus (2010), Outstanding Young Scientist (OYS 2004) in the field of Genetics, Crop Science Society of the Philippines Achievement Award for Crop Science Research (2004), Honorary Foreign Scientist of the Rural Development Administration (RDA) Award of Korea (2002-2005), The Outstanding Young Men (TOYM 2004) Philippines.



# PLENARY SESSION 3

## BIOLOGICAL SCIENCES

### Climate Change Impacts on Food Security from Marine Resources

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#### Executive Summary

by Laura T. David, Ph.D., Rhodora V. Azanza, Ph.D.

Fisheries and associated livelihoods provide livelihood to more than 30 million Filipinos. Additionally, fish consumption of 23-43 kg/year is considered higher than global average (FAO, 2000). This reliance on the coastal system combined with the high climate exposure makes the Philippines highly vulnerable to climate change.

The specific values differ for each of the IPCC5 RCPs (Representative Concentration Pathway Scenarios) but the CMIP5 models project that in the near-term climate change scenario (2016-2035) the Western Equatorial Pacific region shall experience significant increases in sea surface temperature (mean ocean surface change of 0.5-0.75°C). There is a projected seasonal mean percentage precipitation change of up to 10%. More importantly, locally prolonged drought and intense episodic rainfall with increase in variability is the likely scenario. Models also agree that storms will become more intense but the frequency will either decrease or remain unchanged. Global sea-level rise is projected at 20-90 cm per decade with the Western Equatorial Pacific region likely experiencing the higher of these global estimates. Ocean pH is globally projected to decrease 0.1 unit in the near-term.

Slow persistent increase in ocean temperature have been associated to distribution limit consequences of marine flora or fauna (Gaston, 2000; Carricart-Ganivet, 2004; Somero, 2010; Tittensor et al., 2010) and have been linked to changes in timing of spawning events (Wilson and Harrison, 2003; Donelson et al., 2010; Pankhurst and Munday, 2010). Temperature sensitive species will likely adapt to warming waters by temporarily migrating to deeper waters or permanently migrating to higher latitudes where temperatures will still be conducive for typical functioning. For those that cannot migrate, the prediction is for negatively affected reproduction and recruitment failures (Donelson et al. 2010, Ljunggren et al., 2010; Pankhurst and Munday 2011). Decline of locally available fish populations and eventual local extinction is likely.

Extreme rainfall can limit surface manifestation of the upwelling near the coast and significantly reduce aggregation of target species (Cabrera et al., 2011). Extreme rainfall can also impact coastal habitat health due to nutrient input. High nutrient input can make the waters eutrophic and can trigger algal blooms. This in turn

can contribute to water turbidity, anoxia, and toxicity—depending on the algal species. Eutrophication, anoxia, and toxicity can cause massive fish kills (San Diego-McGlone et al., 2008; David, et al., 2014).

Ocean acidification have also been observed to negatively affect the recruitment success of temperate species (Simpson et al., 2011; Munday et al., 2009) but may not necessarily be disadvantageous for tropical benthic-spawning marine fishes (Munday et al., 2009b).

Coastal habitats such as mangrove forests, seagrass meadows, and coral reefs act as refuge for tropical benthic adults and nursery grounds for the benthic and pelagic young. Storms and its associated storm surge were recently documented to defoliate and damage mangrove stands (Gunderson, 2010; Primavera et al., 2016). Old tall mangroves that are taller than the average tree-line are the ones most likely to suffer from the passage of high winds. Seedlings may become buried under storm-associated sedimentation. For moderate rates of sea level rise enhanced vegetation growth is likely as the ecosystem strives to adapt. At faster rates of SLR vegetation however, mortality ensues as the substrate deepens beyond depths capable of supporting vegetation (Kirwan et al., 2010). Also, adults that are only salinity tolerant for short periods of time (typically located more shoreward) will suffer from prolonged exposure to seawater. Over the longer term, the impacts of sea-level rise need not necessarily be negative, provided shoreward migration is possible (Waycott et al, 2011).

More intense storms and sea level rise are likely to impact seagrass meadows. Intense storms bring about increased nutrient and sedimentation from the watershed and increased energy of incoming waves. High nutrient input can be good for the seagrass as these meadows are known to be nutrient poor. However, the increased sedimentation can bury seagrass meadows or at the very least leave the water murky for extended periods of time. These will compromise seagrass productivity (Gacia, et al., 2005; Orth et al., 2006). Intense storms, on the other hand, are likely to uproot shallow water seagrass meadows (Short, 1987; Kim et al., 2015). In addition, sea level rise is expected to lead to a loss of deep water seagrass habitats present at edge of their depth limits due to light availability (Waycott et al. 2011). The combined



effect will lead to a thinning of the meadows and a decrease in seagrass species diversity. In terms of fisheries this specifically impacts on seagrass related fisheries such as that of rabbit fish and prawns. It will also have a cascade effect on larger target fish since seagrass meadows provide food for these higher trophic levels.

Coral reefs are highly susceptible to degradation from increases in ocean temperature (coral bleaching), physical damage from stronger storms, and reduced calcification due to ocean acidification (Munday et al. 2008, Pratchett et al. 2011, Hughes et al. 2003, Hoegh-Guldberg et al., 2011). Loss of coral cover, typically result in the decline of smaller-bodied coral-associated fishes that are dependent on the structure of reef habitat for shelter (Graham et al. 2008). Only the small generalist species and rubble-dwellers are expected to increase in abundance on degraded coral reefs (Bellwood et al. 2006; Ticzon et al., 2012). These species are generally not utilized as food fish.

There are also particular economically important species that require the presence of all three coastal habitats to be sustainable such as groupers.

As habitat health is degraded due to climate change, larger predators will also be affected (Sundblad, 2014). This can happen in two ways. Both pelagic and demersal predators also use the mangroves, seagrass, and corals as nursery ground. Hence, their population will also be compromised as the habitats get degraded. In addition, as the smaller habitat-affiliated fishes are compromised the predators may end up migrating to more bountiful cooler and deeper areas. This will tax small-scale fishers who have limited mobility.

An alternative food resource is mariculture which is a more controlled environment. But experience has showed that this is not climate-proof either. Anomalous warming of ocean water affects the oxygen content of the water and has historically resulted to massive fish kills within mariculture sites (David, et al., 2014). Increase in surface ocean temperature might also abet the formation of algal blooms. Algal blooms impact aquaculture either due to its toxic nature or by further reducing the oxygen content of the water. Increase in the intensity of storms might also compromise the integrity of the mariculture structures themselves with floods bringing debris-laden rushing waters. Lastly, ocean acidification is also likely to compromise large-scale commercial shellfish culture.

Our high biodiversity reduces the overall vulnerability since species having similar ecosystem functions allow for adaptation to slow changes. [1] **There is need therefore to conserve and protect the different alluvial, estuarine and**

**coastal habitats—especially those identified as spawning and nursery grounds.** Corollary to this, increase human utilization of the coastal zone, if mismanaged, can further exacerbate the vulnerability. [2] **A comprehensive ridge-to-reef management must therefore be put into place to mitigate human activities that lead to increase input of nutrients and pollutants or alter the natural buffering capacity of these biodiverse habitats.** [3] **The opportunities to enhance our food security through mariculture should also be fully realized by exploring culture of other indigenous climate tolerant species without compromising the existing natural biodiversity.** [4] **In order to do these, careful site selection must be undertaken – taking into consideration local water renewal, the history & potential of an area for climate-related or bio-chemical stress (e.g. HABs), and potential impact of the mariculture area to surrounding habitat.**

Enhancement of the adaptive capacity of coastal communities therefore relies heavily on the LGUs through the Philippine local government code. Coastal LGUs need to be made to understand and appreciate their role in the transition towards a climate adapted archipelago. Their decisions will need to take into account social and economic, as well as, ecological concerns. [5] **Hence, decision makers need to be provided assessments of valuation of coastal ecosystem services, as well as, adaptations costs and benefits.**

Further, there are still uncertainties on the magnitude of local future scenarios and consequently lack of quantitative predictions of local future coastal changes. [6] **There is need to develop local predictive models based in multi-stressor observations and experiments in detailed levels of space and time.** Finally, all these science-based data will then have to be communicated to decision-makers and institutions so that their role in the transition towards a climate adapted archipelago may be realized. [7] **Therefore, there is a serious need to strengthen the science-to-policy communication sector amongst our ranks.**

VISION: A society where decision-making seriously takes into consideration the weaknesses and strengths of the Philippines as an archipelagic country



## Speaker



**LAURA T. DAVID, Ph.D., OYS 2007**  
Professor VII  
The Marine Science Institute  
University of the Philippines Diliman

Dr. Laura T. David is a Physical Oceanographer and Professor at the University of the Philippines Marine Science Institute who studies ocean physics and its effects to productivity and diversity. She is recognized as one of the country's pioneers in Ocean Remote Sensing. Her expertise is also being tapped to assist in matters related to climate change vulnerability and adaptation.

In 2010, she was recognized as one of The Outstanding Women in the Nation's Service (TOWNS) and one of the two L'Oreal National Fellow. In 2011, she was given the Gawad Chancellor Natatanging Guro by the University of the Philippines Diliman. She is currently the Chair of the Commission of Higher Education Technical Committee on Marine Science, and a member of the National Panel of Technical Experts for the Climate Change Commission.

## Moderator



**ACADEMICIAN**  
**RHODORA V. AZANZA**  
Professor, The Marine Science Institute  
University of the Philippines Diliman  
and Chair, Biological Sciences Division,  
NAST Philippines

Dr. Rhodora V. Azanza, Professor of the The Marine Science Institute, University of the Philippines Diliman and Academician, National Academy of Science and Technology, has served the University in various positions including being the first woman dean of the College of Science for six years. She has been one of the members for seven years of the International Seaweed Association Council, a rare post occupied by a woman.

Dr. Azanza has 170 publications in international journals. She has extended her expertise to government agencies and international organizations, concurrently being the vice-chairman of UNESCO-Intergovernmental Oceanographic Commission (IOC) Panel on Harmful Algal Blooms (IPHAB) and leader of IOC's Harmful Algal Blooms in Southeast Asia (HABSEA) Portal and e-learning for seven years. The ASEAN Red Tide Network has been coordinated by Dr. Azanza for more than ten years.

She has been actively involved in the production and dissemination of UNESCO-IOC HAB information and educational materials. Dr. Azanza received numerous scientific awards which include the 2013 UPAA lifetime Distinguished Achievement Awards from the UP Alumni Association. Recently she has been named as the 2015 DOST-PCAARRD Pantas Awardee for Most Outstanding Researcher/Scientist. At present she is an Assistant Vice President for Academic Affairs and Director of the Office of International Linkages (OIL) of the University of the Philippines.

## Rapporteur



**ARNOLD V. HALLARE, Ph.D.**  
**OYS 2007**  
Professor 9, Department of Biology and  
Director, National Graduate Office for  
the Health Sciences  
University of the Philippines Manila

Dr. AV Hallare is an aquatic toxicologist whose works consist mainly of elucidating the mechanisms of toxic response in organisms exposed to single chemicals or "cocktail" of contaminants present in environmental samples, such as water and soils/sediments. His expertise is on biomarkers of environmental pollution: fish embryotoxicity studies, histopathology, heat shock proteins (hsp 70/90), pollutant-induced DNA damage (comet assay, micronucleus, Ames test), dioxin-like activity (EROD Assay), endocrine disruption (YES Assay), and cytotoxicity assays; He is also involved on researches on bioassay-directed fractionation to characterize teratogens, mutagens, endocrine disruptors, and AhR-active substances in sediments. His very recent works, however, are in the fields of metagenomics research and on the ecotoxicology of biofuels. Results of his works have been presented in various international and national scientific conventions and have been published in internationally refereed journals on environmental toxicology and aquatic ecosystem health. Dr. Hallare received his Ph.D. (Ecotoxicology) from the Eberhard-Karls University of Tübingen (Germany) in 2005 through the DAAD Scholarship. In 2010, he was awarded the Alexander von Humboldt Fellowship, and finished a postdoctoral study at the RWTH-Aachen University (Germany). Earlier in 1998, he had also earned a Diplomate in Ecology and Resource Management from Lincoln University, New Zealand. In 2007, Dr. Hallare was acclaimed as one of the Outstanding Young Scientists of the Philippines by the National Academy of Science and Technology.

# PLENARY SESSION 4

## MATHEMATICAL AND PHYSICAL SCIENCES

### Human Capital in Science Education

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#### Executive Summary

by Bienvenido F. Nebres, S.J.

#### DEVELOPING S&T PH.D. PROGRAMS AND RESEARCH: THE UP-ATENEO-DE LA SALLE CONSORTIUM AND ESEP EXPERIENCE

The major challenge facing S&T manpower in the Philippines is Numbers. We simply have too few high-level scientists and engineers. This is clear from the experience of programs such as PCARI and ERDT and research programs of DOST. There is often more funding than research proposals or applicants for high-level Ph.D. and Masters programs.

The underlying reason is that we have focused on “leaves and fruits of the S&T tree”, i.e. Ph.D.’s and research, but have not worked as hard on the “roots and the trunk”, creating the S&T infrastructure to support the Ph.D. programs and research.

The paper seeks to make a contribution by sharing the experience of building Ph.D. programs in mathematics, physics, and chemistry through the UP-Ateneo-De La Salle Consortium through the 1970s and 1980s. It highlights

- 1) The key role of a dedicated group of academic scientists who gave of their time and effort over these 20 years to develop and nurture the Ph.D. programs
- 2) The role of supportive colleagues in government to provide local funding for these programs
- 3) The importance of academic friends abroad, who opened the doors to support from foreign science agencies, such as JSPS in Japan and AUIDP in Australia.

The experience says that the scientific endeavor is built in large part through a community of friends, who share a common purpose and sustain the endeavor through decades.

It then shares the experience of the Engineering and Science Education Project (ESEP), which helped to build the infrastructure of advanced laboratories, libraries, and networks. It supported a large-scale effort to develop Masters and Ph.D. programs in Science and Engineering. It also worked to strengthen mathematics and science

at the high school level by building laboratories and teacher-training for the 110 public leader schools of DECS (DepEd).

This experience shows the complexity and organizational challenge of building the support infrastructure of laboratories, libraries, a stream of students for S&T programs coming from high schools.

Finally, looking forward, the paper has the following major proposals:

- 1) Identify and support more clusters and consortia across the country to carry out high-level Ph.D. programs and research
- 2) For these programs to succeed, there is need to develop strong undergraduate programs in science and engineering as feeders to these Ph.D. programs and research.
- 3) Most important, there is need for programs to identify and develop S&T talent at the Grade School and High School level. This is particularly important in mathematics and physics, which are foundational.

Finally, in order to succeed in no. 3 there is need to reform the teaching of mathematics and science at the Grade School and High School level for talented students. Teachers have to be identified and trained to do real problem-solving and to teach mathematics as a discipline of problem-solving. For science, this means moving beyond demonstrations to doing real experiments.



# PLENARY SESSION 4

## MATHEMATICAL AND PHYSICAL SCIENCES

### Human Capital in Science Education

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#### Executive Summary

by Maria Victoria C. Bernido, Ph.D.

#### LESSONS FROM THE PAST, PROJECTIONS FOR THE FUTURE: SMARTER SCIENCE LEARNING AND RESEARCH

"A nation's precious human capital is nurtured through education and promoted through the labor market. This is the national resource that more than any other will determine success in terms of GDP, investment environment and so on as nations compete in the global market economy."<sup>1</sup> This view from China is shared by many. There is also a particular concern for the quality of science and math education, compounded by the balance of global economic and political being linked to the strength of human resources in STEM disciplines<sup>2</sup>. See for instance the US National Science Board report on, "Preparing the Next Generation of STEM Innovators: Identifying and Developing our Nation's Human Capital." These advanced countries, like many others, appropriate large portions of their national budget to education. However, huge budgets do not necessarily create huge impact in educational outcomes. As noted in Singapore, "Recent OECD findings show that higher expenditure does not guarantee better student performance"<sup>3</sup>. The UK Royal Society, in comprehensive state-of-the-nation reports on school science and math leading up to higher STEM education states, "It is clear from the evidence presented in this report that, as a whole, our education systems are failing to maximise the numbers of students who could go on to become STEM undergraduates."<sup>4</sup> Considering the magnitude of challenges in STEM education even for such wealthy countries, it would then be easy to suppose that the Philippines can cure large-scale poor performance in basic and tertiary education only by incurring multi-billion foreign debts to augment limited budgets for education and research, while engaging foreign technical assistance for curricular development and personnel training. Indeed, this has been done for decades, yet only with incremental improvement, if any, in tangible outcomes.<sup>5</sup> Here we show how we can have the option of low-cost high-impact strategic solutions to achieve educational, research and development goals for urban or rural schools, and the Philippines at large. At risk of scepticism against low-cost programs, we state our original design problem cast in business lingo<sup>6</sup>: "We will design a learning program for the great multitude. It will be large-scale enough for state school systems, but individualized enough for each student in any school, private or state-run, in any part of the country. It will be composed of the

best evidence-based features, chosen by the best team to be formed, after the simplest designs that modern pedagogy and learning sciences can devise. But it will be so low in cost that no nation will be unable to effectively implement one." These lines echo the memorable statement of Henry Ford<sup>7</sup> on the Ford Model T, a classic model of a supremely successful enterprise designed for the masses by systematically reducing production time, manpower requirements and overall cost in a radically different assembly process.

For our educational program, we had the following working assumptions: 1) A nation-wide distribution of talents; 2) A large mass base of talents to be developed with discipline for globally competitive human capital; 3) Programs that deliberately or unwittingly cater only to the elite in intellectual and socio-economic domains squeeze out precious human resources from the productivity line. These three assumptions led to the immediate objective: The average child in any part of the country – in Luzon, Visayas or Mindanao – performing at least as well as the average German, Finnish, Singaporean, Japanese or Chinese child in math, science, and the humanities. To achieve this objective efficiently, we set the following criteria for the learning program: (1) Small input: Least cost in human and material resources, in energy– both physical and fuel, and social cost in terms of learner leisure and family time; and (2) Big output: Wide spectrum of learners with high criterion-based STEM performance levels. Furthermore, the program has to have built-in mechanisms to mitigate debilitating socio-economic conditions. Finally, for sustainability the program should be systems-based so that learner performance is less dependent on teacher and peer personalities, as well as national and foreign policies.

Our solution package is the CVIF Dynamic Learning Program<sup>8</sup> (DLP), a systems approach to process-induced learning which, since initial implementation in 2002, has been applied in elementary, secondary, and tertiary levels in schools and colleges. Key features of the strategic approach are: going back to first principles and rigorous analysis of longitudinal in situ observations and data, instead of simply following prevailing trends and dominant dogmas. Example 1: Instead of focusing on cost-intensive transitory teacher training (with ever present risk of teacher migration), implement a protocol bypassing need



for frequent teacher intervention. Example 2: Instead of focusing on English, cultivate math and science as easiest to build up on; communication skills develop as by-product of strong content and integrated language learning. Example 3: Instead of focusing on social dimensions of children's and adolescents' psychological make-up, build up on observable anticipatory behavior and goal-setting dimension. We then present some outcomes of CVIF-DLP implementation: performance indicators of public high schools in Bohol and Basilan (Mindanao). Insights from our Learning Physics as One Nation (LPON) project<sup>9</sup> supported by the Fund for Assistance to Private Education also showed quick and progressive development of physics competencies of teachers and students with several schools reporting fewer failures in physics with the LPON, both in and post-high school.

The high level of intellectual discipline, stamina, patience, and attention to detail developed in many students trained in the CVIF DLP way allows us to set higher targets for incoming Grades 11 and 12 students, with 120 taking the STEM strand. With the senior high school curriculum requiring two semesters of practical research, CVIF has mapped out several research directions that optimistically will lead to international journal publications for a significant number of students augmenting national efforts to increase creativity and innovation indices based on international publications and patents. With Jagna facing Bohol Sea, one research area is naturally in biochemical marine studies and biodiversity leading to purposive marine resources preservation and development. Hence, initial collection and sorting for classification and documentation of marine mollusc species in Jagna Bay has been done early this year by incoming Grade 11 students with support from the research team of Prof. Baldomero Olivera of the University of Utah, and NAST Corresponding Member.

<sup>1</sup><http://www.china.org.cn/english/2004/Jun/99696.htm> (Downloaded 29 May 2016), trans. Ni Xiaoliang: Report on an address of Acad. Wei Yu, Chinese Acad. of Engineering.

<sup>2</sup>Read, e.g., 'State of the Nation Addresses' of heads of state.

<sup>3</sup><http://www.moe.gov.sg/media/parliamentary-replies/2013/10/government-expenditure-on-education.php> (Downloaded 5 August 2015).

<sup>4</sup>See e.g., 'State of the Nation' reports on 5-14 (2010) and 14-19 (2008) Science and Mathematics Education, Royal Society, [royalsociety.org/education](http://royalsociety.org/education).

<sup>5</sup>Poor performance in international science and math assessments at the elementary and secondary level, until the government opted not to take recent assessments; No Philippine university in the top 800 of THEED 2015-2016 World University Rankings which list includes those from countries in Southeast Asia and Africa; Low enrollment and cohort retention in STEM fields.

<sup>6</sup>M. V. Carpio-Bernido and C. C. Bernido, Invited talk for the 10th Global Business School Network Annual Conference: Disruptive Education Models from the Developing World, November 2015, Asian Institute of Management, Makati, Philippines; adaptations, with apologies, in italics.

<sup>7</sup>Ford, Henry; Crowther, Samuel (1922), *My Life and Work*. Garden City, New York, USA: Garden City Publishing Company, Inc. Various republications, including ISBN 9781406500189. Original is public domain in U.S.

<sup>8</sup>M. V. Carpio-Bernido and C. C. Bernido, "Science Culture and Education for Change, Part I: Innovative Strategies for Secondary Education in the Philippines," *Transactions of the National Academy of Science and Technology*, Vol. 26, No. 2 (2004), p.243; Carpio-Bernido, M. V., Bernido, C. C. (2011) CVIF Dynamic Learning Program: A Systems Approach to Process-Induced Learning. In *Proc. of the epiSTEME 4* (Mumbai:HBCSE); Carpio-Bernido, M. V., Bernido, C. C. and Carpio, J. A. Z. (2011) CVIF Dynamic Learning Program Reference and Management System Manual (Jagna, Bohol: CVIF)

<sup>9</sup>Carpio-Bernido, M. V., Bernido, C. C. and Porio, C. C. (2011) The Learning Physics as One Nation Initiative: Bypassing the National STEM Teacher Shortage. *Proc. epiSTEME 4* (Mumbai: HBCSE).

## 37<sup>th</sup> ASM IN PHOTOS





## Speaker



### NATIONAL SCIENTIST

**BIENVENIDO F. NEBRES, S.J.**

Member, Mathematical and Physical Sciences Division, NAST Philippines

Fr. Bienvenido F. Nebres, S.J. served as President of the Ateneo de Manila University for 18 years 1993-2011. He was Dean of the Ateneo College of Arts and Sciences 1973-1980. He was Provincial Superior of the Jesuits in the Philippines 1983-89 during the time of democratic transition to President Corazon Aquino after the years of martial law under President Marcos. He was also President of Xavier University in Cagayan de Oro in the early 1990s.

He did extensive work to develop science and mathematics in the Philippines and in Southeast Asia and was elected in 2011 as National Scientist by the National Academy of Science and Technology (NAST). He was conferred the award by President Benigno Aquino III in September 2011.

After retirement as President, he continues as Professor of Mathematics at the Ateneo de Manila and is engaged in various programs to help overcome poverty in the country: improving public education in over 400 public schools with the Ateneo Center for Educational Development (ACED) and in over 200 municipalities, particularly in the Autonomous Region of Muslim Mindanao, with Synergeia Foundation; building homes and communities for the poor with Gawad Kalinga; and supporting young people engaged in social enterprises for poor communities.

He is presently Rector of the Jesuit Residence, Ateneo de Manila University, a member of the Board of Trustees of AY Foundation, Inc., Center for Leadership and Change, Inc., Gawad Kalinga, NCM Mutual Fund of the Phils., Inc., Synergeia Foundation, Inc., Ateneo de Iloilo, Georgetown University and the United Board for Christian Higher Education in Asia (UBCHEA).

## Speaker



**MARIA VICTORIA C. BERNIDO, Ph.D.**

Directress  
Central Visayan Institute Foundation  
Jagna, Bohol

Dr. Carpio-Bernido, physicist and educator, obtained her Ph.D. (Physics) and M.S. (Physics) from the State University of New York, Albany, USA, where she was Most Outstanding Physics Teaching Assistant in 1985. She graduated B.S. (Physics) from the University of the Philippines (UP) Diliman in 1982, a National Science Development Board scholar. At UP Diliman, she received the Chancellor's Award for Most Outstanding Faculty Members and Achievement Award (Physics) from the National Research Council of the Philippines.

She was Associate Member of the International Centre for Theoretical Physics (Italy), Alexander von Humboldt-Stiftung Postdoctoral Research Fellow (Germany), Exchange Scientist in Japan, and has given plenary lectures and presented papers in international conferences, and has international publications on Feynman integrals, quantum mechanics, and stochastic analysis.

In 1992, she co-founded with Dr. Christopher Bernido, the Research Center for Theoretical Physics, Central Visayan Institute Foundation (CVIF) in Jagna, Bohol, co-organized international physics workshops, given lectures and advised graduate students from UP, Mindanao State University - Iligan Institute of Technology, and University of San Carlos in Cebu. In 1999, she helped manage the CVIF high school.

In 2002, she took professional education courses at Ateneo de Naga University (AdeNU), ranked second in the National Licensure Examination for Teachers, and implemented the CVIF Dynamic Learning Program to boost performance in spite of inadequate resources.

In 2008, she co-produced materials for the Learning Physics as One Nation Project (Fund for Assistance to Private Education), used in over 600 schools.

She and her husband received the 2010 Ramon Magsaysay Award and 2009 Gawad Haydee Yorac (UP-Meralco), and were conferred Doctor of Humanities, and Doctor of Pedagogy, *honoris causa*, by Holy Angel University, Angeles City, and AdeNU, respectively.

## Moderator



### ACADEMICIAN

#### FABIAN M. DAYRIT

Professor, Department of Chemistry  
Ateneo de Manila University,  
Acting President and Chair,  
Mathematical and Physical Sciences  
Division, NAST Philippines

Dr. Fabian M. Dayrit is a full Professor at the Department of Chemistry and director of the National Chemistry Instrumentation Center (NCIC), Ateneo de Manila University. He obtained his Ph.D. Chemistry from Princeton University in 1981 with a specialization in Organometallic Chemistry. His current research interests revolve around the chemistry virgin coconut oil, medicinal plants, and microalgae. He is currently chair of the National Science Consortium under DOST-SEI.

In 1993, he was selected as a TOYM awardee for Chemistry. He received the Achievement Award in Chemistry Education by the Philippine Federation of Chemistry Societies in 1995, the Achievement Award in the Chemical Sciences by the National Research Council of the Philippines in 2002, and two awards for outstanding research paper from NAST in 1995 and 2007. In July 2009, Dr. Dayrit was elected as an Academician of the National Academy of Science of Technology.

## Rapporteur



### QUEENA N. LEE-CHUA, Ph.D., OYS 2002

Professor, Mathematics and  
Psychology Departments  
Ateneo de Manila University

Dr. Queena N. Lee-Chua is Professor of mathematics and psychology at the Ateneo de Manila University. A columnist for the Philippine Daily Inquirer, she has written books on education, family businesses, math and science, learning psychology, family, and parenting.

She also headed Ateneo teams that studied the best practices of Filipino student achievers, and the media habits of Filipino youth. A speaker, consultant, and board member for academe, government, business, the DepEd and DOST, Queena served as Philippine Representative to the Governing Board of the Regional Centre on Math and Science Education in Penang, Malaysia.

Aside from NAST's Outstanding Young Scientist and DOST's Great Men and Women of Science, Queena has garnered various recognition: Outstanding Young Filipinos, Outstanding Women in the Nation's Service, Metrobank Outstanding Teachers, National Book Awards, Carlos Palanca, Catholic Mass Media. She was featured in Asia Inc. Magazine's Who's Hot in Asia, and the Singapore Heritage Center's Southeast Asian Personalities of Chinese Descent. In 2010, with a Malaysian scientist, she became the first person to receive the Third World Academy of Sciences Regional Prize for Public Understanding of Science for the East Asia, Southeast Asia, and the Pacific Region.



# PLENARY SESSION 5

## ENGINEERING SCIENCES AND TECHNOLOGY

### Philippine Infrastructure: Looking Back and Looking Forward

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#### Executive Summary

by Primitivo C. Cal, Ph.D.

Urban infrastructure in my presentation consists of transportation, communications, water supply, wastewater treatment & disposal, drainage, and solid wastes management. Energy should have been included but there is a separate presentation of it in this ASM. The roles of urban infrastructure to make urban areas livable, safe and sustainable cannot be overemphasized. Transportation enables the flow of persons, goods and services, whereas communications makes the flow of information and data possible. Water supply is a basic need but used water and the sources of water can cause flooding, if not also a threat to health. Solid wastes, as byproducts of living and economic activities, have to be properly handled.

The Philippines is experiencing rapid urbanization. In 1980, the percentage of the population living in urban areas was under 40% but today it is 70%. This trend is putting a severe strain on urban infrastructure, particularly the transportation systems. Increasing travel demand has caused the emergence of a hierarchy of public transport, virtually offering a door-to-door service. Unfortunately, the provision of transportation has not kept pace with rising travel demand, especially in large urban areas, resulting in traffic congestion and environmental deterioration. In fact, Congress is bent on granting emergency powers to President Duterte to address transportation and traffic problems in Metro Manila and even other large urban areas.

In communications, the Philippines is enjoying the fruits of liberalization. There are about 3.14 million fixed telephone lines in service (2013 figure), with Metro Manila accounting for about 50% of the total. There are 36 million internet users, giving a user penetration of 37%. The use of cellular mobile telecommunications services is even more impressive.

The development of communications in the country, according to Oquindo, dated back as early as in 1867, with the first telegraph link established between Manila and Corregidor. The first telephone system was inaugurated in 1890. In 1949, Globe wireless established the first ground-to-air radio telephone communications for airlines. The country's first cellular mobile telephone network was inaugurated by PLDT in 1988. The liberalization policy which took effect during the Ramos Administration allowed the entry of many players, providing all types of

communication services. As per Buddecomm, 2 million customers subscribed to dial-up internet service in 2014. However, demand is affected by slow broadband speed of only 3.4 Mbps in 2014, the lowest average in the ASEAN region. Mobile speed is likewise very low at 3.8 Mbps. Postal services have also improved with the Philpost taking the lead, delivering about 147 million mails per year

Water is a basic need. Yet the government is unable to meet adequately this need. Most cities experience lack of water supply. In the case of Metro Manila, Metro Cebu and Davao City, the current demand is significantly higher than what their water districts can supply, in the face of abundant water resources in the country. The problem is aggravated by high rates of non-revenue water, reaching as high as 27.7% in the case of Davao City.

Demand for water is increasing due to population growth and the requirements of agriculture, business and industrial establishments. For Metro Manila, water demand will increase from its 2015 value of 1,955,280 cm/day to 2,114,672 cm/day in 2025 and 2,213,712 cm/day in 2045. For Metro Cebu the demand is 461,200 cm/day in 2015 to 561,920 cm/day in 2025, and 751,920 cm/day in 2045. For Davao City, the demand increases from 231,887 cm/day in 2015 to 259,744 cm/day in 2025 and 500,829 cm/day in 2045. In contrast, available supply consists of 3,392,520 cm/day for Metro Manila, 188,082 cm/day for Metro Cebu, and 21,726 cm/day for Davao City. As shown, much is needed to address the widening Demand/Supply gaps, consisting of: water conservation; watershed management; rainwater harnessing and expansion of the water supply system.

Associated with water use is the handling of wastewater in order to avoid endangering human health or the natural environment. The quantity of wastewater is proportional to the amount of water consumed. Considering losses and usage of water for lawn, gardening and irrigation, the amount of sewage flow is assumed to be around 70 to 90% of water consumption.

A centralized sewerage system is the best option of dealing with wastewater, but it is not realistic for most cities because of higher capital and maintenance cost and longer periods of construction. Therefore the use of septic tanks remains the most popular means for primary treatment. The septic tank system should be complemented with a seepage



# PLENARY SESSION 5

## ENGINEERING SCIENCES AND TECHNOLOGY

### Philippine Infrastructure: Looking Back and Looking Forward

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management system for secondary treatment. In the case of Metro Cebu, an investment of P98.8 Billion is proposed for a secondary treatment composed of a septage treatment plant for the first year at P1.2 Billion and the rest for a sewerage system to year 2030.

Flooding in many regions and key cities has become evident in recent years, with increasing and unpredictable severity of rainfall. The latest incident was Yolanda which hit Northern Leyte, Eastern Samar and the northern parts of Cebu and Antique. Death toll of 6,300 and damage to properties at P 89 Billion for Tacloban City alone. Causes of flooding include: obstruction or constriction of waterways; construction within flood plains; encroachment within the river/creek easements; re-routing of channels/rivers; and clogging of drainage.

The solution to flooding consists of regulatory and engineering measures. Local legislation should include: general policies on drainage systems; reforestation and watershed management; protection of waterways; land use control; installation of cisterns in all types of development; and adoption of discharge fee principle. Of course engineering improvements of the system would be needed. In the case of Metro Cebu, P 8.43 Billion would be required to year 2030. The Drainage Master Plan of Cagayan de Oro would entail an investment of just under One Billion Pesos.

A total of 39,422 tons per day (tpd) of solid wastes is generated in the country, with Metro Manila accounting for 8,907 tpd. In Metro Cebu, 1,214 tpd are generated. The ADB has estimated that the average collection efficiency rate in urban areas is about 70%, and for Metro Manila 83%. According to the National Solid Wastes Management Council (NSWMC), as of 2011, there were 643 open dumpsites, 384 controlled dump sites, 1,327 materials recovery facilities, and 38 sanitary landfills.

The NSWMC has forecast the volume of solid wastes that will be generated to year 2050. At the end of the Duterte Administration, Metro Manila would be generating 10,667 tpd, Metro Cebu 1,777 tpd and Davao 1,377 tpd. In 2050, 27,944 tpd would be generated in Metro Manila, 4,656 tpd in Metro Cebu and 3,784 tpd in Davao. Both soft and hard measures are needed to deal with the solid wastes management problems. These are, in the decreasing order of priority: avoidance; reduce, reuse, and recycle (3R); recover; treatment; and residual management. It is forecast that more and more waste-to-energy technology would be

adopted in the future to handle solid wastes. Investments on solid wastes management systems would be needed. In the case of Cebu, investment requirements to year 2050 would amount to P2.747 Billion, including a waste-to-energy facility costing P800 Million.

### Speaker



**PRIMITIVO C. CAL, Ph.D.**

Executive Director, Planning and Development Research Foundation, Inc. (PLANADES)

Dr. Primitivo C. Cal is a civil engineer, environmental planner and lawyer by profession. Dr. Cal spent about 50 years of his professional life in the academe, consulting work and public service. He recently retired from the University of the Philippines where he served as Professor and Dean at the School of Urban and Regional Planning, as Dean of UP College Cebu and as Director of the National Center for Transportation Studies. He served as a Foreign Professor at Tsukuba University in Japan for one year. In consulting works, he has been involved in many projects both in the Philippines and abroad. In public service, he served as Undersecretary for Transportation during the Ramos Administration and as Traffic Engineer in Southampton City in England. He is also a Construction Arbitrator and has handled more than 30 cases with the Construction Industry Arbitration Commission. He is a Returning-Scientist Awardee of the Philippine Government and a recipient of awards from the Professional Regulation Commission as Outstanding Professional in the field of Civil Engineering in 2002 and in the field of Environmental Planning in 2015.



## Moderator



**ACADEMICIAN  
REYNALDO B. VEA**  
President and CEO  
Mapua Institute of Technology and  
Malayan Colleges Laguna and  
Chair Engineering Sciences and  
Technology Division  
NAST Philippines

Academician Reynaldo B. Vea is currently the President and CEO of the Mapua Institute of Technology and Malayan Colleges Laguna. He is the President of iPeople, Inc. and is a Director of House of Investments, Maibarara Geothermal, Inc. and Petrogreen, Inc.

He is Chairman of the S&T Committee of the UNESCO National Commission and is a Director of the Philippine American Educational Foundation (PAEF), otherwise known as the Philippine Fulbright Commission. Acd. Vea was formerly Dean of the U.P. College of Engineering (1993-1997) and Administrator of the MWSS (1997-2000).

He worked as a Naval Architect and Marine Engineer for the Hudson Shipbuilders, Inc. in Pascagoula, Mississippi and the Herbert Engineering Corp. in San Francisco, California.

Currently, Acd. Vea is the Vice-President of the East Asia Society for Transportation Studies (EASTS) and is the President of the Transportation Science Society of the Philippines (TSSP). He is Chairman of the Philippine Science High School Foundation, Inc.

Acd. Vea has a Ph.D. in Engineering from the University of California at Berkeley, an M.S. in Naval Architecture and Marine Engineering from the Massachusetts Institute of Technology (Tau Beta Pi Honor Society), and a B.S. in Mechanical Engineering, *magna cum laude*, from the University of the Philippines. He is the first Valedictorian of the Philippine Science High School.

## Rapporteur



**ENRICO C. PARINGIT, D. Eng.,  
OYS 2015**  
Associate Professor  
Department of Geodetic Engineering  
College of Engineering  
University of the Philippines

Dr. Eric Paringit is a Surveyor by profession, a Remote Sensing Specialist by training and a Hydrologist by Research. Dr. Paringit graduated with a B.S. degree in Geodetic Engineering and M.S. Remote Sensing in 1997 and 1999, respectively, from the University of the Philippines.

He finished his Doctor of Engineering degree at the Tokyo Institute of Technology (TokyoTech) in 2003 where he also took up his post-doctoral fellowship. He is the former Chair of the UP Department of Geodetic Engineering and Director of the Training Center for Applied Geodesy and Photogrammetry (TCAGP). He was awarded as a NAST Outstanding Young Scientist awardee in 2015.

# PLENARY SESSION 6

## HEALTH SCIENCES

### Universal Health Care in the Philippines

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#### Executive Summary

by Ernesto O. Domingo, M.D.

The most ubiquitous and challenging problem in health and all over the world is not a disease or a class of diseases but a social phenomenon, INEQUITY. This is best exemplified by the tremendous disparity in access to quality health care in the population from within countries and among countries.

There is a global consensus that the best strategy to address this inequity is to adopt a health care system called Universal Health Care (UHC). The simplest definition of UHC as it applies to Filipinos is a health care system that guarantees them access to quality health care based on need and not on ability to pay. It is anchored on the principle that health is a fundamental human right. This right is enshrined in the Constitution of the Philippines (Section 15) as well as that of the World Health Organization.

In 2009, a team from the University of the Philippines Manila which participated in the 2008 Centennial Lecture Series of the university converted itself into an advocacy group. They pushed for the adoption of UHC as the health care system for the Philippines. In the presidential election of 2010, UHC became a major issue in the platforms of the candidates. The elected president adopted and implemented UHC in 2011, a year after assuming office. This was embodied in the Department Order 2011-0188 of the Department of Health which translated UHC into the national language as *Kalusugan Pangkalahatan* or KP.

Upon implementation of KP, three strategic thrusts were launched converging on the most important purpose of serving the poor Filipino families. The three strategies are:

- 1) financial risk protection via the Philippine Health Insurance Corporation (Philhealth);
- 2) attainment of the Millennium Development Goals of 2015; and
- 3) improved access to quality health care facilities under the Health Facilities Enhancement Program (HFEP).

The strategic thrust is to be supported by reforms in the traditional sectors of health namely; financing, service delivery, policy standards and regulation, human resource, information and governance.

At this juncture of the implementation of UHC or KP, the following conclusions are supported by evidence:

- 1) neither government subsidy nor Philhealth has adequately protected the poor from financial risk;
- 2) the poor remain largely unable to access quality outpatient care (via rural health units) or inpatient facility (hospitals); and
- 3) millennium Development Goals of 2015 specially those related to maternal and child health will not be achieved.

This is not to say that UHC implementation in the Philippines is exceptionally slow when compared to other countries. After all, Germany took all of 105 years to cover 88% of its population. Nevertheless, effective implementation of the objectives of UHC can be speeded up or accelerated if the following corrections are made now.

- 1) UHC should be grounded on Primary Health Care (PHC) to promote inclusiveness;
- 2) funds intended for health services should be pooled regardless of source and allocated based on a set of priorities that are continuously vetted, for the purpose of giving priority to the poor;
- 3) health human resource production should respond to the needs of UHC and government must assure attractive emolument and career path for those working in the health sector;
- 4) reforms in leadership and governance must address the problems brought about by devolution; and
- 5) immediate implementation of a National Health Information System to provide accurate and real time data.

The UHC is only 5 years old but that should be enough time to weed out policies and programs that do not work and do not have a chance of working. There are abundant data pointing to the right policies and programs for UHC to work.



## Speaker



**NATIONAL SCIENTIST**  
**ERNESTO O. DOMINGO**

Member, Health Sciences Division  
NAST Philippines

NS Domingo is recognized for his outstanding accomplishments in the study of liver infections, and the pathophysiology, clinical behavior, and treatment of liver cancer (hepatocellular carcinoma) in Filipinos. He received the 2013 Ramon Magsaysay Award and the 2015 University of the Philippines Alumni Association (UPAA) Distinguished Alumni Award.

He is an advocate of the Universal Health Care or “Kalusugan Pangkalahatan”. In 2008, he formulated the Universal Health Care (UHC) Study Group of the University of the Philippines–National Institutes of Health (UP-NIH) with several distinguished colleagues.

He is a University Professor Emeritus of the University of the Philippines College of Medicine.

## Moderator



**ACADEMICIAN**  
**EDWARD H.M. WANG**

Member, Health Sciences Division  
NAST Philippines

Academician Edward H.M. Wang is the Chair of the Department of Orthopaedics, College of Medicine, University of the Philippines Manila. He is currently Professor 12 and University Scientist 3 of the UP College of Medicine. He is also the Head of the UP- Musculoskeletal Tumor Unit, Philippine General Hospital.

He is the author of the book “bone Tumors in Filipinos (2007) and has written 58 scientific and technical publications (national and international)

Acd. Wang is an Immediate Past President of the ASEAN Orthopaedic Association (2015). He served as a member of the International Advisory Board, Asia-Pacific Musculoskeletal Tumor Society. His international organizations include

the International Society of Limb Salvage and the East Asian Musculoskeletal Oncology Group.

He is part of the editorial board of the Journal of Orthopaedic Surgery. He serves as the manuscript editor of the Journal of ASEAN/Malaysian Orthopaedic Association and Reviewer of the Bone & Joint Journal or the British JBS (ISI).

He is the Founding President of the Philippine Musculoskeletal Tumor Society and an Academician at the National Academy of Science and Technology (NAST), Philippines.

## Rapporteur



**RAUL V. DESTURA, MD, FPSMID,**  
**OYS 2008**

Clinical and Research Associate  
Professor, College of Medicine  
University of the Philippines Manila

Dr. Raul V. Destura is currently the division chair for Medical Sciences of the National Research Council of the Philippines of the Department of Science and Technology and past Deputy Executive Director of the National Institutes of Health and past director of the National Institute of Molecular Biology and Biotechnology of UP-NIH. As a clinician-scientist, he continuously tries to narrow down the gap between Basic Science, Medical Science, Biotechnology and community service by forging strong collaboration among disciplines to reach a focused goal. His “research bench to community approach” is ultimately geared towards developing low-cost technologies for the control of infectious diseases in the Philippines and the generation of new knowledge to find sustainable and equitable solutions to diseases of poverty.

Currently, one of his pioneering work, “Lab in a Mug” Project utilized an isothermal platform and a handheld LED trans-illuminator, a portable multi-infectious disease device about the size of a mug, generated its first ever spin-off company for the University of the Philippines. This technology is being rolled out to 100 primary and secondary hospitals all over the country. This work has helped him move the health-biotechnology landscape in the Philippines and was given recognition in the inter-academy medical panel during the World Health Summit in Berlin as Top 20 Young Physician Leader.



# TECHNICAL SESSION I

## Overseas Filipino Workers: Household Welfare Impact

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### Executive Summary

by Geoffrey M. Ducanes, Ph.D., OYS 2014

The study analyzed the impact of overseas migration on the welfare of Philippine households. The household's gain of an OFW was found to result in a windfall in remittances that more than offsets a decline in household wage income. The study found that the gain of an OFW allows a household to quickly climb up the income ladder, and raise spending on food, clothing, education, real property and equipment. Positive spillover also results in the form of significantly higher contributions and gifts to other households. The study also finds no merit in the claim found in other studies that gaining an OFW results in increased laziness in the remittance-receiving households.

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The study first highlights the importance of overseas migration to the overall economy, in terms of total remittances received and the share of overseas Filipino workers (OFWs) in the working age population. It then examines the profile of overseas Filipino workers over time and in comparison with the domestic labor force. OFWs were found to be typically younger, much better educated, and more evenly distributed between men and women than the domestic labor force, and that over time the shares of the college educated and the women among OFWs have tended to increase.

The study then undertakes a critical review of the data and literature on the economic impact of overseas migration on households. The study finds that, though there is a general sense of growth in the stock and flow of overseas workers, the three main sources of data on the number of OFWs – the CFO, the POEA, and the NSO – give different magnitudes and a different sense of how fast such growth is occurring. In some cases, the figures provided by the three sources are inconsistent with each other. More importantly, the study showed that household surveys – the FIES, the SOF, and the APIS – are severely and increasingly undercounting remittances ('the missing remittances'), assuming that the central bank figures are more accurate. This puts a cloud on the results of many studies on remittances – the motives behind them, their uses, and their consequences – which use these data presuming their representativeness.

The study's literature review shows that methodological problems beset many of the studies most frequently focused on the household impact of overseas migration and remittances. Some studies were shown to fail to account for crucial variables in their analysis (e.g. foregone earnings of overseas workers),

or to make claims incommensurate to their evidence. Others, still, it was argued, spoiled their findings by proceeding with an incomplete understanding of the data or by misusing the data.

The study then sets out to undertake its own analysis of the economic impact of overseas migration on household welfare using a panel of 8 thousand households common to the 2006 FIES, the 2007 APIS, the 2008 APIS, and the various linked LFS. It shows first that a prior connection to overseas Filipinos (network), income status, and the level of human capital are important predictors of a household's ability to send a member overseas. Then it shows that a household's gain of an OFW results in a windfall in remittances that more than offsets a strongly associated decline in household wage and salary income. The gain of an OFW allows a household to quickly climb up the income ladder, and raise spending on food, clothing, education, real property and equipment – especially house-related expenditures, medical care, and even recreation. There is also strong evidence of positive spillover to other households, as the gain of an overseas worker is found to lead to significantly higher contributions and gifts to others. OFW households were found to allocate a greater share of expenditure on education and housing.

The study further shows that the gain of an overseas worker considerably raises a poor household's chance of moving out of poverty, and furthermore, that overseas migration sharply reduces poverty gap and poverty severity. The study finds that a household's gain of an overseas worker significantly increases the chance of enrollment of its 5-11 years old members. On the flipside, overseas labor migration was found to contribute to increasing overall income inequality. If one excludes households that lost and gained an overseas worker from 2007 to 2008 from the analysis, overall inequality would have been observed to be lower in 2008 and to have declined more in the period. Finally, the study tested the hypothesis that the presence of longer term overseas workers in the household induces lower labor supply among the members. Using what it called 'better-matched' samples, the study finds no evidence of lower labor supply in OFW households overall (combining both men and women), whether with long-term or short-term overseas workers, finding the opposite in fact.

The study shows that, at least in the short term and for overseas workers' own households, overseas labor migration confers many economic benefits (e.g., increased income and spending,



reduced poverty, increased enrollment), which appear to far outstrip its costs (e.g., higher overall inequality). Everything else being equal, in the absence of overseas labor migration, average household economic welfare in the country would almost certainly be lower. The study argues that there seems to be little point, absent countervailing evidence, in actively discouraging labor migration, at least at present amidst the lack of quality employment opportunities in the country. This is not to argue that government should actively pursue overseas migration as a development strategy, or actively encourage its citizens to migrate. There is a line that separates a policy of letting overseas migration play out from that of actively pursuing it as a development strategy. As we have also shown, though overseas migration contributes to poverty reduction, the bulk of overseas migrants, even the new ones, actually come from better-off households to begin with.

However, for broad-based growth that is truly poverty-reducing, domestic development and quality employment opportunities within the country are indispensable. The government will better serve the country by working towards ensuring that OFWs are well-protected (via bilateral agreements with destination countries and by bearing down on illegal recruiters, for instance), by ensuring that they make the decision to migrate with a fair assessment of the risks and rewards of overseas migration (through proper pre-departure orientation), and by focusing on fostering the enabling environment that will maximize the economic use and benefits of the substantial amount of remittances coming into the country. In other words, the government, as well as the private sector, must find a way to utilize remittances to better serve domestic economic development. The historical experience of other countries is that overseas migrants return when domestic economic conditions improve and allow them to be as productive or nearly as productive as they are abroad. There is no reason to believe it will be different for the Philippines.

## Speaker



**GEOFFREY M. DUCANES, Ph.D.,  
OYS 2014**

Assistant Professor  
School of Economics  
University of the Philippines Diliman

Dr. Geoffrey Ducanes is currently an Assistant Professor at the UP School of Economics (UPSE). He obtained his undergraduate degree from the UP Statistical Center, now UP School of Statistics, and his M.A. and Ph.D. degrees from the UP School of Economics.

He is also currently Associate Editor of the UP-based journal *Social Science Diliman* and heads UP Diliman's Intellectual Property and Technology Transfer Unit. Previously, he has worked for the International Labour Organization (ILO) in Bangkok focusing on issues relating to international labour migration, for the Asian Development Bank on macroeconomic models for the Philippines and other developing countries, and had stints doing research work for non-government organizations. In the UPSE, he teaches mainly econometrics and mathematical economics to both graduate and undergraduate students. He was one of the NAST Outstanding Young Scientists in 2014 (Economics).

He is currently working on several studies, one of them an assessment of the feasibility of deep labor market integration in ASEAN amidst increasing migration pressure, another on the "inclusiveness" of economic growth under the country's different presidential regimes, and still another on the impact on economic inequality of overseas migration and remittances.

## Moderator



**ACADEMICIAN**  
**ARSENIO M. BALISACAN**  
**Chairman**  
**Philippine Competition Commission**  
**and Member, Social Sciences Division**  
**NAST Philippines**

Dr. Arsenio Balisacan is an economist with extensive practice in high-level policymaking, public administration, academe, and multilateral organizations. He is serving as the first Chairman of the Philippine Competition Commission (on leave from the University of the Philippines where is Professor of Economics).

Prior to his appointment in the Commission in January 2016, he was the Economic Planning Secretary in the Cabinet of President Benigno S. Aquino III and, concurrently, the Director-General of the National Economic and Development Authority (NEDA). In his capacity as NEDA Director-General, he served as the first Chairperson of the Boards of the Philippine Statistics Authority and the Public-Private Partnership Center of the Philippines.

Previous to his Cabinet appointment, he was Dean and Professor of the University of the Philippines (UP) School of Economics, Director-Chief Executive of the Southeast Asian Regional Centre for Graduate Study and Research in Agriculture (SEARCA), and Undersecretary of the Philippine Department of Agriculture. Before joining the UP faculty in 1987, he was Research Fellow at the East West Center in Honolulu and Economist at the World Bank in Washington, D.C.

He holds a Ph.D. in Economics from the University of Hawaii and a Master of Science degree from the University of the Philippines Los Baños.

## Rapporteur



**LAWRENCE G. DACUYCUY, Ph.D.**  
**OYS 2009**  
Professor, School of Economics  
De La Salle University

Dr. Lawrence Dacuycuy is a Full Professor at the School of Economics, De La Salle University. He was the Dean of the School from 2013 to 2015 and currently, sits as a member of the Commission on Higher Education's Technical Committee for Economics. He finished his B.S. and M.S. in Economics degree in 1998 and 2000, respectively, from the School of Economics, University of the Philippines. He obtained his doctorate in Economics from Kyoto University in 2006.

His research focuses on applied nonparametric and semiparametric econometrics, theoretical migration, labour economics, and macroeconomic modelling. He was part of research teams organized by the DLSU- Angelo King Institute and commissioned by the ASEAN Secretariat to study the role and functions of the banking sector, credit rating agencies and securitization markets.

In 2009, he was one of the recipients of the National Academy of Science and Technology's (NAST) Outstanding Young Scientist (OYS) award. In 2012, he was a recipient of the NAST Outstanding Scientific Paper Award for his research on wage functional analysis. His current research focuses on fiscal policy and related issues using Dynamic Stochastic General Equilibrium (DSGE) models.



# TECHNICAL SESSION 2

## Filipino 2040 Energy: Power Security and Competitiveness\*

### Executive Summary

by Majah-Leah V. Ravago, et.al.\*\*

While developing countries like the Philippines are often beset by problems that require immediate action, looking ahead over the span of a full generation affords decision makers with a perspective that can guide the choice of present responses. We identified two scenarios for the Philippine economy up to 2040: strong-growth and mediocre-growth. The first scenario assumes an average GDP growth rate of 7% annually and a lower population growth rate until 2040. With this sustained economic growth, the country is elevated to “high-income status” in 2040. The second scenario is “business as usual”, which assumes an average GDP growth of 4% annually, the inherited rate similar to the average growth rate of the GDP from 1990 to 2014.

Given these two scenarios, we forecast the corresponding electricity consumption using a statistical model. We consider this the lower bound since the expected lower prices and temperature changes favor increased electricity consumption. We then conduct a numerical exercise to determine the required installed capacities needed to support the electricity consumption under the two scenarios. We consider two policy regimes with regard to the fuel mix: the current policy stance of the government of maintaining a 30% share of renewables and an alternative policy that favors increased temporary utilization of the lesser-cost resources but takes into account environmental costs. The result of the exercise shows that the alternative policy regime performs much better in supporting the desirable strong-growth scenario in terms of bringing down the cost of power generation, thereby lowering the price of electricity and improving the well-being of Filipinos. The numerical exercise serves to illustrate that the optimal fuel mix is not constant over time but should exploit the opportunities opened up by less-costly resources while taking into account environmental (and health) costs to bring the price of power down.

\*\* M. Ravago, R. Fabella, R. Alonzo, R. Danao, and D. Mapa

The authors are Faculty members of the University of the Philippines (UP) and Research Fellows of EPDP. We acknowledge the inputs of Dr. Jeff Ducanes in the modeling of electricity consumption. We thank the excellent research assistance of EPDP's Shirra de Guia, J.Kat Magadia, Miah Pormon, Tim Guanzon, and Mico del Mundo. Mari-an Santos assisted in the finalization of the draft paper. The comments and suggestions from the participants of Filipino 2040 project of NEDA and ADB helped steer the final shape of this paper.

### Speaker



**MAJAH-LEAH V. RAVAGO, Ph.D.**

Assistant Professor

School of Economics

University of the Philippines Diliman

Dr. Majah-Leah V. Ravago is Assistant Professor at the University of the Philippines School of Economics (UPSE). She is also the Program Director of the USAID grant – Energy Policy and Development Program (EPDP) at the UPecon Foundation, Inc. She is a Member of the Board and Secretary of the Philippine Economic Society (PES) since January 2014. Her research interests include environmental and resource economics, development economics, energy economics, and economics of natural disaster. She has published papers on resource management and sustainability, climate change, agriculture, and experimental games. She has received research grants from the University of the Philippines, East-West Center, and the Metrobank Foundation. She obtained her B.S. in Business Economics and M.A. in Economics degrees from the University of the Philippines. Her Ph.D. in Economics is from the University of Hawaii under the East-West Center (EWC) Graduate Degree Fellowship Program.

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\* This paper is made possible by the generous support of the American People through the United States Agency for International Development (USAID) under the Energy Policy and Development Program (EPDP). EPDP is a four-year program implemented by the UPecon Foundation, Inc. The contents or opinions expressed in this paper are the authors' sole responsibility and do not necessarily reflect the views of USAID or the United States Government or the UPecon Foundation, Inc." Any errors of commission or omission are the authors' and should not be attributed to any of the above.

## Moderator



**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 proved to be useful for problems in economics. His research studies covered the micro-economic 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; problems 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 masters 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.

## Rapporteur



**RONALD U. MENDOZA, Ph.D.**  
**OYS 2012**  
Dean, School of Government  
Ateneo De Manila University

Ronald U. Mendoza, Ph.D. is Dean and Associate Professor at the Ateneo School of Government. From 2011 to 2015, he was an Associate Professor of Economics at the Asian Institute of Management (AIM), and the Executive Director of the AIM Rizalino S. Navarro Policy Center for Competitiveness. Prior to that, he was a Senior Economist with the United Nations in New York. His research background includes work with UNICEF, UNDP, the Federal Reserve Bank of Boston, the Economist Intelligence Unit (EIU), and several Manila-based non-governmental organizations. Mendoza obtained his Bachelor's Degree in Economics (Honors Program) from the Ateneo de Manila University in the Philippines, his Masters in Public Administration and International Development (MPA-ID) from the John F. Kennedy School of Government, Harvard University, and his M.A. and Ph.D. in Economics from Fordham University. He is a recipient of various awards, including the 2012 National Academy of Science and Technology's Ten Outstanding Young Scientist (OYS) in the Philippines (in Economics), the World Economic Forum's Young Global Leaders in 2013, and Devex 40 Under 40 Development Leader in 2013.



## 2016 NAST PHL AWARDS

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The sculptural trophy for the NAST Awards shows fluid 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.



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IN PURSUIT OF EXCELLENCE**

## CALL FOR NOMINATIONS FOR NAST AWARDS

The National Academy of Science and Technology (NAST), the government's highest recognition and advisory body on science and technology, will give the following awards and recognition to deserving scientists on the 2nd week of July every year in Manila, Philippines.

**OUTSTANDING YOUNG SCIENTIST (OYS)** are given to young Filipino scientists (must not be 41 years old within January to December in the year of the award) who have made significant contributions to science and technology.

**OUTSTANDING BOOK and/or MONOGRAPH AWARDS** are given annually for books and/or monographs published by Filipino publishers based in the Philippine. Majority of the authors of publications should be Filipino.

Books or monographs are judged based on the quality and originality of their content, contribution to science and technology, clarity of presentation, and thoroughness of documentation.

**TWAS PRIZE FOR YOUNG SCIENTIST IN THE PHILIPPINES** is an award given to an outstanding young Filipino scientist (must not be 41 years old within January to December in the year of the award) by the Academy (NAST) and The World Academy of Sciences for the Advancement of science in the developing countries (TWAS).

One award each year, consisting of US \$2,000 and a plaque, is given in the selected discipline for the year - biology, chemistry, mathematics, or physics. For 2015, the TWAS Prize for Young Scientist in the Philippines will be given for Chemistry. For 2016, 2017 and 2018, the award will be for Mathematics, Physics, and Biology.

**OUTSTANDING SCIENTIFIC PAPER AWARDS** are given annually for papers published in Philippine scientific or technical journals within five years preceding the award.

Papers are judged based on the quality of their content, contribution to science and technology, clarity of presentation, and thoroughness of documentation.

**NAST TALENT SEARCH FOR YOUNG SCIENTIST** is a project of NAST to encourage young people (must be 35 years old or younger within January to December in the year of the award) to pursue a career in science.

Trophies and cash prizes will be awarded to the best three scientific paper presenters. The paper which will be presented may be basic or applied research.

### DR. GEMINIANO T. DE OCAMPO VISIONARY AWARDS FOR MEDICAL RESEARCH

is intended to recognize clinician researchers who have created the vision for medical research in the country through their outstanding work in medical research that have blazed and/or pioneered the trail for medical innovations and health research and development.

The research should have created and traversed new frontiers in medicine through significant contributions to the fund of medical knowledge or the advancement of clinical practice in the country and have significantly impacted on the lives of the Filipino people.



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

- Sajid Imao

**NAST ENVIRONMENTAL SCIENCE AWARD** is intended to recognize outstanding scientific and technological research works that contribute to environmental protection and conservation.

The grand prize winner will receive PhP50,000 and a plaque of recognition from the Academy. Winners of special citations will receive plaques of recognition.

**NAST AWARD FOR OUTSTANDING RESEARCH IN TROPICAL MEDICINE** is intended to recognize research works that contribute to the advancement of country's knowledge and practice in tropical medicine. The award aims to honor outstanding research contributions in the field of tropical medicine and recognize the role of scientific research in the country's development.

**Nomination forms are available at the NAST Secretariat and can be obtained at the NAST website: [www.nast.ph](http://www.nast.ph)**

#### WHEN TO SUBMIT

DEADLINE FOR SUBMISSION of entries is on the last working day of November each year except for the Dr. Geminiano T. De Ocampo Visionary Awards for Medical Research which is a biennial award.

#### WHERE TO SUBMIT

Submit ten (10) complete sets of entries to the:  
NAST Secretariat, 3rd Level Science Heritage Building DOST Complex, Bicutan, Taguig City 1631  
Email: [secretariat@nast.ph](mailto:secretariat@nast.ph)



# MEMBERSHIP TO THE ACADEMY

## VIRGINIA C. CUEVAS

*Ph.D. (Botany)*



In recognition of her significant contributions as scientist, educator, and mentor in the field of mycology and environmental biology. Her studies on cellulose and lignin degrading fungi led to the development of a rapid composting technology using

*Trichoderma harzianum* as activator, which is now used in organic agriculture in the country. She also developed the Trichoderma Microbial Inoculant (TMI) which enhances crop growth and acts as a biocontrol agent for crop fungal diseases. The TMI has been tested and proven effective against the clubroot disease of cabbage that causes millions of pesos of damage in Benguet. These Trichoderma technologies are being further tested in areas covered by mine tailings and in agroforestry areas in various parts of the country. A recipient of various national and professional awards for her contributions as a scientist, she has also received prestigious teaching awards such as the Metrobank Outstanding Teacher Award (tertiary level) for her contributions as an educator and mentor to more than 30 B.S., M.S. and Ph.D. students and countless students who took her courses over the past 39 years.

## ALFREDO MAHAR FRANCISCO

### A. LAGMAY

*Ph.D. (Geology)*



In recognition of his significant and pioneering research contributions toward understanding the multi-faceted aspects of natural hazards, including volcanic hazards, tectonics, persistent scatter interferometry of faulted regions, and natural hazards management,

particularly as they apply to the Philippines. For his research on the relationship of strike-slip faults and deformation of volcanoes that made volcanologists around the world realize that underlying faults contribute to the evolution and behavior of stratovolcanoes; for his research that led to the understanding that the eruptive behavior of volcanoes and the character of the land where they have grown are interconnected; and for his published articles on the Philippine plate boundaries which have served as technical basis for the Philippine claim in the Benham Rise region, a sea bed territory equivalent to nearly half the size of the archipelago, approved by the UN Commission on the Law of the Sea. With his wide range of expertise and experience in geology and disaster science, he continues to serve the Filipino people by conducting research in areas stricken by disaster.

## CORRESPONDING MEMBERSHIP

### JOEL L. CUELLO

*Ph.D. (Agricultural and Biological Engineering)*



In recognition of his significant contributions in sustainable biological and agricultural engineering systems which provides the platform for engineering designs in various agricultural and biological systems, with emphasis on optimizing biological and agricultural productivity while fostering resource sustainability and environmental

protection. Among his outstanding works are algal bioreactor systems used in industry; a hybrid solar-electric lighting system for crop production in bioregenerative space life support at NASA, and phytometric system. Since 1996, he has served as lecturer, visiting professor, and adviser to graduate students and has provided valuable advice in the improvement of graduate programs and program accreditation in various universities in the Philippines. He has also served as technical advisor to the Philippine Congressional Commission on Science, Technology and Engineering (COMSTE), the Commission on Higher Education, the Department of Agriculture and the Department of Science and Technology.

### ENRIQUE M. OSTREA, JR.

*M.D. (Pediatrics)*



In recognition of his significant contributions in the field of pediatrics, specifically in neonatal hyperbilirubinemia, neonatal drug addiction, and his pioneering work on the detection of fetal exposure to drugs, tobacco smoke, alcohol and environmental toxicants by analysis of meconium. Among his outstanding works are the development of the meconium drug test, one of the most

sensitive tests to detect fetal exposure to illicit drugs by the analysis of meconium; the development of an affordable Philippine-made ventilator for sick newborn infants; his US NIH funded studies in the Philippines on fetal exposure to environmental pesticides and its long term effect on the neurobehavioral development of infants and children; and his collaborative study on food supplementation of pre-school Filipino children with Moringa-enriched snacks which resulted in improvement in their IQ. Although he has chosen to live abroad, he has remained committed to the advancement of science in the Philippines. A significant portion of his research works were done in the Philippines beginning in 2002 in collaboration with local hospitals and the UP National Institutes of Health. This collaboration served as impetus for local scientific activities and has opened many opportunities for Filipino neonatologists and young pediatricians to be trained under his tutelage and obtain training abroad.



# OUTSTANDING YOUNG SCIENTISTS

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**TONETTE P. LAUDE**  
Ph.D. (Plant Science)  
University of the Philippines  
Los Baños

In recognition of her outstanding contributions in the field of plant breeding that led to the identification of the superior populations of white corn with high quality protein, one of which was released for commercial production as IPB Var 6 (NSIC CN 2008-244), the most preferred variety of corn grits. For leading the effort to prevent genetic erosion of the corn landraces in the Philippines using recurrent selection procedures and in the creation of superior varieties and hybrids that are resistant to biotic and abiotic stresses typical of marginal corn growing areas in the Philippines.



**IAN A. NAVARRETE**  
D.Sc. (Soil Science)  
Ateneo de Manila University

In recognition of his outstanding research in the field of soil science, particularly in understanding the biophysical, chemical, mineralogical characteristics, and fertility constraints of degraded soils in the Philippines. Such information is important in designing soil management strategies leading to sustainable utilization of problematic soils and decreases the negative ecological consequences of soil degradation.



**RICHARD N. MUALLIL**  
Ph.D. (Marine Science)  
Mindanao State University-  
Tawi-Tawi

In recognition of his outstanding contributions in the field of marine science that directly address emergent issues, such as climate change, coastal resources deterioration, fisheries depletion, poverty, and food security in fishing communities. His research findings provide valuable scientific insights that contribute to the improvement of social-ecological conditions of coastal communities specifically in Tawi-Tawi, Southern Philippines, where research undertakings are limited due to its isolated location and volatile peace and order situation.



**GLENN L. SIA SU**  
Ph.D. (Environmental Science)  
University of the Philippines Manila

In recognition of his outstanding works in the field of environmental biology that enhance our knowledge on how plants, animals and microorganisms function and interact with each other and the environment. His studies focused on creating an understanding essential in the management and conservation of the ecosystems that aim to assess biodiversity and the response of these organisms to the threats that continue to affect the environment.



**MARY DONNABELLE L. BALELA**  
Ph.D. (Materials Science and Engineering)  
University of the Philippines Diliman

In recognition of her outstanding research in the field of metallic oxide sustainable and functional nanomaterials and their applications in semiconductor and electronics; and for spearheading the formation of the Sustainable Electronic Materials Research Group in the Department of Mining, Metallurgical and Materials Engineering at the University of the Philippines Diliman, which aims to establish simple and easily scalable synthetic methods for various metallic oxide nanomaterials, to explore their applicability in semiconductor and electronic applications, and to develop homegrown technologies to boost the country's industry competitiveness and technological capabilities, particularly the small and medium scale industries.



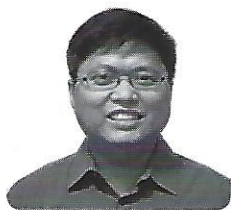
**ARISTOTLE T. UBANDO**  
Ph.D. (Mechanical Engineering)  
De La Salle University

In recognition of his outstanding research in the design and integration of algal systems with other processes for the development of algal biorefinery; for leading a study to aid policy makers in environmental and energy policy and strategic planning related to the algal industry in the Philippines; and for being instrumental in catalyzing three inter-disciplinary research projects at the De La Salle University on microalgae which are intended to position the Philippines at the forefront of research on algal systems.



# OUTSTANDING YOUNG SCIENTISTS

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**MANUEL JOSEPH C. LOQUIAS**  
*Doktor der Matematik*  
University of the Philippines Diliman

In recognition of his outstanding contributions in the field of theoretical and mathematical crystallography and related structures which greatly advanced the state of knowledge in the field. His work brings more closely the intrinsic connection between mathematics, crystallography, mineralogy, materials science, and related sciences which have applications in the geometry of crystal and quasicrystal structures, classification of grain boundaries and twinning, fractals, and the packing problem. Through his talent and dynamism, Dr. Loquias has raised the level of research and the country's stature in the areas of theoretical and mathematical crystallography and discrete geometry by producing significant published works and successfully mentoring M.S. and Ph.D. students in these areas.



**AARON JOSEPH L. VILLARAZA**  
Ph.D. (Chemistry)  
University of the Philippines Diliman

In recognition of his outstanding research in the field of chemistry, in particular the synthesis of Nobilamide b, a neuroactive peptidic secondary metabolite from a mollusk bacterial symbiont isolated from Philippine waters which has a strong potential as a drug for pain-relief. The research findings of their team, which were published in an international journal, demonstrated for the first time that the total synthesis and characterization of non-trivial molecules can now be achieved entirely within the facilities and premises of a Philippine laboratory, using purely local talent and available resources. Dr. Villaraza has helped extend the portfolio of the research groups dedicated to natural products chemistry to include natural products from marine environments which possess great potential for yielding bioactive compounds with novel carbon skeletons. Such carbons skeletons may serve as new leads in the design of new drugs.

Dr. Villaraza's efforts in encouraging young Filipino scientists to return to the Philippines have resulted in the recruitment of 44 new Ph.D.s under the BalikPhD program of the University of the Philippines.



**MAJAH-LEAH V. RAVAGO**  
Ph.D. (Economics)  
University of the Philippines Diliman

In recognition of her scholarly contributions to energy and resource economics particularly in her research that provides evidence-based analyses on which to anchor a more secure growth-enhancing energy future for the country; for spearheading and shepherding the energy policy segment of the multi-disciplinary Philippines 2040 program mandated by the National Economic and Development Authority to provide an economic roadmap for the next 25 years; for her remarkable ability at gathering and leading groups of researchers both locally and internationally to rigorously pursue research questions that enlighten policy.

# NAST ENVIRONMENTAL SCIENCE AWARD

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**REX VICTOR O. CRUZ**  
Ph.D. (Watershed Management)  
University of the Philippines  
Los Baños

For his significant contributions to the development and implementation of the watershed approach to land use planning and natural resources management to promote integrated and holistic development across different landscapes and socio-political units; for leading the formulation of development master plans of many key watershed areas in the country; and for leading the National Conservation Farming Village (CFV) Program that provides an alternative model for promoting the sustainability and resiliency of upland ecosystems and communities through science-based upland farming systems.

## NAST TALENT SEARCH FOR YOUNG SCIENTISTS

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### Winners



**JOSE ISAGANI B. JANAIRO**  
Ph.D. (Chemical Science)  
De La Salle University

#### FIRST PRIZE

In recognition of his outstanding scientific and technological research entitled:  
**“Effects of biomineralization peptide topology on the structure and catalytic activity of Pd nanomaterials”**



**JOMAR F. RABAJANTE**  
D.Sc. (Mathematical and Systems  
Engineering)  
University of the Philippines  
Los Baños

#### SECOND PRIZE

In recognition of his outstanding scientific and technological research entitled:  
**“Equilibrium switching and mathematical properties of nonlinear interaction networks with concurrent antagonism and self-stimulation”**



**ROLLY G. FUENTES**  
Ph.D. (Pharmaceutical Sciences)  
University of the Philippines Visayas  
Tacloban College

#### THIRD PRIZE

In recognition of his outstanding scientific and technological research entitled:  
**“Scopadulciol, isolated from *Scoparia dulcis*, induces  $\beta$ -catenin degradation and overcomes tumor necrosis factor-related apoptosis Ligand resistance in AGS human gastric adenocarcinoma cells”**



# NAST TALENT SEARCH FOR YOUNG SCIENTISTS

## Special Citation



**MICHAEL R. MANANGHAYA**  
Ph.D. (Physics)  
De La Salle University

In recognition of his outstanding scientific and technological research entitled:

**“Hydrogen adsorption of novel N-doped carbon nanotubes functionalized with Scandium”**

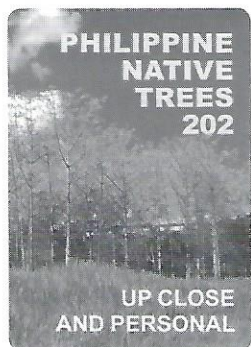


**CHRISTINA D. CAYAMANDA**  
M.S. (Chemical Engineering)  
De La Salle University

In recognition of her outstanding scientific and technological research entitled:

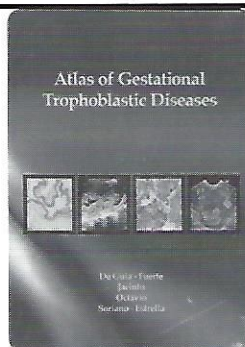
**“P-graph approach to optimal operational adjustment in polygeneration plants under conditions of process inoperability”**

## OUTSTANDING BOOKS



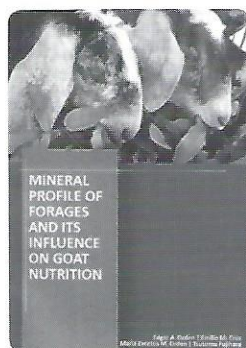
### **PHILIPPINE NATIVE TREES 202: UP CLOSE AND PERSONAL**

(by Marietta R. Marciano and Domingo A. Madulid)  
ISBN 978-971-95469-1-7  
Published by Green Convergence for Safe Food, Healthy Environment and Sustainable Economy and Hortica Filipina Foundation, Inc. 2015



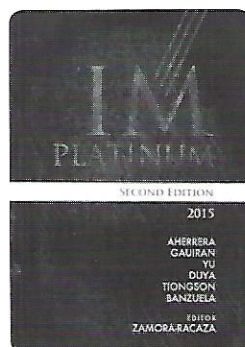
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### **MINERAL PROFILE OF FOR- AGES AND ITS INFLUENCE ON GOAT NUTRITION**

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ISBN 978-971-705-355-4  
Published by Central Luzon State University and Bureau of Agricultural Research - Department of Agriculture 2015

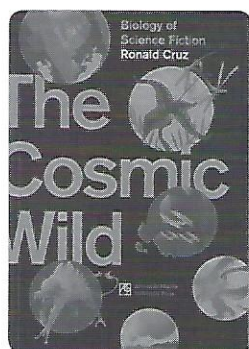


### **IM PLATINUM (2<sup>ND</sup> EDITION)**

(by Jaime Alfonso M. Aherrera, Deonne Thaddeus V. Gauran, Marc Gregory Y. Yu, Jowe Eduardo DL Duya, Marc Denver A. Tiongson, Enrico Paolo C. Banzuela, Geraldine Zamora-Racaza)  
ISBN 978-621-95388-0-0  
Published by Top Practice Medical Publishing Corporation 2015

# OUTSTANDING BOOKS

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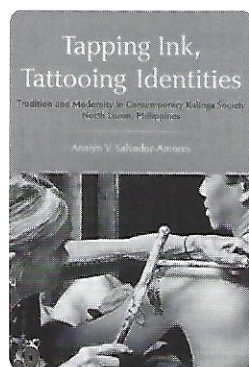
## THE COSMIC WILD: BIOLOGY OF SCIENCE FICTION

(by Ronald Cruz)  
ISBN 978-971-550-704-2  
Published by Ateneo de Manila University Press 2015



## BUILDING INCLUSIVE DEMOCRACIES IN ASEAN

(by Ronald U. Mendoza, Edsel L. Beja Jr., Julio C. Teehankee, Antonio G.M. La Viña, Maria Fe Villamejor-Mendoza)  
ISBN 978-971-27-3172-3  
Published by Anvil Publishing, Inc. 2015



## TAPPING INK, TATTOOING IDENTITIES: TRADITION AND MODERNITY IN CONTEMPORARY KALINGA SOCIETY, NORTH LUZON, PHILIPPINES

(by Analyn Salvador-Amores)  
ISBN 978-971-542-705-0  
Published by University of the Philippines Press and the Cordillera Studies Center, University of the Philippines Baguio 2013

# OUTSTANDING SCIENTIFIC PAPERS

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## “Updates on the status of giant clams *Tridacna spp.* and *Hippopus hippopus* in the Philippines using mitochondrial CO1 and 16S rRNA genes”

(by Apollo Marco D. Lizano and Mudjekeewis D. Santos)  
ISSN 2094-2818 **Philippine Science Letters** 7(1):187-200 2014

## “Biogenic synthesis of gold nanoparticles by plant-growth-promoting bacteria isolated from Philippine soils”

(by Lilia M. Fernando, Florinia E. Merca, Erlinda S. Paterno)  
ISSN 0031-7454 **Philippine Agricultural Scientist** 96(2): 129-136 2013

## “An individual-based model of long-term forest growth and carbon sequestration in planted mangroves under salinity and inundation stresses”

(by Severino G. Salmo III and Drandreb Earl O. Juanico) ISSN 2449-3767 **International Journal of Philippine Science and Technology** 8(2):31-35 2015

## “Taxonomic identification of ‘Ludong’ fish from the Cagayan River (Philippines)”

(by Minerva Fatimae H. Ventolero, Evelyn C. Ame, Billy Joel N. Catacutan, Mudjekeewis D. Santos)  
ISSN 2094-2818 **Philippine Science Letters** 7(1): 45-554 2014

## “Are remittances inducing laziness in households?: a reexamination of the evidence”

(by Geoffrey M. Ducanes)  
ISSN 1655-1516  
**UP School of Economics and Philippine Economics Society** XLIX(2):1-24 2012



# 38<sup>th</sup> ANNUAL SCIENTIFIC MEETING

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# 37<sup>th</sup> ANNUAL SCIENTIFIC MEETING

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## SENATOR PIA CAYETANO KEYNOTES NAST PHL 37<sup>TH</sup> ANNUAL SCIENTIFIC MEETING

The National Academy of Science and Technology, Philippines (NAST PHL) conducted its 37<sup>th</sup> Annual Scientific Meeting (ASM) on July 8-9, 2015 at the Manila Hotel. The NAST PHL, established by Presidential Decree No. 1003-A in 1976 and the primary adviser to the government and science community on matters related to science and technology, chose The Challenges of Non-Communicable Diseases (NCDs): Responding through Multisectoral Action as the theme of last year's ASM.

The meeting aimed to extensively discuss the control and prevention of NCDs, share new conceptual framework in the development of NCDs, identify the major role of the various sciences, civil society and other sectors in the prevention of NCDs, and to draft recommendations to the President and policy makers responsible for the prevention and control of NCDs.

Acad. William G. Padolina, president of the NAST Philippines welcomed the participants and gave a brief overview of the two-day program which included presentation and discussion of current knowledge on NCDs, research gaps, and policy interventions to address the growing prevalence of NCDs using the tools of science and technology.

Honorable Mario G. Montejo, secretary of the Department of Science and Technology, graced the said event. He highlighted the DOST's RxBox project, co-sponsored with the University of the Philippines Manila, which harnesses telemedicine that can be an effective tool to initially diagnose the occurrence of NCDs in isolated and disadvantaged communities nationwide.

Senator Pia Cayetano, the keynote speaker, emphasized the importance of being persistent in pursuing solutions that are relevant to society. She discussed in particular the bills that she helped to pass, such as the sin tax law, reproductive health law, among others. She also brought into light the economic cost of having non-communicable diseases.

Experts shared their insights and experiences in the six plenary sessions of the meeting. In Plenary Session 1, Academician Antonio Miguel L. Dans, professor, University of the Philippines (UP) Manila and member of the NAST Health Sciences Division, discussed the Burden and Prevention of Non-Communicable Diseases. For Plenary Session 2, Dr. Ma. Concepcion C. Lizada, professor emeritus, UP Diliman, talked about Synergy in Managing Non-Communicable Diseases. National Scientist Angel C. Alcala, chair of the NAST Biological Sciences Division, discussed Acute Non-Communicable Diseases Caused by Ingestion of Marine Finfish and Shellfish in Plenary Session 3. During Plenary Session 4, Dr. Evangeline C. Santiago, Scientific Career System Scientist I and former head of the Analytical Chemistry Laboratory of the Natural Sciences Research Institute of UP Diliman, and Academician Filemon A. Uriarte, Jr., member of the Engineering Sciences and Technology Division, discussed Environmental Chemical Pollutants and NCDs: Prevention and Mitigation. In Plenary Session 5, Mr. Gerardo F. Parco, senior environmental specialist of the World Bank, discussed

How Effective have the Clean Air, Clean Water, and Solid Waste Management Acts been? Lastly, in Plenary Session 6, Dr. Stella Luz A. Quimbo, professor, School of Economics, UP Diliman, expounded on Does Sin Taxing Deliver us from Diseases? An Initial Assessment of the Health Impact of Sin Taxes in the Philippines.

Three (3) simultaneous technical sessions were conducted on the second day of the event. Technical session 1 featured Dr. Beatrice Jayme-Tiangco, oncologist at Cancer Center, Medical City, who talked about the Role of Stem Cells in the management of NCDs; In Technical Session 2, Dr. Jaime Z. Galvez Tan, president of Health Futures Foundation discussed the Role of Nutraceuticals in the Management of NCDs; and Technical Session 3 explored the Interaction of and between CDs and NCDs by National Scientist Ernesto O. Domingo, member of NAST Health Sciences Division.

Academician Antonio Miguel L. Dans, chair of the ASM resolutions committee, presented the resolutions to DOST Secretary Honorable Mario G. Montejo, who was represented by Dr. Amelia P. Guevara, DOST undersecretary for Research and Development and Dr. Kenneth Hartigan Go, DOH undersecretary for Health Regulations. The resolutions are the summarized resulting recommendations of this year's pre-ASM roundtable discussions.

Five (5) new Academicians joined the roster of NAST members. They are: Drs. Ceferino P. Maala, Jurgenne H. Primavera, Estrella F. Alabastro, Fortunato B. Sevilla III, and Edward H.M. Wang.

Part of the two-day activity was the annual recognition rite for the following awards; Outstanding Young Scientists (OYS), The World Academy of Sciences (TWAS) Prize for Young Scientists in the Philippines, NAST Talent Search for Young Scientists, NAST Environmental Science Award, Outstanding Books and Monographs, Outstanding Scientific Papers, and Best Scientific Posters.

The 37<sup>th</sup> ASM was organized by the Academy with the assistance from various donors and sponsors. Almost a thousand scientists and researchers from key institutions and agencies gathered at the venue to attend and participate in this important event. The 37<sup>th</sup> ASM was hosted by the Health Sciences Division chaired by Academician Jaime C. Montoya and co-Chaired by Academician Antonio Miguel L. Dans.

This annual activity serves as the leading forum for the presentation of scientific and policy research conducted by the Academy. Policy recommendations on appropriate interventions are submitted to the Philippine government and concerned sectors.



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# NAST MEMBERS

Year of Entry	Name	Field of Specialization		Remarks
1978	Paulo C. Campos, M.D.	Nuclear Medicine	Proclaimed N.S. 1989	Died 2 June 2007
	Alfredo V. Lagmay, Ph.D.	Experimental Psychology	Proclaimed N.S. 1988	Died 15 December 2005
	Cecilio F. Lopez, Dr. phil.	Philippine Linguistics and Oriental Studies		Died 5 September 1979
	Tito A. Mijares, Ph.D.	Statistics		Died 18 August 2003
	Juan S. Salcedo, Jr., M.D., D.Sc. (h.c.)	Nutrition and Public Health	Proclaimed N.S. 1978	Died 20 October 1988
	Alfredo C. Santos, Dr. phil.	Physical Chemistry	Proclaimed N.S. 1978	Died 11 April 1990
	Dioscoro L. Umali, Ph.D.	Genetics and Plant Breeding	Proclaimed N.S. 1986	Died 1 July 1992
	Carmen C. Velasquez, Ph.D.	Parasitology	Proclaimed N.S. 1983	Died 16 October 1994
	Gregorio T. Velasquez, Ph.D.	Phycology	Proclaimed N.S. 1982	Died 29 July 1989
	Gregorio Y. Zara, D. Sc.	Engineering and Inventions	Proclaimed N.S. 1978	Died 15 October 1978
1979	Encarnacion A. Alzona, Ph.D.	Philippine History	Proclaimed N.S. 1985	Died 13 March 2001
	Teodoro A. Agoncillo, Litt.D. ( <i>honoris causa</i> )	Philippine History	Proclaimed N.S. 1985 (Posthumous)	Died 14 January 1985
	José Encarnación, Jr., Ph.D.	Economics	Proclaimed N.S. 1987	Died 5 July 1998
	Pedro B. Escuro, Ph.D.	Genetics and Plant Breeding	Proclaimed N.S. 1994	Died 8 September 2000
	Raymundo A. Favila, Ph.D.	Mathematics		Died 31 January 1995
	Francisco M. Fronda, Ph.D.	Animal Husbandry	Proclaimed N.S. 1983	Died 17 February 1986
	Bienvenido O. Juliano, Ph.D.	Organic Chemistry	Proclaimed N.S. 2000	
	Melecio S. Magno, Ph.D.	Physics		Died 27 September 2003
	Fe del Mundo, M.D., M.A.	Pediatrics	Proclaimed N.S. 1980	Died 06 August 2011
	Geminiano T. de Ocampo, M.D.	Ophthalmology	Proclaimed N.S. 1982	Died 2 September 1987
	Eduardo A. Quisumbing, Ph.D.	Plant Taxonomy, Systematics and Morphology	Proclaimed N.S. 1980	Died 23 August 1986
	Jose N. Rodriguez, M.D.	Leprology		Died 1982
	Casimiro del Rosario, Ph.D.	Physics, Astronomy and Metrology	Proclaimed N.S. 1982	Died 15 September 1982
1980	Luz Oliveros-Belardo, Ph.D.	Pharmaceutical Chemistry	Proclaimed N.S. 1987	Died 12 December 1999
1980	Magdalena C. Cantoria, Ph.D.	Botany		Died 30 December 2008
	Emerita V. de Guzman, Ph.D.	Plant Physiology		Died 18 November 1981
	Conrado S. Dayrit, M.D.	Pharmacology, Cardiology		Died 06 October 2007
	Francisco O. Santos, Ph.D.	Human Nutrition and Agricultural Chemistry	Proclaimed N.S. 1983 (Posthumous)	Died 19 February 1983
	Joventino D. Soriano, Ph.D.	Cytogenetics and Mutation Research		Died 09 January 2004



Year of Entry	Name	Field of Specialization	Remarks
1980	Clara Y. Lim-Sylianco, Ph.D.	Biochemistry and Organic Chemistry	Proclaimed N.S. 1994 Died 23 July 2013
1981	Clare R. Baltazar, Ph.D.	Systematic Entomology	Proclaimed N.S. 2001
	Julian A. Banzon, Ph.D.	Biophysical Chemistry	Proclaimed N.S. 1986 Died 14 September 1988
	Amando M. Dalisay, Ph.D.	Economics	Died 20 January 1986
	Benjamin D. Cabrera, M.D., M.P.H.	Medical Parasitology and Public Health	Died 7 August 2001
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 Died 18 December 1987
	Bienvenido F. Nebres, S.J., Ph.D.	Mathematics	Proclaimed N.S. 2011
	Faustino T. Orillo, Ph.D.	Mycology	Died 13 December 2006
	Jose R. Velasco, Ph.D.	Plant Physiology	Proclaimed N.S. 1998 Died 24 January 2007
1985	Quintin L. Kintanar, M.D., Ph.D.	Environmental Medicine	
	Quirino O. Navarro, Ph.D.	Nuclear Chemistry	Died 22 August 2002
	Gregorio F. Zaide, Ph.D.	History	Died 31 October 1986
1987	Solita F. Camara-Besa, M.D., M.S.	Biochemistry	Died 12 August 2012
	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	Died 15 August 2011
	Carmen Ll. Intengan, Ph.D.	Nutrition	Died 23 January 2011
	Dolores A. Ramirez, Ph.D.	Biochemical Genetics	Proclaimed N.S. 1998
	Benito S. Vergara, Ph.D.	Plant Physiology	Proclaimed N.S. 2001 Died 24 October 2015
	Prescillano M. Zamora, Ph.D.	Plant Anatomy-Morphology	Died 03 August 2010
1988	Ricardo M. Lantican, Ph.D.	Plant Breeding	Proclaimed N.S. 2005
1990	Leopoldo S. Castillo, Ph.D.	Animal Science	Died 15 July 2011
	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	

# NAST MEMBERS

Year of Entry	Name	Field of Specialization		Remarks
1993	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	
1994	Perla D. Santos Ocampo, M.D.	Pediatrics	Proclaimed N.S. 2010	Died 29 June 2012
1995	Ledivina V. Cariño, Ph.D.	Sociology		Died 12 June 2009
	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		Died 29 January 2006
1999	Onofre D. Corpuz, Ph.D.	Political Economics and Government	Proclaimed N.S. 2004	Died 23 March 2013
2000	Filemon A. Uriarte, Jr., Ph.D.	Chemical Engineering		
	Norman E. Borlaug, Ph.D.	Agronomy/ Plant Breeding	Honorary Member (1970 Nobel Peace Prize Laureate)	Died September 2009
	Ceferino L. Folloso, Ph.D. (h.c.)	Mechanical, Electrical, & Agricultural Eng'g.		Died 13 March 2016
	Angel L. Lazaro III, Ph.D.	Civil Engineering		
	William T. Torres, Ph.D.	Computer Science		
	Reynaldo B. Veja, 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 ( <i>honoris causa</i> )	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		
2007	Reynaldo L. Villareal, Ph.D.	Genetics	Corresponding Member	
	Allan Benedict I. Bernardo, Ph.D.	Cognitive Psychology		
	Christopher C. Bernido, Ph.D.	Theoretical Physics		



Year of Entry	Name	Field of Specialization	Remarks
2007	Leonardo Q. Liongson, Ph.D.	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 and Biomedical 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	
	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	
	Kelvin S. Rodolfo, Ph.D.	Marine Geology	Corresponding Member
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.	Orthopaedics	

Legend: N.S. - National Scientist

# OUTSTANDING YOUNG SCIENTIST AWARDEES

Year	Name	Field of Specialization	Year	Name	Field of Specialization
1980	Ernesto J. del Rosario, Ph.D. (Elected Academician, 2011)	Chemistry	1983	Vicente B. Paqueo, Ph.D.	Human Resource Economics
	Salcedo L. Eduardo, Ph.D. (Elected Academician, 1993)	Veterinary and Medical Parasitology		Luzvismina U. Rivero, Ph.D.	Chemistry
	Rafael D. Guerrero III, Ph.D. (Elected Academician, 1992)	Fisheries Management	1984	William T. Chua, M.D.	Cardiovascular Medicine
	Rufino H. Ibarra, Ph.D.	Physics		Reynaldo E. dela Cruz, Ph.D.	Forestry
	Florian M. Orejana-Ward, Ph.D.	Fish Processing and Quality Control		Evelyn Mae T. Mendoza, Ph.D. (Elected Academician, 1992)	Biochemistry
	Ely Anthony R. Ouano, Ph.D.	Environmental Engineering		Roger R. Posadas, Ph.D.	Physics
	Ernesto M. Pernia, Ph.D.	Economic Demography		Eufemio T. Rasco, Ph.D. (Elected Academician, 2009)	Plant Breeding
	Alberto Romualdez, Jr., M.D.	Medicine		Filemon A. Uriarte, Jr., Ph.D. (Elected Academician, 2000)	Chemical Engineering
	Thelma E. Tupasi-Ramos, M.D. (Elected Academician, 2006)	Infectious Diseases	1985	William D. Dar, Ph.D.	Agriculture
	Victoria A. Vicente-Beckett, Ph.D.	Chemistry		Alumanda M. dela Rosa, Ph.D.	Radiation Chemistry
1981	Romeo M. Bautista, Ph.D.	Economics		Ann Inez N. Gironella, Ph.D.	Statistics
	Paciente A. Cordero, Jr., Ph.D.	Marine Biology		Jose A. Magpantay, Ph.D.	Physics
	Lourdes J. Cruz, Ph.D. (Elected Academician, 1987; Proclaimed National Scientist, 2005)	Biochemistry		Corazon M. Raymundo, D.Sc.	Population Science
	Severino V. Gervacio, Ph.D.	Mathematics		Mediadora C. Sanial, M.D.	Epidemiology
	Esperanza A. Icasas-Cabral, M.D.	Cardiology		Amaryllis T. Torres, Ph.D.	Psychology
	Ernesto P. Lozada, Ph.D.	Agricultural Engineering	1986	Regalado G. Zamora, Ph.D.	Animal Science
	Manolito G. Natera, Ph.D.	Physics		Edwin A. Benigno, Ph.D.	Entomology
1982	Carmelo A. Alfiler, M.D.	Pediatric Medicine		Ida F. Dalmacio, Ph.D.	Food Microbiology
	Rodolfo P. Cabangbang, Ph.D.	Agronomy		Ma. Concepcion C. Lizada, Ph.D.	Biochemistry
	Virgilio G. Enriquez, Ph.D. (deceased)	Psychology		Ernesto S. Luis, Ph.D.	Food Chemistry
	Alejandro N. Herrin, Ph.D.	Demographic Economics		Manolo G. Mena, Ph.D.	Metallurgy
	Jose G. Marasigan, Ph.D.	Mathematics		Glorina N. Pocsidio, Ph.D.	Zoology
	William G. Padolina, Ph.D. (Elected Academician, 1995)	Phytochemistry		Danilo M. Yanga, Ph.D.	Physics
	Percy A. Sajise, Ph.D.	Ecology	1987	Ruperto P. Alonzo, M.A.	Economics
	Benito L. Tanhehco, M.D.	Biomedical Engineering		Dante B. Canlas, Ph.D.	Economics
1983	Ponciano S.M. Halos, Ph.D.	Plant Pathology		Rene P. Felix, Ph.D.	Mathematics
	Remigio M. Olveda, M.D. (Elected Academician, 2014)	Parasitic Diseases		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



# OUTSTANDING YOUNG SCIENTIST AWARDEES

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.	Botany
	Mary Ann D. Lansang, M.D.	Clinical Epidemiology
	Alfenitta Fermina B. Zamora, M.S.	Agronomy
	Ambrosio Raul R. Alfiler, MS	Entomology
	Adelina A. Barrion, Ph.D.	Insects Genetics
	Manuel M. Dayrit, M.D.	Epidemiology and MPH
1990	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
	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
1991	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
	Arsenio M. Balisacan, Ph.D. (Elected Academician, 2008)	Economics
	Rhodora A. del Rosario, M.D.	Health Science
	Portia G. Lapitan, M.S.	Forest Biology
1992	Luz R. Noche-franca, 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
	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
1994	Gerardo C. Janairo, D. Nat. Sci.	Chemistry
	Shirley R. Tiong-Palisoc, Ph.D.	Physics
	Graciano P. Yumul, Jr., D. Sc.	Geology
	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
1995	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
	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, Dr. Sc.	Biophysics
	Zenaida N. Ganga, Ph.D.	Plant Breeding
	Randy A. Hautea, Ph.D.	Plant Breeding
1996	Antonio Carlos Laurena, Ph.D.	Agricultural Chemistry
	Merlyn S. Mendioro, Ph.D.	Genetics
	Fidelina B Natividad-Carlos, Ph.D.	Economics
	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

# OUTSTANDING YOUNG SCIENTIST AWARDEES

Year	Name	Field of Specialization	Year	Name	Field of Specialization
1996	Eduardo C. Lim, M.D.	Immunology	2000	Arnel N. del Barrio, Ph.D.	Ruminant Nutrition
	Jose M. Oclarit, Ph.D.	Applied Biochemistry		Ireneo L. Lit, Jr., M.S.	Entomology
	Jossie M. Rogacion, M.D.	Pediatrics Nutrition and Gastroenterology		Pablito M. Magdalita, Ph.D.	Plant Breeding
	Roland V. Sarmago, Ph.D.	Physics		Francisco A. Magno, Ph.D.	Political Science
1997	Tessa T. Torres-Edejer, M.D.	Clinical Economics		Roberto M. Malaluan, Dr. Eng.	Chemical Engineering
	Rhodora R. Aldemita, Ph.D.	Botany		Perry S. Ong, Ph.D.	Behavioral Ecology Evolutionary Biology
	Orville L. Bondoc, Ph.D.	Animal Breeding/ Genetics		Ishmael D. Ordoñez, Ph.D.	Chemistry
	Leonorina G. Cada, Ph.D.	Chemistry		Ricardo Jose D.L.T. Quintos II, M.D.	Vascular Surgery
	Antonio Miguel L. Dans, M.D., M.S.(Elected Academician, 2010)	Clinical Epidemiology	2001	Jose Ramon T. Villarin, S.J., Ph.D.	Atmospheric Physics
	Ricardo T. Jose, Ph.D.	History/Area Study		Lemnuel V. Aragones, Ph.D.	Marine Biology
	Rodel D. Lasco, Ph.D. (Elected Academician, 2009)	Forestry		Conrado H. Balatero, Ph.D.	Plant Breeding
	Damasa M. Magcale-Macandog, Ph.D.	Botany		Edward F. Barroga, Ph.D.	Veterinary Oncology
	Blessilda P. Raposa, Ph.D.	Mathematics		Christina A. Binag, Ph.D.	Chemistry
	Cesar L. Villanoy, Ph.D.	Physical Oceanography		Dindo M. Campilan, Ph.D.	Communication and Innovation Studies
	Edward H.M. Wang, Ph.D.	Orthopedics		Albert A. Gapud, Ph.D.	Physics
	Vermando M. Aquino, Ph.D.	Plant Pathology		Ma. Antonia E. Habana, M.D., M.S.	Epidemiology
1998	Philbert S. Bonilla, Ph.D.	Plant Physiology		Patricio P. Palmes, M.D.	Internal Medicine
	Mark J. Encarnación, Dr. techn.	Technical Mathematics		Simeona V. Siar, Ph.D.	Plant Breeding
	Mario R. Festin, M.D.	Obstetrics and Gynecology		John Paul C. Vergara, Ph.D.	Computer Science and Applications
	Ma. Emma Concepcion D. Liwag	Psychology	2002	Renato A. Avenido, Ph.D.	Agricultural Sciences
	Ronald R. Matias, Ph.D.	Zoology		Peter S. Guzman, Ph.D.	Plant Breeding
	Jaime C. Montoya, M.D. (Elected Academician, 2008)	Microbiology		Gabriel O. Romero, Ph.D.	Genetics
	Felix P. Muga II, Ph.D.	Mathematics		Rea Victoria P. Anunciado, Ph.D.	Animal Genetics/ Physiology
	Edilberto D. Redoña, Ph.D.	Genetics		Noli N. Reyes, Ph.D.	Mathematics
	Ma. Jamela R. Revilla, Ph.D.	Biochemistry		Raymund C. Sison, Ph.D.	Computer Science
	Vicente Y. Belizario, Jr., M.D.	Tropical Medicine/ Hygiene		Arnel A. Salvador, Ph.D.	Physics
	Merdelyn T. Caasi-Lit, Ph.D.	Plant Science/ Entomology		Eva Maria C. Cutiongco, M.D.	Genetics
1999	Sergio R. Canoy, Jr., Ph.D.	Mathematics		Maria Lourdes de Leon-Matsuda, M.D.	Surgery
	Cesar G. Demayo, Ph.D.	Entomology/Genetics		Queena N. Lee-Chua, Ph.D.	Psychology
	Danilo B. Largo, Ph.D.	Aquatic Environmental Science		Nathaniel C. Bantayan, Ph.D.	Forestry Engineering
	Bernadette D.L. Libranda-Ramirez, Ph.D.	Immunology		William L. delos Santos, Ph.D.	Agronomy and Soils
	Eric R. Punzalan, Ph.D.	Chemistry	2003	Ma. Corazon A. de Ungria, Ph.D.	Molecular Biology
	Leocadio S. Sebastian, Ph.D.	Plant Breeding		Evelyn Grace T. de Jesus-Ayson	Zoology
	Rafael C. Bundoc, M.D.	Orthopedics		Agnes T. Paras, Ph.D.	Mathematics
				Carla B. Dimalanta, Ph.D.	Geology
2000				Mary Ann A. Endoma, Ph.D.	Chemistry
				Jesus N. Sarol, M.D.	Epidemiology
				Jose Alberto S. Reyes, Ph.D.	Psychology
				Glenn B. Gregorio, Ph.D.	Genetics



# OUTSTANDING YOUNG SCIENTIST AWARDEES

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.	Mechanical Engineering
2005	Marie Carmela M. Lapitan, M.D.	Urology
	Jonna DLP. Estudillo, Ph.D.	Economics
	Ma. Joy V. Abrenica, Ph.D.	Economics
	John Donnie A. Ramos, Ph.D.	Molecular Biology/Immunology
	Julie F. Barcelona, Ph.D.	Botany
	Ricardo CH. Del Rosario, Ph.D.	Mathematics
2006	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
	Ma. Genaleen Q. Diaz, Ph.D.	Genetics
2007	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
2008	Jericho Thaddeus P. Luna, M.D.	Obstetrics and Gynecology
	Windell L. Rivera, Ph.D.	Medical Science
	Rollin P. Tabuena, M.D.	Pulmonary Medicine
	Willie P. Abasolo, Ph.D.	Agriculture
	Christian Joseph R. Cumagun, Ph.D.	Agriculture
	Arnold V. Hallare, Dr rer nat	Ecotoxicology
2009	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
2009	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
2010	Edsel L. Beja Jr., Ph.D.	Economics
	Antonio G. Lalusin, Ph.D.	Plant Breeding
	Ronald D. Villanueva, Ph.D.	Marine Science
	Lucille C. Villegas, Ph.D.	Microbiology
2011	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
2012	Lawrence G. Dacuyucuy, Ph.D.	Economics
	Stella Luz A. Quimbo, Ph.D.	Economics
	Von Mark V. Cruz, Ph.D.	Plant Breeding
	Roel R. Suralta, Ph.D.	Agricultural Sciences
2013	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
2014	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
2015	Mary Janet M. Arnado, Ph.D.	Sociology
	Nathaniel C. Añasco, Ph.D.	Fisheries Science
	Claro N. Mingala, Ph.D.	Infectious Diseases
	Mudjekeewis D. Santos, Ph.D.	Applied Marine Biosciences
2016	Waren N. Baticados, Ph.D.	Veterinary Science
	Juan Carlos T. Gonzalez, M.Sc	Zoology

## OUTSTANDING YOUNG SCIENTIST AWARDEES

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 Ethelbherth C. Yu, Ph.D.	Chemistry
	Ronald U. Mendoza, Ph.D.	Economics
	Edwin A. Combalicer, Ph.D.	Forest Environmental Sciences
	Alma O. Canama, M.Sc.	Genetics
2013	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 Engineering
	Alonzo A. Gabriel, Ph.D.	Food Microbiology and Hygiene
	Liane P. Alampay, Ph.D.	Psychology
	Glenn S. Banaguas, M.Sc.	Environmental Management
2014	Rommel C. Sulabo, Ph.D.	Animal Science
	Ian Kendrick 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 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
	Clarissa C. David, Ph.D.	Communication



# PHILIPPINE CARABAO CENTER

National Headquarters and Gene Pool  
Science City of Muñoz, Nueva Ecija

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## BRIEF HISTORY

In 1992, after PCARRD-coordinated UNDP-FAO project, the Philippine government realized the need to institutionalize the Carabao Development Program. Through Republic Act 7307 or better known as the Philippine Carabao Act of 1992, the Philippine Carabao Center was born. The law was signed on March 27, 1992 and operationalized on April 1, 1993.

D.A. A.O. 9 Series of 2008 | PCC is the Lead Agency for Livestock  
Biotechnology Research and Development in the DA Network

## Transcending Boundaries for Inclusive Development

### Mandate

To conserve, propagate, and promote the carabao as a source of milk, meat, draft power and hide to benefit the rural farmers.

### Vision

A premiere research and development institution propelling sustainable growth of the livestock industry.

### Mission

Improve the general well-being and competitiveness of the livestock industry stakeholders thru animal biotechnology and technology development, technology dissemination and knowledge resource management, active private sector participation, livestock-based and policy reforms to sustain development of livestock enterprises, thus, ensuring socio-economic empowerment for nation building.

### Integrated Management Systems Policy

The Philippine Carabao Center aims to be a premiere research and development institution for the sustainable growth of the livestock industry.

In order to achieve this, we, at PCC, are dedicated to provide quality products and services that address customers' needs consistent with statutory, regulatory and other requirements, and the International Standards; and committed to continuously improve the effectiveness of our integrated management systems, products and services, processes, people, and workplace while ensuring safety of our workers, prevention of pollution, and protection of the environment.

### Our Services

**Artificial Insemination (AI)** - rendered nationwide in villages by trained private village-based AI technicians (VBAITs) as well as technicians of local government units and PCC, AI is used to produce animals with better productivity for milk and meat through sustained backcrossing to at least four generations, without disregard for draft power through harnessing superior genetic materials of riverine buffalo breed.

**Bull loan** - purebred dairy-type Murrah bulls are loaned out to qualified farmers for natural mating with native or crossbred carabaos in areas where AI services are not available.

**Training and Technical Assistance** - Trainings on animal reproduction, animal nutrition, animal health, forage production, cooperative development, dairy production and processing and marketing are provided to farmers and the agency's partner-implementers.

**Community Development** - the agency takes premium in ensuring the mobility of the social medium, the cooperatives, assisting in organizational strengthening and in enterprise development.

**Frozen Buffalo Semen Distribution** - Selected buffalos undergo performance and progeny testing and these are processed at the PCC Semen Laboratory. Frozen semen are made available nationwide through a semen distribution system linked with AI technicians, cooperatives, DA-RFUs and LGUs.

**Production of Quality Breeding Stocks** - Out of the institutional herds of purebred buffaloes, breeding stocks are produced and are made available to interested farmers at production cost. This would ensure that, other than superior breeds accessible either by the semen used in AI or bulls for natural mating, female breeder dairy stocks of good quality are also available.

**Laboratory Services** - committed to a continued full support to its clients, laboratory services are provided including analysis of feed and milk samples and animal health-related tests.

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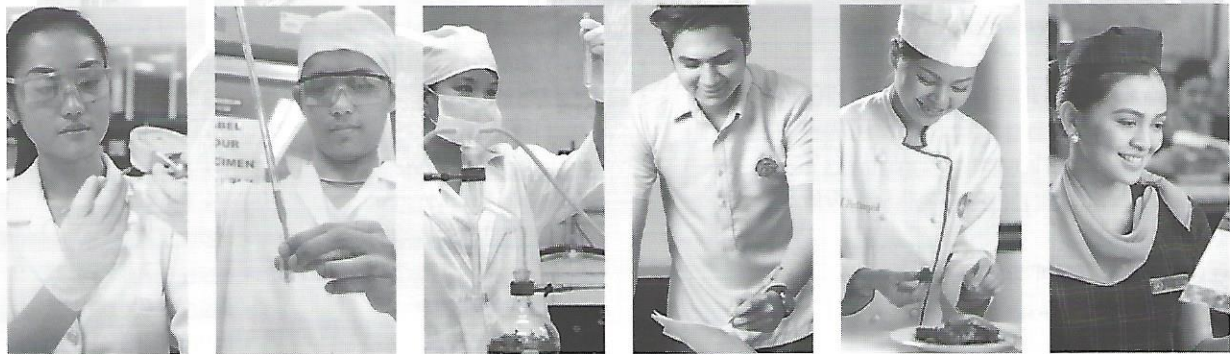
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- Master of Science in Clinical Medicine  
(Child Health/Family Med/Medical Onco/Obstetrics-Gynecology/Surgery)
- Master of Science in Genetic Counseling
- Master of Science in Health Informatics (Medical Informatics Track)
- Master of Science in Pharmacology
- Master of Science in Physiology
- Master of Science in Bioethics
- Master of Medical Anthropology
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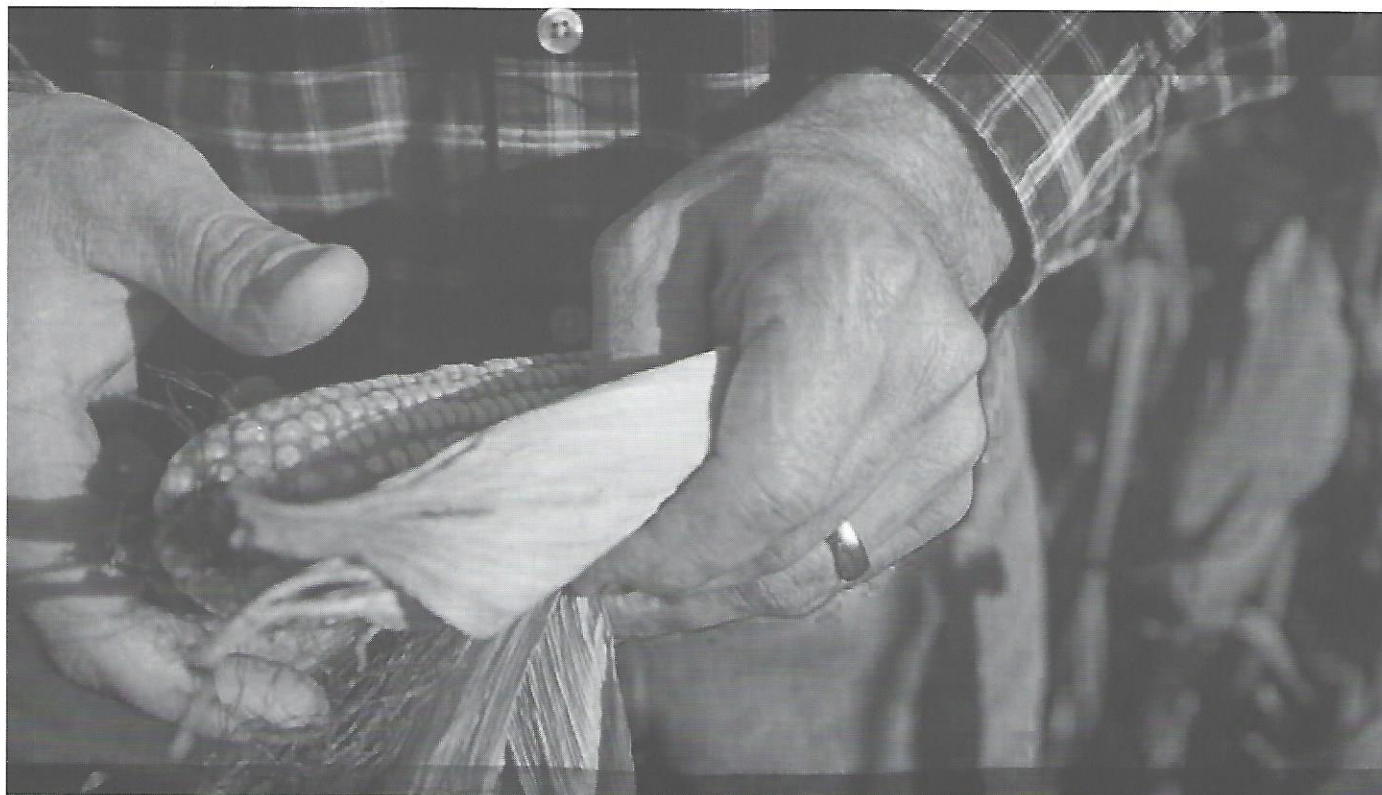
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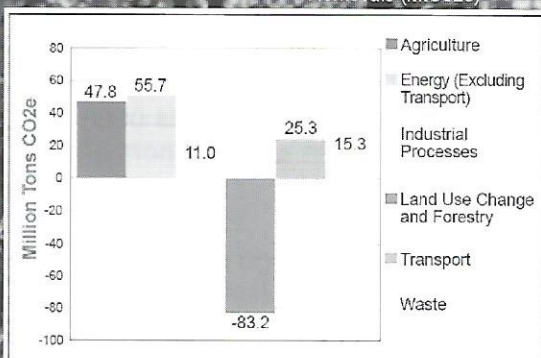
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Source: Climate Change Commission (Philippines)

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Advocates for the safe and responsible use of modern biotechnology



### *Our Mission...*

To contribute to national development goals of eradicating poverty, achieving food security, improving health and sustaining the environment by harnessing the actual and potential benefits of modern biotechnology through its safe and responsible use.

### *Who We Are...*

The BCP, a non-stock, non-profit membership association duly registered with the Philippine Securities and Exchange Commission, is a broad-based multi-sectoral coalition of advocates for the safe and responsible use and advancement of modern biotech in the Philippines. Our members are representatives from academe, farmers' organizations, industries, church, media and the science community.

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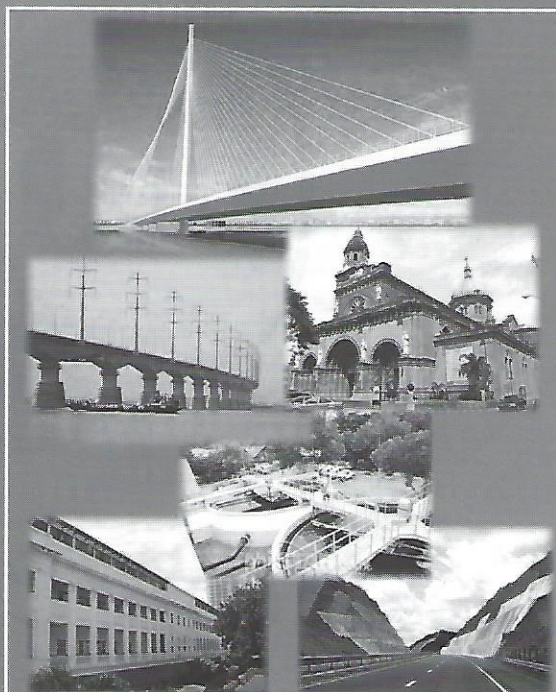
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## PLENARY SESSION I

SOCIAL SCIENCES

FROM SCRIBES TO SEERS: DOING SOCIAL SCIENCE IN THE PHILIPPINES

## NOTES

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### PLENARY SESSION I

SOCIAL SCIENCES

FROM SCRIBES TO SEERS: DOING SOCIAL SCIENCE IN THE PHILIPPINES



# NOTES

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## PLENARY SESSION 2

AGRICULTURAL SCIENCES

Looking Back and Looking Forward: What to Do with Agriculture

## NOTES

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## PLENARY SESSION 2

AGRICULTURAL SCIENCES

Looking Back and Looking Forward: What to Do with Agriculture



# NOTES

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## PLENARY SESSION 3

### BIOLOGICAL SCIENCES

Climate Change Impacts on Food Security from Marine Resources

## NOTES

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### PLENARY SESSION 3

BIOLOGICAL SCIENCES

Climate Change Impacts on Food Security from Marine Resources



# NOTES

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**PLENARY SESSION 4**  
MATHEMATICAL AND PHYSICAL SCIENCES  
Human Capital in Science Education

## NOTES

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**PLENARY SESSION 4**  
MATHEMATICAL AND PHYSICAL SCIENCES  
Human Capital in Science Education



## NOTES

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## PLENARY SESSION 5

ENGINEERING SCIENCES AND TECHNOLOGY

Philippine Infrastructure: Looking Back and Looking Forward

## NOTES

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### PLENARY SESSION 5

ENGINEERING SCIENCES AND TECHNOLOGY

Philippine Infrastructure: Looking Back and Looking Forward



## NOTES

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**PLENARY SESSION 6**  
HEALTH SCIENCES  
Universal Health Care in the Philippines

## NOTES

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### PLENARY SESSION 6

HEALTH SCIENCES

Universal Health Care in the Philippines



## NOTES

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## TECHNICAL SESSIONS

Technical Session 1- Overseas Filipino Workers: Household Welfare Impact  
Technical Session 2- Filipino 2040 Energy: Power Security and Competitiveness

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## TECHNICAL SESSIONS

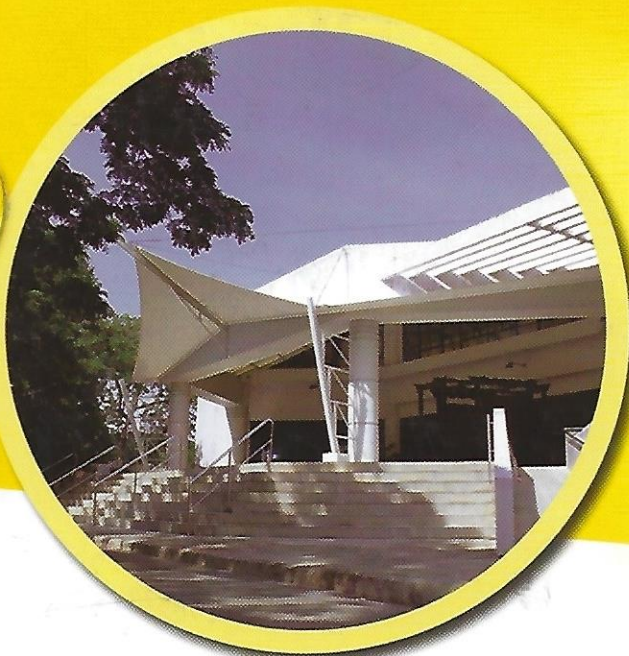
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The Philippine Science Heritage Center (PSHC) or *Salinlahi* (meaning heirloom of a generation), under the management of the National Academy of Science and Technology, Philippines, is a science center mandated by the **Republic Act of 9107** to be the repository of the achievements and outstanding accomplishments of the Filipino scientific community.

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