PROJECT PROFILE

Program Title:	Accelerating Salt Research and Innovation (ASIN) Center
Project 2:	Establishment of Asin R&D Center through Technology, Competence, and Services Development
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Implementing Agency:	Pangasinan State University
Collaborating Agencies:	Mariano Marcos State University (Project 1) President Ramon Magsaysay State University (Project 3) Don Mariano Marcos Memorial State University (Project 4) DOST - Niche Centers in the Regions for R&D (DOST - NICER) Philippine Association of Salt Industry Networks (PhilASIN) Bureau of Fisheries and Aquatic Resources Region 1 (BFAR Region 1) JM Salt Manufacturer India's Central Salt & Marine Chemicals Research Institute (CSMCRI) Japan's Salt Industry Center Pangasinan, La Union, Ilocos Sur, Ilocos Norte
Year 1 Proposed Budget	30,533,583.00
First Release	27,610,556.50
Total Release	27,610,556.50

1. INTRODUCTION

The salt industry in the Philippines stands at a critical juncture, facing numerous challenges that threaten its sustainability and self-sufficiency. With salt imports comprising 92 to 93 percent of the nation's supply and domestic production accounting for only 7 to 8 percent, there exists a pressing need to address the industry's decline (DA-AFID, 2022).

Moreover, the recent enactment of Republic Act No. 1024, aimed at assisting coconut farmers with fertilizers, is increasing the demand for salt, further emphasizing the need to bolster local production (Nineteenth Congress of the Republic of the Philippines, 2022). However, the sector is grappling with several challenges, including limited innovation, an aging farmer population, and inadequate research infrastructure (Muyot & Asuncion, 2022).

As the Philippines grapples with its heavy reliance on salt imports (DA-AFID, 2022) and braces for increased demand due to legislative measures (Nineteenth Congress of the Republic of the Philippines, 2022), the need to rejuvenate the domestic salt industry is becoming ever more pressing. The sector faces a myriad of challenges, from inadequate infrastructure to technological stagnation, calling for a united and comprehensive approach (Ventayen et al., 2023)

Meanwhile in 2021 Pangasinan, the forefront in terms of salt production in the Philippines, according to the Office of the Provincial Agriculturist the province produced 64,156 MT from its 1,432.4-hectare salt farms located in multiple municipalities (Iñigo, 2023). But this number is still dwarfed by the 683,000 metric tons consumed in the country every year.

In contrast to countries like India, Korea, Australia, and Japan, which boast state-of-the-art Salt R&D Centers, the Philippines lacks a dedicated hub for salt technology advancement. In light of these challenges, the proposal to establish an Asin R&D Center at Pangasinan State University stands out as a proactive response. By fostering innovation, facilitating knowledge exchange, and conducting applied research, the center has the potential to spark transformative change in salt production.

The center, which is to be divided into three sections: Membrane Science and Separation Technology, Salt and Marine Chemicals, and Process Design and Engineering, holds the promise of rejuvenating the salt industry and positioning the Philippines on the path towards self-sufficiency. Thus, considering these imperatives, the establishment of the Asin R&D Center signifies a pivotal step towards revitalizing the nation's salt production sector and addressing its longstanding challenges.

Through collective effort and strategic investments, the Asin R&D Center potentially not only breathes new life into the salt industry but also reflects the nation's resilience and determination to carve out a sustainable future. With stakeholders rallying behind this initiative, the Philippine salt industry is poised for a significant shift marked by innovation, sustainability, and self-reliance.

2. REVIEW OF LITERATURE

R&D Centers in the Philippines

The Department of Science and Technology (DOST) is the government agency responsible for planning, directing, coordinating, and supervising the scientific and technological aspects of R&D in the Philippines. This agency provides opportunities and funding for R&D projects. They partner with academe to carry out research and development initiatives due to their capability, especially in research and development. Academe has great researchers, a workforce, and multidisciplinary experts. The NICER Program is one of the best R&D programs of the DOST that aims to enable HEIs in the regions to make significant improvements in R&D by integrating the region's development needs with existing research capabilities and resources. Currently, 38 approved NICER projects in 17 areas are awarded to 46 HEIs in the Philippines. However, based on the data, none approved are for salt R&D.

Salt R&D Centers Abroad

Salt Industry Center of Japan

The Salt Industry Center of Japan was established 1996 (as an Incorporated Foundation and transferred to a Public Incorporated Foundation in 2014.) located at Sakawa, Odawara, Kanagawa, Japan as the only research institute in this field. Since its establishment, the center has been engaged in developing technology for effective production of safe and inexpensive salt and providing scientific information about salt to clients.

The center’s research interests include salt manufacturing, new analytical techniques, and the utilization of seawater resources. They have also several joint research and studies in other organizations in salt manufacturing, and analysis technology such as ion exchange membranes which is usually used in brine production, water purification and seawater desalination, anticorrosion technology, applicability of salt to food processing, and analytical techniques for application to salt and seawater.

Central Salt & Marine Chemicals Research Institute (CSIR-CSMCRI) of India

Central Salt and Marine Chemicals Research Institute is a constituent laboratory of the Council of Scientific and Industrial Research, India. Jawahar Lal Nehru inaugurated the Institute on 10 April 1954 at Bhavnagar, in Gujarat.

India had been an importer of salt for a long time as her production was insufficient to meet the demand. The position deteriorated further after partition when the extensive rock salt deposits in Punjab and the marine salt works in Sind went to Pakistan. Soon after attaining independence in 1947, India faced the problem of meeting the acute shortage of edible salt in various parts of the country. The Government set up an inter-departmental committee under the chairmanship of Shri H.M. Patel, who was then the Cabinet Secretary, to examine and report on the measures for overcoming the salt shortage. The committee submitted several short-term proposals to the Government. It recommended that a Salt Expert Committee be appointed to investigate the problems relating to salt production, quality, and utilization. The need for salt

research was recognized by the Council of Scientific & Industrial Research (CSIR), New Delhi, as early as 1940, when, at the instance of Dr.S.S.Bhatnagar, a Salt Research Committee was established to formulate a program of research on the production and utilization of salt. Today, it is the third largest salt producer in the world, exporting surplus salt across regions from Japan to Indonesia.

CSIR-CSMCRI currently focuses on diverse and highly applied research areas such as salt and marine chemicals, water desalination and purification, membrane based processes for separation & concentration, inorganic materials and catalysis, fine & specialty chemicals including sensing and diagnostics molecules, renewable energy, plant molecular biology & biotechnology with emphasis on seaweeds & salinity tolerance and waste management with a thrust on value recovery and environmental Impact assessment.

Currently, the center has eight divisions namely: Analytical & Environment Science Division and Centralized Instrumentation Facility, Salt & Marine Chemicals, Inorganic Materials & Catalysis, Natural Products & Green Chemistry, Applied Phycology & Biotechnology, Plant Omics, Membrane Science and Separation Technology, and Process Design & Engineering.

Foundation of Agri, Tech, Commercialization & Transfer of South Korea

Consumers are increasingly concerned about micro-plastic particles in seafood. It turns out that sun-dried salt made in South Korea was not free from this problem. Foundation of Agricultural Technology Commercialization, located at Pyeongdong-Ro, Iksan-Si, Jeollabuk- Do, South Korea a unique and exclusive organization for commercializing R&D achievements in agricultural science & technology.

They used a new salt production method utilizing greenhouses and IT technology in smart salt farms. They used technology-generating foam to filter out impurities in brine water. The foam contains animal protein from seawater or dust particles outside the country. Then the seawater is strained through a filtering system before being channeled to the salt fields inside a greenhouse. The water evaporates, leaving behind clean salt. Various sensors are set up inside the greenhouse to create conditions optimal for salt production in real-time. The greenhouse helps block out fine dust particles, and the filtering system strains out micro- plastics. Tests showed no micro-plastics or other impurities were found in the salt. This clean salt will soon be exported to Russia.

Tongxiao Electrodialysis Salt Factory in Taiwan

Tongxiao is the only table salt manufacturing factory in Taiwan located in Neidao Village, Tongxiao Township, Miaoli County, Taiwan that uses electrodialysis technology in their production line dedicated to promoting salt and water technology education.

Based on these established R&D Centers in other countries, it would be good to use the ion exchange membrane technology of Japan's Salt Industry Center. This technology is usually used in brine production, water purification, and seawater desalination, as well as in anticorrosion

technology, how salt can be used in food processing, and analytical techniques that can be used with salt and seawater.

The Asin R&D Center could also use the best practices from CSMCRI. The Salt and Marine Chemicals Division is not only working on a cost-effective way to improve the quality and yield of solar salt, but they are also running Skill Development Programs for salt manufacturers. These programs include Design and layout of solar salt works that can be used with any type of brine, Skill development of salt producers, and fundamental studies on brine systems and ionic liquids, among others. Recently, they also issued certificate in Solar Salt Technology as part of the skill India initiative of CSIR-CSMCRI. Their Process Design and Engineering Division is also equipped with a wide range of lab-scale and pilot plant equipment and facilities.

For advanced salt production, South Korea's Foundation of Agri, Tech, Commercialization & Transfer is a good example such as their greenhouses and IT technology in smart salt farms that can separate microplastics and other impurities from seawater.

3. PROJECT OBJECTIVES

Generally, this project aims to provide support and address the needs of local salt industry through research and development on alternative salt production technologies, availability of salt testing facilities, technical consultancy, human resource development and S&T promotion.

Specifically, it aims to:

a. To equip personnel with knowledge and techniques through training and international collaboration with research institutions with solid foundation in modern salt production.

b. To design and develop at least 2 salt production technologies that will provide alternative solutions to the existing salt production processes.

c. To establish R&D facility and salt testing and analysis capabilities

d. To provide consultancy and local salt industry such as technical training/seminar/workshop, technical consultancy, and testing & analysis.

4. SCIENTIFIC BASIS/THEORETICAL FRAMEWORK

This project is guided by the IPO framework which aims to improve salt production methods in coastal areas by engaging stakeholders, building capacity, and developing infrastructure. Through the evaluation of current practices and involvement of communities in technology development, production efficiency is enhanced. Moving on, the establishment of facilities and trainings to be offered will create job opportunities which increases the demand for salt benefiting local economies and promising sustainable progress in the salt production industry.

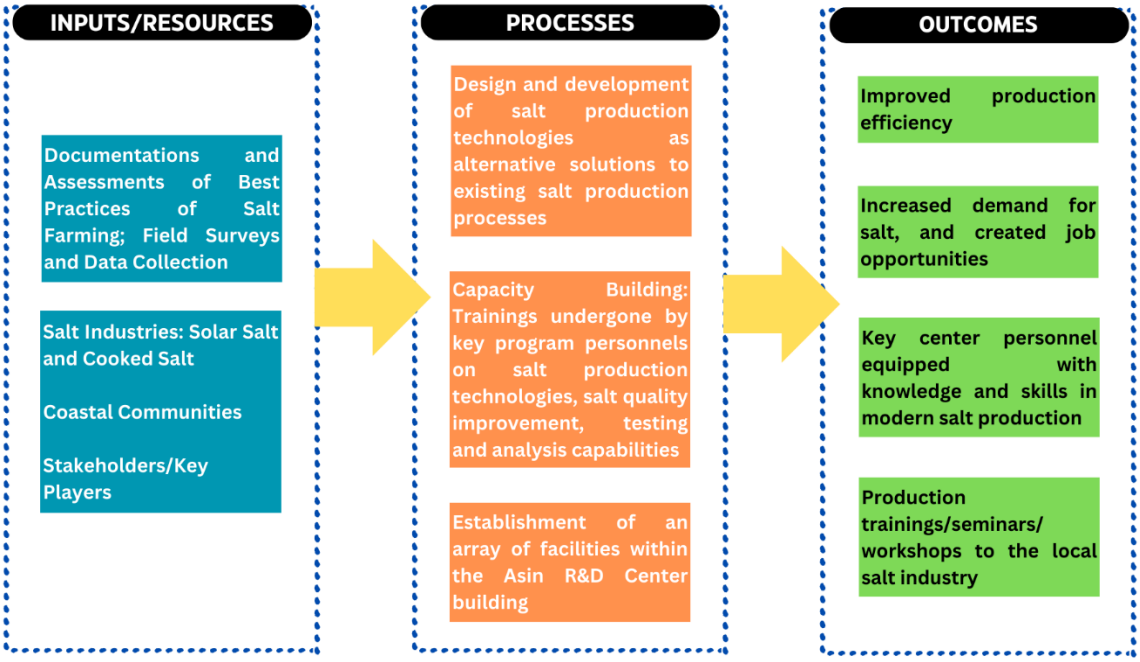


Figure 1. Framework of the project

5. METHODOLOGY

Objective 1

The personnel involved in this project must undergo specific training to ensure they possess the necessary knowledge and skills in salt production technologies. These trainings encompass acquiring expertise in major salt concentrate production methods, with a particular emphasis on the Ion-exchange membrane electrodialysis method. Additionally, it is crucial for the personnel to be well-versed in high purity solar salt technologies, fundamental studies on brine systems and ionic liquids, as well as the boiling-down process.

To enhance the quality of salt, it is essential to provide adequate education and training to the personnel involved. These individuals should possess a comprehensive skill set that encompasses various aspects of salt production. This includes acquiring knowledge in conducting surveys of saline lands, designing and implementing solar salt works that are suitable for different types of brine, and fortifying common salt with vital nutrients like iodine, iron, zinc, and others. Moreover, it is crucial to train them in the proper utilization of equipment such as the Vacuum Mixer and Magnetic Stirrer.

In order to effectively assess and analyze various materials, it is essential for personnel to possess extensive expertise in elemental analysis using cutting-edge techniques such as atomic absorption spectrometer, Automatic Titrator, Ultraviolet and Visible (UV-Vis) absorption spectroscopy. Additionally, they must be proficient in operating sophisticated instruments as these tools are indispensable for conducting accurate and detailed tests.

Regarding water treatment, it is imperative for the personnel to acquire knowledge regarding membrane-based technologies utilized for the purpose of water desalination and

purification. Additionally, they should be well-versed in the design and manufacturing of synthetic membranes to ensure the provision of safe drinking water. Membranes can be categorized into two types: microfiltration (MF) and reverse osmosis (RO) membranes. Furthermore, membranes possessing an acidic charge are classified as cation-exchange membranes, while those with a basic charge are categorized as anion exchange membranes. In conjunction with this knowledge, it is crucial for the personnel to undergo training on the operation of specific machines such as the electrode ionization system, and membrane casting machine.

The project aims to form partnerships with reputable international institutions that specialize in Salt production. One such institution is the Central Salt & Marine Chemicals Research Institute (CSMCRI), which was established by the Council of Scientific & Industrial Research (CSIR) of India. CSMCRI operates a Skill Development Program that regularly conducts training programs for salt manufacturers and officials at various levels. The objective of these programs is to educate them on enhancing salt production quantity and achieving high-quality salt through the implementation of scientific methodologies in the field. CSMCRI is renowned as a leading research institute in the field of synthetic membrane design, manufacturing, and membrane-based technologies. They have successfully developed numerous membrane-based technologies using domestically produced membranes, which have been extensively tested and commercially implemented in remote rural areas of India. Additionally, CSMCRI's Process Design and Engineering Division actively engages in activities such as process development (e.g., Salt fortification with iron and iodine), scaling up production, and facilitating the transfer of technology for industrially significant products.

The project also intends to collaborate with The Research Institute of Salt and Sea Water Science (RISSWS), which operates within the framework of The Salt Industry Center of Japan. RISSWS focuses on the development of technology aimed at efficiently producing safe and affordable salt, while also providing consumers with scientific information about salt. Their research encompasses various areas, including salt manufacturing technology, where they strive to enhance the efficiency of salt production processes and reduce costs, as well as explore seawater resource recovery technology. Additionally, RISSWS conducts research on commodity technology, seeking to develop product design techniques and appropriate processing methods. They also specialize in assessing the quality of salt and employ sophisticated analysis techniques. Their analysis services are highly trusted for salt, sea water, and related matters. Furthermore, RISSWS boasts expertise in major salt concentrate production methods such as the Ion-exchange membrane electrodialysis method and the Boiling-down process. The project aims to embark on a visit to India, where it will participate in a comprehensive 1-month training program held at the esteemed Central Salt & Marine Chemicals Research Institute in Bhavnagar, Gujarat. During this training, one of the notable benefits will be gaining expertise in conducting surveys of saline lands, solar salt farm construction, and filtration, as well as acquiring the skills to produce a Double fortified salt, a type of salt fortified with both iron and iodine.

In addition to India, the project intends to visit Japan as well, where it will undergo a similarly extensive 1-month training program at The Salt Industry Center of Japan. This renowned institution is headquartered in Shinagawa, Tokyo, while its Research Institute of Salt and Sea

Water Science can be found in Odawara, Kanagawa. The training offered by this program will cover several unique areas of knowledge, including reverse osmosis, ion-exchange membranes, advanced analysis techniques pertaining to salt, and the technology for recovering resources from seawater.

The learnings gained from these training programs at the two institutes (India and Japan) will play a crucial role in the center's research endeavors concerning the development and production of synthetic membranes and membrane-based technologies. These membrane science and separation technologies will be instrumental in the center's pursuit of water desalination and purification, as well as saline production. Also, the acquired knowledge on efficiently utilizing specialized equipment such as the polarize microscope, ion exchange machine, and membrane casting machine, among others, which will be procured by the center, holds great significance. Moreover, the center plans to share the knowledge acquired from these institutes with salt producers and academic institutions through seminars and training sessions it will organize.

Additionally, as part of the project's endeavors, a benchmarking activity will be conducted at the Reverse Osmosis Desalination Plant in Manila Water Philippine Ventures unit, Bulacan Aqua Estates. This plant, a collaborative effort between the provincial government, and the Local Government Unit (LGU) of Bulacan, provides a substantial amount of high-quality potable drinking water to the residents.

Objective 2

Cooked Salt Method: Development of Integrated filtration and Ion-exchange Membrane Electrodialysis Method for Cooked Salt Brine Production

In the Philippines, particularly region 1, there are two types of salt production methods: cooked salt and solar dried salt. Brine is produced by pumping seawater into a reservoir and salt workers typically add additive such as pure Australian Salt or "Barara" to increase the salinity concentration of the seawater from 3 to 20 Baumé which is ideal prior to heating or cooking. However, this process is tedious and attracts salt importation. According to Ms. Grace Monterola, cooked salt maker in Infanta, Pangasinan, she spends almost P4,000,000.00 every year of imported Australian Salt and diesel fuel expenses amount to P50,000.00 annually to pump seawater into the reservoir.

Therefore, using an integrated filtration system in the cooked salt production line will help the removal of seawater impurities such as organic materials, and other particles to make it clean before it is made into salt. The electrodialysis reversal desalination method will also be used to produce concentrated (brine) with recovery rate of 20% by applying electrical power, cation, and anion exchange membranes. The diesel pumps will be replaced with a solar power pump to eliminate annual fuel costs.

In this new method, it will reduce the dependency and expenses on salt importation by 50% since the system could concentrate seawater into an ideal salinity with a recovery rate of 20%. In addition, the system could also produce safe drinking water as one of the byproducts after the desalination process which can also bring an additional income. Moreover, with the

system, it could also eliminate the annual fuel cost of pumping seawater by replacing the diesel pump into solar pumps. Combining all these technologies could annually increase salt production by salt farmers and save about 50% on imported salt. Only once will the salt farmers/producers invest in this technology that will match how much brine is needed to be cooked every day. This technology is user friendly and could be upgraded if farmers want to produce more brine. A full setup of the system will cost 4 million pesos, but it will be regained because the salt producers can save almost 2 million pesos in imported salt.

Filtration System

The first step is the filtration of the seawater. Before seawater pour to the brine cooking facility, it goes through a filtration process to remove algae, organic materials, and other particles. Seawater will be pumped into filtration tank that have layers of anthracite, sand, and gravel on top. After filtering, the seawater will be stored in a 5-unit 2,000 L HDPE tank. This serves as the seawater feed tank.

Brine Concentration System

Filtered seawater will be pumped to the brine concentrator system. The brine concentration is equipped with desalination technology called electrodialysis reversal where seawater will be concentrated by using ion-exchange membrane electrodialysis method. This method is based on the principle that the salt in seawater exists as separated electrically charged positive ions such as sodium, magnesium and calcium ions and electrically charged negative ions such as chloride ions. Initially, the salt concentration in seawater is about 3.5%. The ion-exchange membrane electrodialysis method is expected to produce brine with a concentration of between about 15% and 20%. Produce brine from the system will be stored in a 5-unit 2,000L HDPE tank. The system can also produce drinkable water aside from producing concentrated brine.

Evaluation of Filtration and Electrodialysis System

Seawater samples will be collected before and after the filtration process and allowed to crystallize to form salt using existing cooking methods. Salt samples will be analyzed in terms of composition, crystal structure, crystal size, and crystal shape as well as the presence of microplastics, heavy metals, minerals, and NaCl concentration. The effect of combining the desalination system on the time required for seawater concentration to rise will be evaluated. Test analyses is based on AOAC, CODEX and ASIN Law standard to ensure acceptability, reliability and replicability of test results.

Materials:

The materials to be used are locally available.

- Electrodeionization System
- HDPE tank
- Solar water pump
- Pipe
- Anthracite, sand, and gravel
- Gate valve

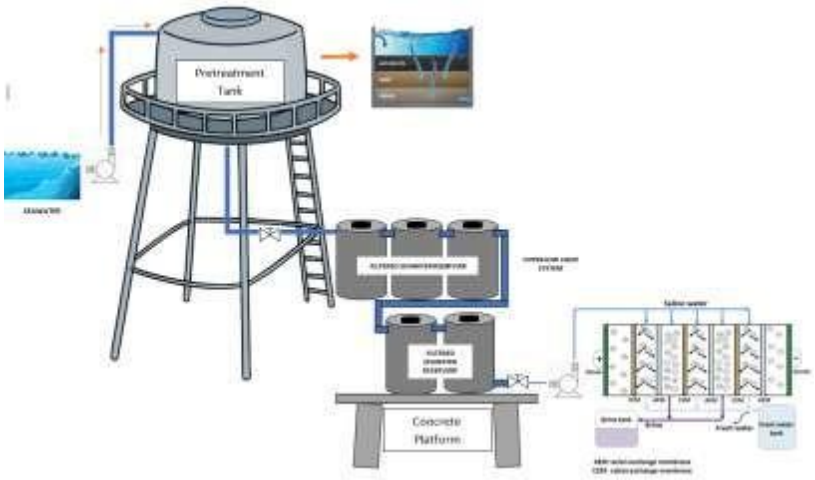


Figure 2. Diagram of the Integrated Filtration and Electrodialysis for Cooked Salt Brine Production

Parameter	Existing Equipment/Process/ Technique in the Market	Target Propose Fabricated Equipment/Process/ Technique
Process/Techniques	Addition of 100% NaCl imported salt to produce brine.	Integrated filtration and desalination technology to produce safe and ideal brine.
Material	Concrete Seawater Reservoir, no membrane	HDPE storage tank, micro filtration and desalination membrane, water pump
Speed/performance	**Need 100% NaCl imported salt additive per batch to increase the seawater salinity before cooking.**	**No 100% imported salt additive needed.**
Capacity	A **concrete reservoir** can accommodate 10,000 liters of brine. But prone to rust and cracks due to the prolong exposure to seawater.	**HDPE reservoir** can accommodate 5-2,000 liters of brine with strong resistance to rust and cracks.
Quality (e.g., produced product/equipment)	**Unfiltered, and uncharacterized brine led to poor quality of salt product.**	Filtered brine using **filtration** layers of anthracite, sand, and gravel that will lead **to high quality and safe salt product.**
Manpower Needed	Two **traditional** salt workers.	One **skilled in desalination and filtration technology** salt workers
Cost of the equipment	Php. 500,000 for the construction of the concrete brine reservoir, but **high maintenance** due to the prolonged exposure to brine causing concrete cracks and rust. Need 100% NaCl salt imported salt to increase the salinity level of the seawater. Total of approximately P4M expenses annually.	Php. 1.5M to 4M for the complete set of the system with **low maintenance**, ion and cation membrane will last to 5-10 years. Reduce salt importation expenses by 50%. Savings of approximately P2M per year of total production.

Solar Evaporation Method: Development of Spray Pipe and Mesh Net Technology for Seawater Evaporation System for Solar Dried Salt

This is the earliest method for producing salt. It is only applicable in temperate climates where the evaporation rate exceeds the precipitation rate, either annually or for extended periods, and where, ideally, the prevailing winds are consistent. Typically, solar salt production involves

collecting saline water in shallow ponds where the sun evaporates the majority of the water. The concentrated brine precipitates the salt which is then gathered by mechanical harvesting machines. Any impurities that may be present in the brine are drained off and discarded prior to harvesting.

Typically, two kinds of wetlands are utilized. First, there are the concentrating ponds, in which ocean water is concentrated to enhance its salinity. The second is known as the crystallizing ponds, where salt is produced.

However, salt production in the case of solar evaporation may take weeks to obtain salt. Generally, evaporation in pond plots is carried out until the degree of salinity reaches 22-24 Baumé. Evaporation using solar heat is still considered in order to save energy. Spray flash evaporation technology is a promising way for efficient low-temperature desalination that can utilize solar energy as a heat source. Therefore, to address this concern, alternative method to evaporation seawater using a pressurize spray pipe to increase the salinity of seawater to at least 23 Baumé will be develop. Several factors were observed related to its effect on salinity, including injection pressure, pipe diameter and length, wind speed, seawater flow rate, humidity, evaporation pond area, and evaporation time.

The system will be implemented in a 500-square-meter geomembrane-lined pond, with a seawater flow rate of 1.5, 3.0, and 5.0 L/min using a 2-unit diesel-powered water pump, and a 30-hour observation period for evaporation and salinity. The tube is 3 inches in diameter, 1200 meters in length, arranged in an S-shape, black in color, and connected to the water pump. Parallel pairs of this system will be arranged and exposed to sunlight. Because black absorbs and radiates heat more effectively than other colors. The seawater sprayed from the tube will be blown into the net set in the center of the pond to increase the contact between hot air and the water surface, thereby increasing the rate of evaporation. This pilot project will be conducted on the partnered salt farm. The water pump will be stop manually until it reached 23-24 Be. In addition, measurements were taken of wind speed, ambient temperature, spray height from the spray tube, and humidity. Wind velocity was measured with an Anemometer Digital Thermometer, salinity with Digital Salinometers, and humidity with a Themo Hygrometer.

As previously described in the conventional method of salt production, it takes approximately 3 to 4 weeks of evaporation to attain a salinity of 23 to 24 B. The alternative method is anticipated to reduce evaporation time in sunny conditions by 3–4 days to attain the same salinity.

For the maintenance of the system, the pipeline will be flash with low salinity seawater after every operation, this is to remove any clogging issues occurs during operation due to precipitation of brine. When salt is mixed with seawater, the salt dissolves easily since the covalent bonds of seawater are more robust than the ionic bonds in the salt.

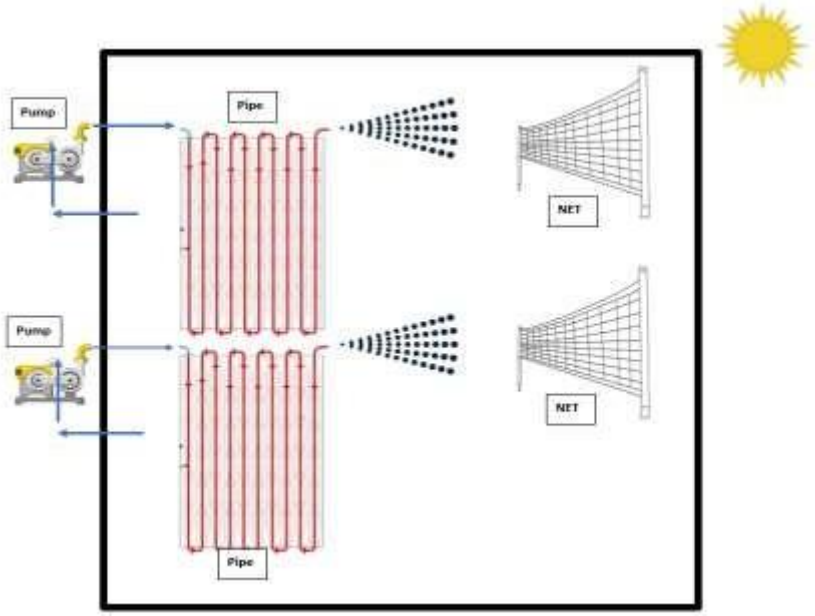


Figure 3. Diagram of Spray Pipe and Mesh Net Technology for Seawater Evaporation System for Solar Dried Salt

Parameter	Existing Equipment/Process/ Technique in the Market	Target Propose Fabricated Equipment/Process/ Technique
Process/Techniques	10 Evaporation and 4 Crystallization ponds. Manual and long process of producing brine.	Spray Pipe and Net Metho for Solar Evaporation System. Only 1 evaporation pond is needed to produce brine. Quick process in producing brine.
Material	none	Diesel pump, pipe, nozzle, and Mesh Net
Speed/performance	3-5 weeks to meet the ideal salinity.	4-6 days to meet the ideal salinity.
Capacity	Small-scale salt producers usually have 3 hectare of salt farm that include the evaporation and crystallization ponds.	Only need 500 sq. m of evaporation pond to produce brine.
Quality (e.g., produced product/equipment)	Same quality of brine but longer to produce.	Same quality of brine but quicker to produce.
Manpower Needed	Usually, 10-15 salt workers	2-3 salt workers
Cost of the equipment	N/A	Php. 500,000 to 1M investment.
Production quantity	Same quality of brine but longer to produce	Same quality of brine but faster to produce.

Objective 3

These are the facilities that will be established:

Asin R&D Center Facility: The Asin R&D Center building will comprise office spaces for administrative staff, a reception area, conference rooms, and other areas necessary for the administrative, research, and extension functions of the facility.

Membrane Science and Separation Technology Facility: This facility will be equipped with advanced membrane casting equipment, and other specialized instruments. Additionally, dedicated spaces will be provided for sample preparation and storage within the facility.

Salt and Engineering Facility: The Salt and Engineering Facility will feature a range of pre- and post-salt production technologies that will be utilized for practical training programs.

Conference and Meeting Room: This room will serve as a space for conducting conferences and meetings.

Training and Education Facility: This dedicated room will be used for providing training and education to salt farmers/producers, faculty, students, and other stakeholders involved in the salt industry. This includes demo equipment for brine production technology, such as electrodialysis reversal, and a demo salt furnace designed by DOST ITDI.

Asin R&D Center Analytical Laboratory: Once established, the Asin R&D Center will be equipped with a diverse selection of sophisticated analytical instruments and equipment necessary for scientific studies. The laboratory will offer an extensive range of diagnostic testing and consultation services to both government and private clients. The services provided will include UV VIS, automatic titrator, atomic absorption spectrometer, polarized microscope, use of vacuum mixer, pH level measurements, and complete chemical analysis.

A complete chemical analysis of salt typically involves measuring various properties that can provide information about its composition, purity, and potential impurities. Here is the scope of testing and analysis for salt:

Sodium chloride content: Salt primarily consists of sodium chloride (NaCl), and its percentage in the sample can be determined through quantitative analysis methods such as titration or gravimetric analysis.
Moisture content: The water content in salt can be measured using methods like Karl Fischer titration or loss on drying. It indicates the amount of water present, which can affect the quality and stability of the salt.

Insoluble matter: The presence of insoluble impurities in salt, such as sand, dirt, or other contaminants, can be determined by filtering a sample and weighing the residue left behind after drying.

Iodine content (as received): Iodized salt contains added iodine, which helps prevent iodine deficiency disorders. The iodine content can be determined by titration methods or instrumental techniques like spectrophotometry.

Other mineral impurities: A complete analysis may include determining the levels of other minerals or impurities present in the salt, such as magnesium, sulfate, calcium, potassium, nitrate, or heavy metals.

pH value: The pH of a salt solution can be measured to assess its acidity or alkalinity. This property can be determined using a pH meter or indicators.

Particle size distribution: The particle size distribution of salt can be analyzed using techniques like laser diffraction, sieving, or microscopy. This information is relevant for certain applications, such as in the food industry.

These properties collectively provide a comprehensive understanding of the composition, purity, and potential impurities present in salt, ensuring its quality and suitability for various applications.

The state-of-the-art Asin R&D Center Analytical Laboratory is dedicated to conducting scientific studies and providing a comprehensive range of diagnostic testing and consultative services to both government and private clients. Equipped with an array of sophisticated analytical instruments and equipment, the laboratory ensures accurate and reliable results.

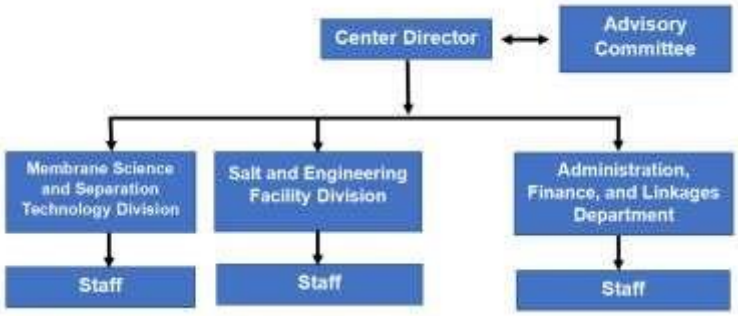
To submit a sample for analysis, a streamlined process is in place to make it convenient for the clients. The first step is to initiate an online consultation by sending an email to rbasuel@psu.edu.ph. A dedicated staff will be available to address any inquiries or concerns. Once ready to proceed, one can request an appointment by sending another email to the same address. This allows the staff to schedule the visit and ensure that sufficient resources are allocated for the analysis.

On the day of the appointment, fill out the Request for Analysis Form. This form helps the facility to gather important details about the sample and its testing requirements. Once the form is completed, the sample can be submitted for assessment and labeling.

After the sample is received, a charge slip containing the appropriate service fee will be generated. It is essential to bring this charge slip to the PSU accounting office, where the service fee can be conveniently paid. Service rates are based on the current testing and analysis rates charged by the DOST (Department of Science and Technology). The specific services provided will depend on the project's requirements and the equipment needed for analysis. To finalize the process, a picture of the Official Receipt (OR) must be sent to rbasuel@psu.edu.ph. This step helps the facility maintain accurate records and streamline the administrative aspects of the transaction.

In terms of visiting the laboratory, it will be open every Monday to Friday from 8:30 am to 5:30 pm. While appointments are preferred, walk-in clients are also welcome. However, to ensure efficient service, all are encouraged to request an appointment by sending an email to rbasuel@psu.edu.ph before visiting the center. In situations where online booking is not possible, the facility operates on a first come, first serve basis. And to maintain a conducive environment for analysis and ensure personalized attention, a maximum of 15 persons per batch is allowed at any given time.

Organizational Structure:



Asin R&D Center Facility:

Proposed Asin R&D Center

Asin R&D Center Analytical Laboratory:

Upon establishment of the Asin R&D Center it will be equipped with array of sophisticated analytical instruments and equipment which will be necessary for scientific studies. It will provide a comprehensive range of diagnostic testing and consultative services to both government and private clients.

Sample Submission:

- Do an online consultation by sending an e-mail to rbasuel@psu.edu.ph.
- Request an appointment by sending an e-mail to the same address.
- On the appointment day, fill out the Request for Analysis Form. Submit the sample for assessment and labeling.
- A charge slip will be issued containing the appropriate service fee. Bring the charge slip to the PSU accounting office and pay the service fee.
- Take a picture of the Official Receipt (OR) and send the file to rbasuel@psu.edu.ph.

Analytical Laboratory Services Offered

Analytical Equipment	Analyte
Polarized Microscope	Photographed and subsequently analyzed analyze the number of microplastics in seawater as well as inorganic and organic materials in salt product.
pH/TDS/ DO/ Temp meter	Used to measure pH, EC (conductivity) and TDS in seawater, and brine product.
Atomic Absorption Spectrometry (AAS)	Use to analyze microplastic analysis, heavy metals, and chemical properties of seawater, brine, and salt product.
Automatic Titration Equipment	Analyze iodine content of salt
UV-Vis Spectrophotometry	Determine transition metals, colored compounds (dyes or pigments), and organic compounds, biological materials in sweater, brine, and salt product.

SERVICE NAME	SAMPLE REQUIREMENTS	REQUIRED FEES, Php	
		Regular	Student
Particle Size Analysis by Dynamic Light Scattering: One sample	Sample/s to be tested (at least 3 grams powder samples, dispersing medium, Refractive Index (RI) of the powder and RI of dispersing medium)	2,611.00	2,089.00
Use of Vacuum Mixer	Sample/s to be processed (100- 600grams)	2,868.00	2,294.00
pH	200 g	474.00	264.00
Salt/Sodium Chloride			
Iodine (as received)	at least 250g-1 kg sample for Complete Chemical Analysis	700.00	500.00
Magnesium		700.00	500.00
Moisture		700.00	500.00
Assay, NaCl (as received)		650.00	450.00
Sulfate		700.00	500.00

Water Insoluble		800.00	600.00

The rates are based on current testing and analysis rates charged by the DOST. The services provided are determined on the project's specified equipment.

Open Day

- Open every Monday to Friday from 8:30 am – 5:30 pm
- Open to all walk-in clients
- Request an appointment by sending an e-mail to the same address before visiting the center.
- In the moment that online booking is not possible, first come, first serve must be observed.
- Only 15 persons per batch is allowed at a given time.

Objective 4

The ASIN R&D Center will offer a range of training programs, seminars, and workshops specifically tailored for the local salt industry. These educational opportunities aim to enhance the knowledge and skills of participants in various aspects of the industry. Here is an overview of the training offerings:

1. Practical training sessions will be conducted to provide hands-on experience with ion exchange electrodialysis and other water treatment technologies. Participants will gain valuable insights into the operation and maintenance of these systems.

2. Practical hands-on training on the vacuum evaporator system, a modern, energy-efficient, and cost-effective salt production technology that uses pressure and heat exchangers to evaporate and separated water from seawater to produced salt.

3. Another practical training module will focus on solar salt farm design and the development of Salt Furnaces. This training will equip participants with the necessary expertise to design efficient salt farms and optimize the performance of Salt Bath Furnaces.

4. A specialized training program will be conducted to educate participants on conducting surveys of saline lands. This training will cover the techniques and methodologies required to assess and analyze saline land resources.

5. Participants will have the opportunity to receive hands-on training in salt pre- and post-production technologies. This module will provide practical knowledge on the various processes involved in salt production, including quality control and packaging.

6. The center will also provide training on the proper utilization of equipment such as the Vacuum Mixer and Magnetic Stirrer. Participants will learn how to effectively operate and utilize these tools for salt-related processes.

7. A seminar will be organized on the topic of saline agriculture, covering areas such as the cultivation of halophytic plants, the principles of circular economy and industrial symbiosis, and the development of salt value-added products. This seminar will provide valuable insights into innovative practices and potential opportunities in the field of saline agriculture.

8. The ASIN R&D Center will facilitate college and high school students' immersion in its facilities, research projects, and services. This initiative aims to expose students to the center's ongoing research activities and foster their interest in the salt industry.

These comprehensive training programs and seminars offered by the center will equip individuals in the local salt industry with the necessary knowledge and skills to excel in their respective fields. These are the testing and analysis services that will be provided by the ASIN R&D Center:

Electrode ionization equipment produces salt concentrate from seawater using electrical power. This method is based on the principle that the salt in seawater exists as separated electrically charged positive ions such as sodium, magnesium and calcium ions and electrically charged negative ions such as chloride ions. This lab. equipment will be used for training and demonstration of the latest brine production technology.

Membrane Casting Equipment is ideal for synthesis of flat sheet polymeric membranes. The instrument is optimized for membrane applications. This equipment will be used for filtration membranes, separation technologies, and manufacturing research.

Ultraviolet (UV) spectrometry will be used to determine the properties of seawater in terms of NaCl, $MgCl_2$, Na_2SO_4, $CaCl_2$, KCl, KBr, H_3BO_3, $SrCl_2$, NaF, and $NaHCO_3$.

Automatic Titrator is a general method to determine the concentration of iodine in salt product. Automated Titrator is an essential analytical instrument for quality control and chemical analysis.

Atomic absorption spectrometry (AAS) detects elements in either liquid or solid samples through the application of characteristic wavelengths of electromagnetic radiation from a light source. AAS is also a technique used for determining the concentration of a particular heavy metal element, and microplastics within a sample.
Use of Vacuum Mixer: A vacuum mixer is a specialized device that utilizes a vacuum environment to facilitate the thorough and efficient mixing of substances by eliminating air bubbles and enhancing homogeneity.

pH Level: A pH analyzer is a sophisticated scientific instrument used to measure and quantify the acidity or alkalinity of a solution based on the concentration of hydrogen ions present.

Complete Chemical Analysis: Complete Chemical Analysis is the comprehensive examination and evaluation of a substance's composition, structure, and properties using various analytical techniques, enabling a detailed understanding of its chemical characteristics.

Partnership:

DA-BFAR will provide support to the center for the construction of demo salt facilities planned to be built in the Ilocos Region and Pangasinan. In addition, the DA-BFAR will be going to support the center for activities held in the salt industry such as training, seminars, acquisition of salt related data and statistics, introducing new technologies to salt producers as well as to be introduced to the LGUs in region 1 that have salt production.

DTI will help the ASIN R&D CENTER in assisting local salt producers/manufacturers in upgrading their production technologies by promoting the salt production technologies and new methods developed in ASIN R & D Center. Also helps the ASIN R & D Center in formulating effective salt production and marketing policies, organize trade fairs and business missions, conduct seminars, workshops, conferences, product design and development, market consultancy, and salt product consultancy.

DOST1 and DOST ITDI will assist the research, development, and adaption of need-based technologies produced in the center to help uplift local salt industry's production

TESDA and R1 SUCs will help the center to provide develop standard curricula, educational training, manpower development and industry-wide training on various topics in salt production, salt iodization, quality standards, values formation, farm management, agribusiness, and others.

Local Government Units (LGUs) will play a big role in the implementation of the center's activities for local salt producers and farmers in region 1. They will be responsible for coordinating the center in their municipalities with salt production areas and promoting developed technologies and salt products from the center to salt communities. They will also accompany the center for seminars, workshops, and training for local salt farmers in region 1.

Philippine Association of Salt Industry Networks (PhilASIN) is a collaborator in supporting the salt industry's research, development, innovation, and modernization efforts. They are also engaged in the development of the center's proposed salt production policies and the house and senate's legislation that will benefit the salt industry. They will also provide any necessary resources, such as salt data, as well as permission and space for the salt farm pilot area required for the center's implementation.

6. RESULTS

Objective 1

The project team has conducted extensive site visits across cooked-salt farms in Pangasinan, La Union, Ilocos Sur, Ilocos Norte, and BFAR 1. With this, survey questionnaire were developed and administered to Salt Farmers/Producers in Region 1. Out of the 10 individual farmers and 10 associations targeted, the following results were obtained:

Target	Individual (10)	Association (1)
Pangasinan	10	1
Ilocos Sur	3	2
Ilocos Norte	1	1

Pangasinan Cooked Salt Farms (December 26-29, 2023)

On the inaugural day, the research squad visited a pair of salt farms producing cooked salt in Infanta—specifically, one located in Barangay Cato and another in Barangay Batang. Our interaction at JM Salt Manufacturer, the first establishment, involved an interview with a salt worker since the proprietor, Ms. Grace Monterola, was away in Manila. At the second farm, we had the opportunity to interview Mrs. Rowena Monterola, the owner, who incidentally is the cousin of Ms. Grace Monterola.

Figure 4. Documentation in JM Salt Manufacturer, Infanta, Pangasinan

Subsequently, in the afternoon, the team conducted surveys at three solar-salt farms in Dasol—two situated in Barangay Hermosa and one in Barangay Bobonot. During interviews with tenants of these farms, we uncovered the various challenges they face, including the revelation that only one-third of the harvest is allocated to them. This portion is then divided equally among their fellow salt-farm workers.

On the second day, the research crew visited a pair of solar-salt farms and two cooked-salt farms in Anda, accompanied by Mr. Eric Areniego from the Anda Municipal Agriculture Office. The initial solar-salt farm, situated in Barangay Macaleeng, spans roughly 12.3 hectares and is under the ownership of D.O.D. and Sons Inc. The second solar-salt farm is situated in Barangay Dolaoan. Moving on to the cooked-salt farms, the one in Barangay Tondol covers an area of around 3,500 square meters and is managed by Mr. Loreto de Guzman. Another cooked-salt farm, located in Barangay Macaleeng, is comparatively smaller at 1,360 square meters.

Figure 5. Documentation in Tondol Salt Farms, Anda, Pangasinan

On the third day, our team kicked things off at the Municipal Agriculture Office of Bolinao, where we linked up with Ms. Irene, the representative for Mr. Eulalio Ramirez, the Municipal Agriculturist. It came to our attention that Pacific Farm, the biggest salt player in Pangasinan, is now owned and controlled by the Provincial Government of Pangasinan. We then visited that sprawling 473-hectare farm, now officially dubbed the Pang-asin-an Salt Center. Mr. Sonny Licayan and two other consultants, the experts behind the salt farm's operation, welcomed us. In the latter part of the day, we headed over to the City Agriculture Office of Alaminos. There, we got the lowdown on the key salt farms in the city from Mr. Alejandro Baybon, their Focal Person for Salt.

Figure 6. Documentation in Pangasinan Salt Center, Bolinao, Pangasinan

On the conclusive day, the team explored Alaminos' solar-powered salt farms. The primary site, situated in Barangay Pangapisan, and another sizable one in Barangay Pandan, along with a more remote salt farm in Barangay Mona, were the key highlights. Our insights revealed a community of over 40 salt farmers in Alaminos, encompassing both medium and small-scale operations. Notably, some of these farmers benefited from BFAR grants, acquiring essential resources such as storage facilities, baskets, gloves, and boots.

La Union, Ilocos Sur, Ilocos Norte Cooked Salt Farms and BFAR1 (February 15-18)

The visit to the salt farms of Ilocos Norte and Ilocos Sur was conducted on February 17 and 18, 2024, by the Project 2 Team of Pangasinan State University. The purpose was to carry out interviews, surveys, and benchmarking activities to gather salt production data within the two provinces. This initiative is a vital component of the workplan for the DOST-NICER: ASIN Center Program’s Project 2, titled “Establishment of ASIN Research and Development Center Through Technology, Competence, and Development Services.”

Figure 7. Documentation in Ilocos Sur and Ilocos Norte Salt Farms Visit

The team embarked on visits to various salt manufacturers in the municipalities of Ilocos Sur and Ilocos Norte. In Ilocos Sur, we engaged with the salt makers in Cabugao (Barangay Salasap), Magsingal (Barangay Pagsanaan), and San Vicente (Barangay San Sebastian). Notable encounters included discussions with the Salasap Salt Makers Association, led by President Mrs. Elena Segui, and the proprietor of Kap Saltmaking Factory.

Figure 8. Documentation in Salapasap Salt Making Association

Similarly, in Ilocos Norte, our team visited salt manufacturers in Badoc (Barangay Pagsanahan Norte), Burgos (Barangay Saoit), and Pasuquin (Barangay Davila). Here, we interacted with the Burgos Salt Makers Association, under the leadership of President Mr. Larry Baniaga, and the Mariposa Salt Makers Association.

Figure 9. Documentation in Mariposa Salt Association

Apart from industry visits, the team also engaged with government units and academic institutions in the region. Coordination efforts were made with the La Union Agriculturist Office,

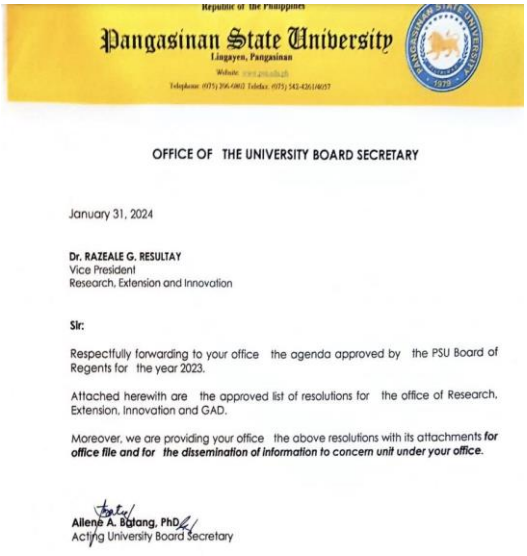
BFAR Region 1, Ilocos Sur Agriculturist Office, Ilocos Norte Agriculturist Office, and the Municipalities of Bangar and Bolaoan, La Union. Additionally, courtesy visits were paid to SUCs in Region 1, namely: MMSU, UNP, and ISPSC.

In conclusion, the collaborative efforts between salt manufacturers, their associations, government units, and academic institutions signify a promising path towards the advancement of the salt industry. By leveraging expertise, resources, and fostering cooperation among stakeholders, we can catalyze positive change and steer the industry towards a better and more sustainable future. The support and cooperation of all parties involved are crucial as we collectively strive to achieve our shared goals.

Moving on, the project team is currently producing ongoing research papers as deliverables for Year 2:

- Characterization and Optimization of Salt Production Processes and Products for Enhanced Sustainability and Quality in Northern Philippines
- Material Flow Analysis of Salt Industry in the Philippines
- Environmental Performance of Salt Industry in the Philippines

The project team has also secured Board of Regents (BOR) approval for the Memorandum of Understanding (MOU), travel arrangements in Japan as well as acceptance letter from ASIN Center Steering Committee Members.



Republic of the Philippines
Pangasinan State University
Lingayen, Pangasinan

OFFICE OF THE UNIVERSITY BOARD SECRETARY

January 31, 2024

Dr. RAZEALE G. RESULTAY
Vice President
Research, Extension and Innovation

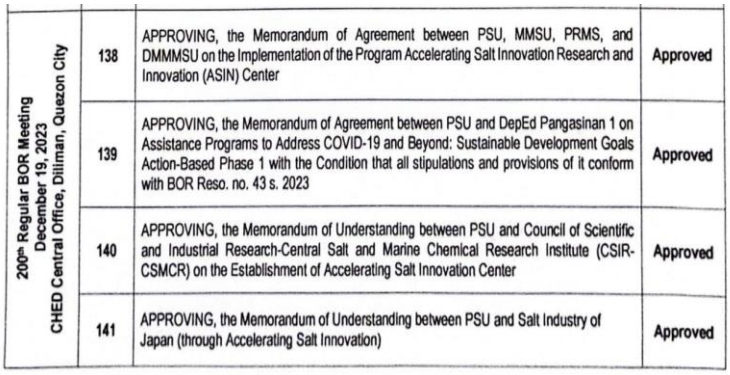
Sir:

Respectfully forwarding to your office the agenda approved by the PSU Board of Regents for the year 2023.

Attached herewith are the approved list of resolutions for the office of Research, Extension, Innovation and GAD.

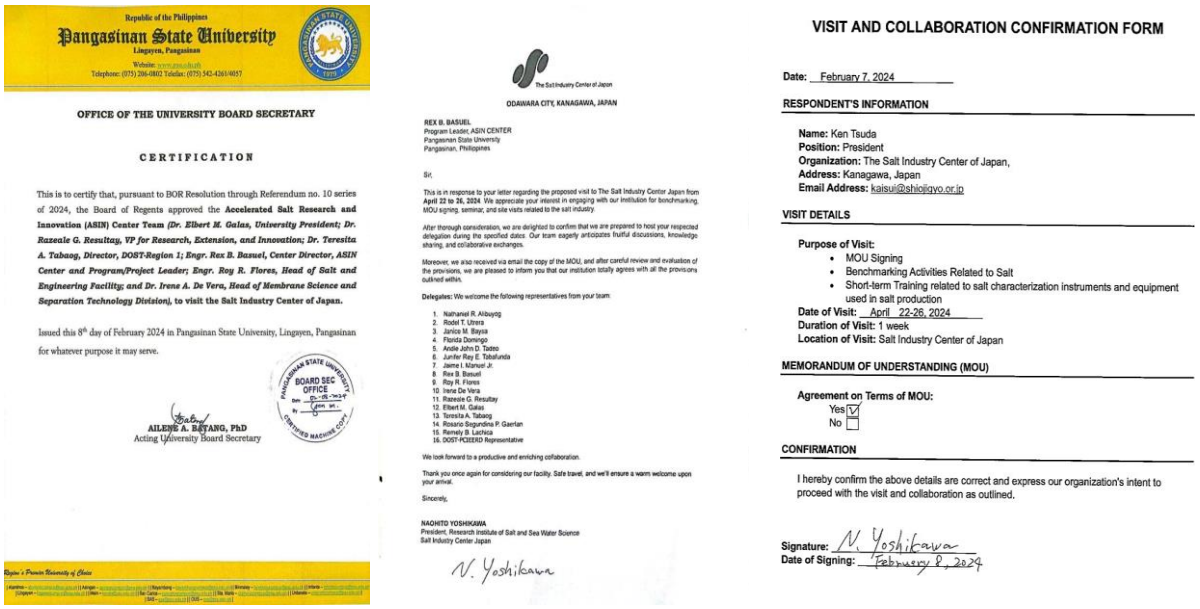
Moreover, we are providing your office the above resolutions with its attachments ***for office file and for the dissemination of information to concern unit under your office.***

Allene A. Bulang, PhD
Acting University Board Secretary



200th Regular BOR Meeting December 19, 2023 CHED Central Office, Diliman, Quezon City			
	138	APPROVING, the Memorandum of Agreement between PSU, MMSU, PRMS, and DMMMSU on the Implementation of the Program Accelerating Salt Innovation Research and Innovation (ASIN) Center	Approved
	139	APPROVING, the Memorandum of Agreement between PSU and DepEd Pangasinan 1 on Assistance Programs to Address COVID-19 and Beyond: Sustainable Development Goals Action-Based Phase 1 with the Condition that all stipulations and provisions of it conform with BOR Reso. no. 43 s. 2023	Approved
	140	APPROVING, the Memorandum of Understanding between PSU and Council of Scientific and Industrial Research-Central Salt and Marine Chemical Research Institute (CSIR-CSMCR) on the Establishment of Accelerating Salt Innovation Center	Approved
	141	APPROVING, the Memorandum of Understanding between PSU and Salt Industry of Japan (through Accelerating Salt Innovation)	Approved

Figure 10. PSU BOR Resolution



Republic of the Philippines
Pangasinan State University
Lingayen, Pangasinan
Website: www.psu.edu.ph
Telephone: (075) 206-0802 Telefax: (075) 542-4261/4017

OFFICE OF THE UNIVERSITY BOARD SECRETARY

CERTIFICATION

This is to certify that, pursuant to BOR Resolution through Referendum no. 10 series of 2024, the Board of Regents approved the **Accelerated Salt Research and Innovation (ASIN) Center Team *(Dr. Elbert M. Galas, University President; Dr. Razeale G. Resultay, VP for Research, Extension, and Innovation; Dr. Teresita A. Tabaog, Director, DOST-Region 1; Engr. Rex B. Basuel, Center Director, ASIN Center and Program/Project Leader; Engr. Roy R. Flores, Head of Salt and Engineering Facility; and Dr. Irene A. De Vera, Head of Membrane Science and Separation Technology Division)*, to visit the Salt Industry Center of Japan.**

Issued this 8th day of February 2024 in Pangasinan State University, Lingayen, Pangasinan for whatever purpose it may serve.

BOARD SEC OFFICE
Date: 2-08-2024
Time: 10:30
CERTIFIED MACHINE COPY

AILENE A. BOTANG, PhD
Acting University Board Secretary

Region's Premier University of Choice

The Salt Industry Center of Japan
ODAWARA CITY, KANAGAWA, JAPAN

REX B. BASUEL
Program Leader, ASIN CENTER
Pangasinan State University
Pangasinan, Philippines

Sir,

This is in response to your letter regarding the proposed visit to The Salt Industry Center Japan from **April 22 to 26, 2024**. We appreciate your interest in engaging with our institution for benchmarking, MOU signing, seminar, and site visits related to the salt industry.

After thorough consideration, we are delighted to confirm that we are prepared to host your respected delegation during the specified dates. Our team eagerly anticipates fruitful discussions, knowledge sharing, and collaborative exchanges.

Moreover, we also received via email the copy of the MOU, and after careful review and evaluation of the provisions, we are pleased to inform you that our institution totally agrees with all the provisions outlined within.

Delegates: We welcome the following representatives from your team:

1. Nathaniel R. Albuyog
2. Rodel T. Utrera
3. Janice M. Baysa
4. Florida Domingo
5. Ande John D. Tadeo
6. Junifer Rey E. Tabalunda
7. Jaime I. Manuel Jr.
8. Rex B. Basuel
9. Roy R. Flores
10. Irene De Vera
11. Razeale G. Resultay
12. Elbert M. Galas
13. Teresita A. Tabaog
14. Rosario Segundina P. Gaerlan
15. Remely B. Lachica
16. DOST-PCIERD Representative

We look forward to a productive and enriching collaboration.

Thank you once again for considering our facility. Safe travel, and we'll ensure a warm welcome upon your arrival.

Sincerely,

NAOHITO YOSHIKAWA
President, Research Institute of Salt and Sea Water Science
Salt Industry Center Japan

N. Yoshikawa

VISIT AND COLLABORATION CONFIRMATION FORM

Date: February 7, 2024

RESPONDENT'S INFORMATION

Name: Ken Tsuda
Position: President
Organization: The Salt Industry Center of Japan,
Address: Kanagawa, Japan
Email Address: kaisui@shioligyo.or.jp

VISIT DETAILS

Purpose of Visit:
- MOU Signing
- Benchmarking Activities Related to Salt
- Short-term Training related to salt characterization instruments and equipment used in salt production

Date of Visit: April 22-26, 2024
Duration of Visit: 1 week
Location of Visit: Salt Industry Center of Japan

MEMORANDUM OF UNDERSTANDING (MOU)

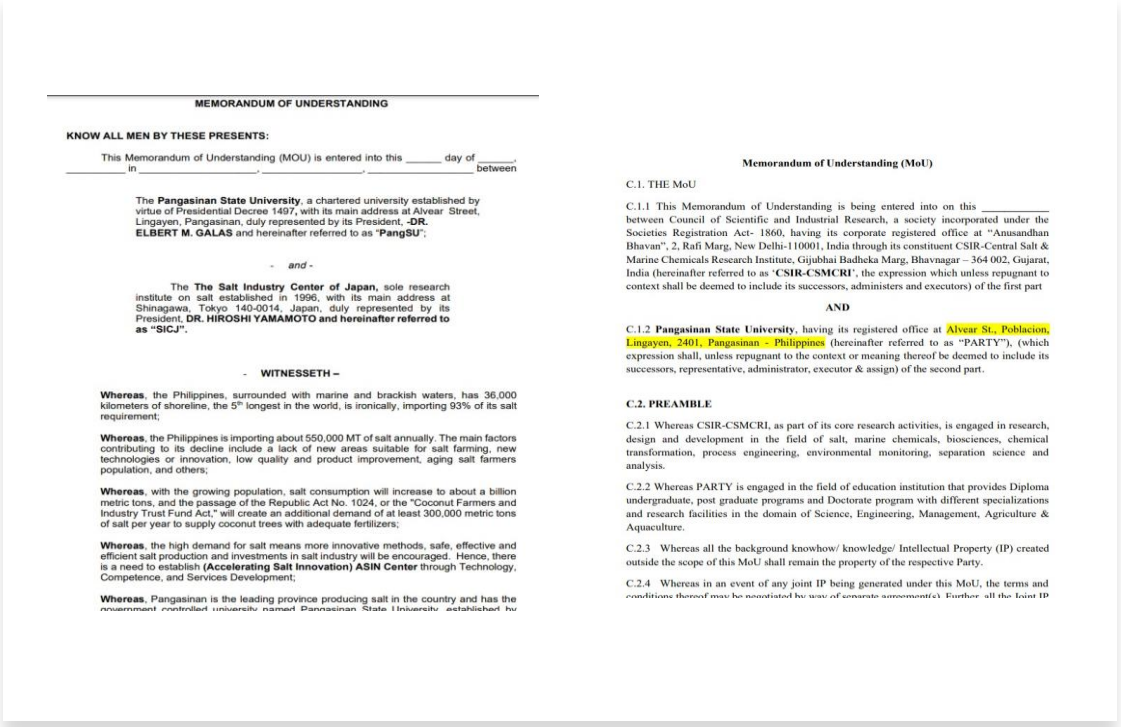
Agreement on Terms of MOU:
Yes ☑
No ☐

CONFIRMATION

I hereby confirm the above details are correct and express our organization's intent to proceed with the visit and collaboration as outlined.

Signature: N. Yoshikawa
Date of Signing: February 8, 2024

Figure 11. Approved PSU BOR Japan Travel (April 21-27, 2024)



MEMORANDUM OF UNDERSTANDING

KNOW ALL MEN BY THESE PRESENTS:

This Memorandum of Understanding (MOU) is entered into this _____ day of _____, _____ in _____, _____, _____ between

The **Pangasinan State University**, a chartered university established by virtue of Presidential Decree 1497, with its main address at Alvear Street, Lingayen, Pangasinan, duly represented by its President, **-DR. ELBERT M. GALAS** and hereinafter referred to as "**PangSU**";

- and -

The **The Salt Industry Center of Japan,** sole research institute on salt established in 1996, with its main address at Shinagawa, Tokyo 140-0014, Japan, duly represented by its President, **DR. HIROSHI YAMAMOTO and hereinafter referred to as "SICJ".**

- WITNESSETH –

Whereas, the Philippines, surrounded with marine and brackish waters, has 36,000 kilometers of shoreline, the 5th longest in the world, is ironically, importing 93% of its salt requirement;

Whereas, the Philippines is importing about 550,000 MT of salt annually. The main factors contributing to its decline include a lack of new areas suitable for salt farming, new technologies or innovation, low quality and product improvement, aging salt farmers population, and others;

Whereas, with the growing population, salt consumption will increase to about a billion metric tons, and the passage of the Republic Act No. 1024, or the "Coconut Farmers and Industry Trust Fund Act," will create an additional demand of at least 300,000 metric tons of salt per year to supply coconut trees with adequate fertilizers;

Whereas, the high demand for salt means more innovative methods, safe, effective and efficient salt production and investments in salt industry will be encouraged. Hence, there is a need to establish **(Accelerating Salt Innovation) ASIN Center** through Technology, Competence, and Services Development;

Whereas, Pangasinan is the leading province producing salt in the country and has the government controlled university named Pangasinan State University, established by

Memorandum of Understanding (MoU)

C.1. THE MoU

C.1.1 This Memorandum of Understanding is being entered into on this _____ between Council of Scientific and Industrial Research, a society incorporated under the Societies Registration Act- 1860, having its corporate registered office at "Anusandhan Bhavan", 2, Rafi Marg, New Delhi-110001, India through its constituent CSIR-Central Salt & Marine Chemicals Research Institute, Gijubhai Badheka Marg, Bhavnagar – 364 002, Gujarat, India (hereinafter referred to as '**CSIR-CSMCRI**', the expression which unless repugnant to context shall be deemed to include its successors, administers and executors) of the first part

AND

C.1.2 **Pangasinan State University**, having its registered office at Alvear St., Poblacion, Lingayen, 2401, Pangasinan – Philippines (hereinafter referred to as "PARTY"), (which expression shall, unless repugnant to the context or meaning thereof be deemed to include its successors, representative, administrator, executor & assign) of the second part.

C.2. PREAMBLE

C.2.1 Whereas CSIR-CSMCRI, as part of its core research activities, is engaged in research, design and development in the field of salt, marine chemicals, biosciences, chemical transformation, process engineering, environmental monitoring, separation science and analysis.

C.2.2 Whereas PARTY is engaged in the field of education institution that provides Diploma undergraduate, post graduate programs and Doctorate program with different specializations and research facilities in the domain of Science, Engineering, Management, Agriculture & Aquaculture.

C.2.3 Whereas all the background knowhow/ knowledge/ Intellectual Property (IP) created outside the scope of this MoU shall remain the property of the respective Party.

C.2.4 Whereas in an event of any joint IP being generated under this MoU, the terms and conditions thereof may be negotiated by way of separate agreement(s). Further, all the Joint IP

Figure 12. Portion of PSU-JAPAN Salt Center MOU

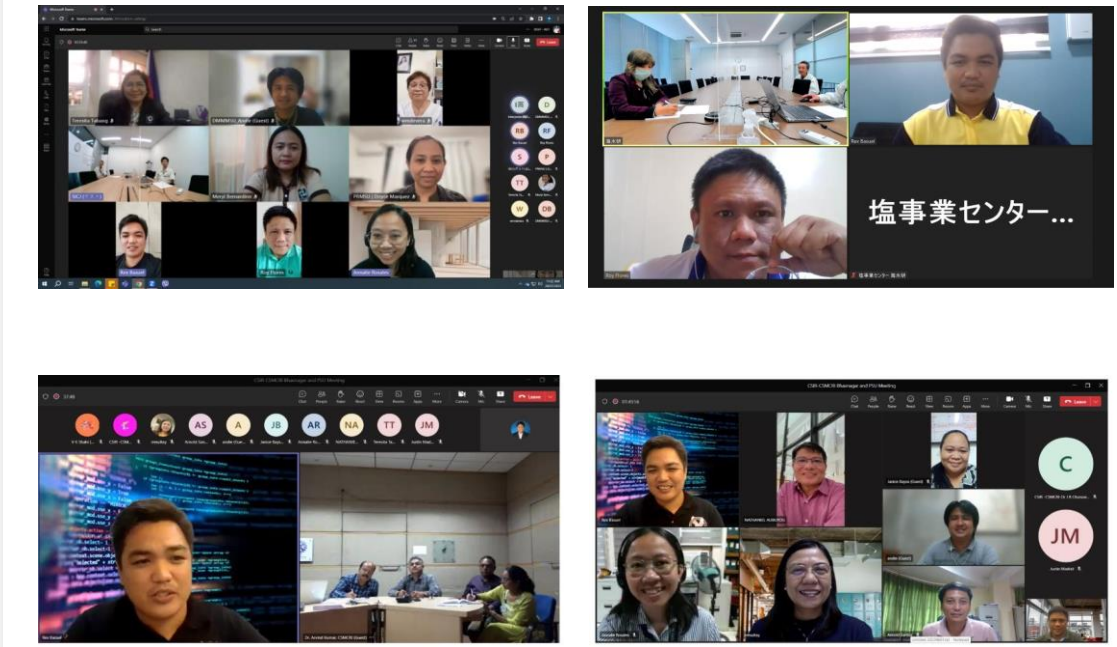
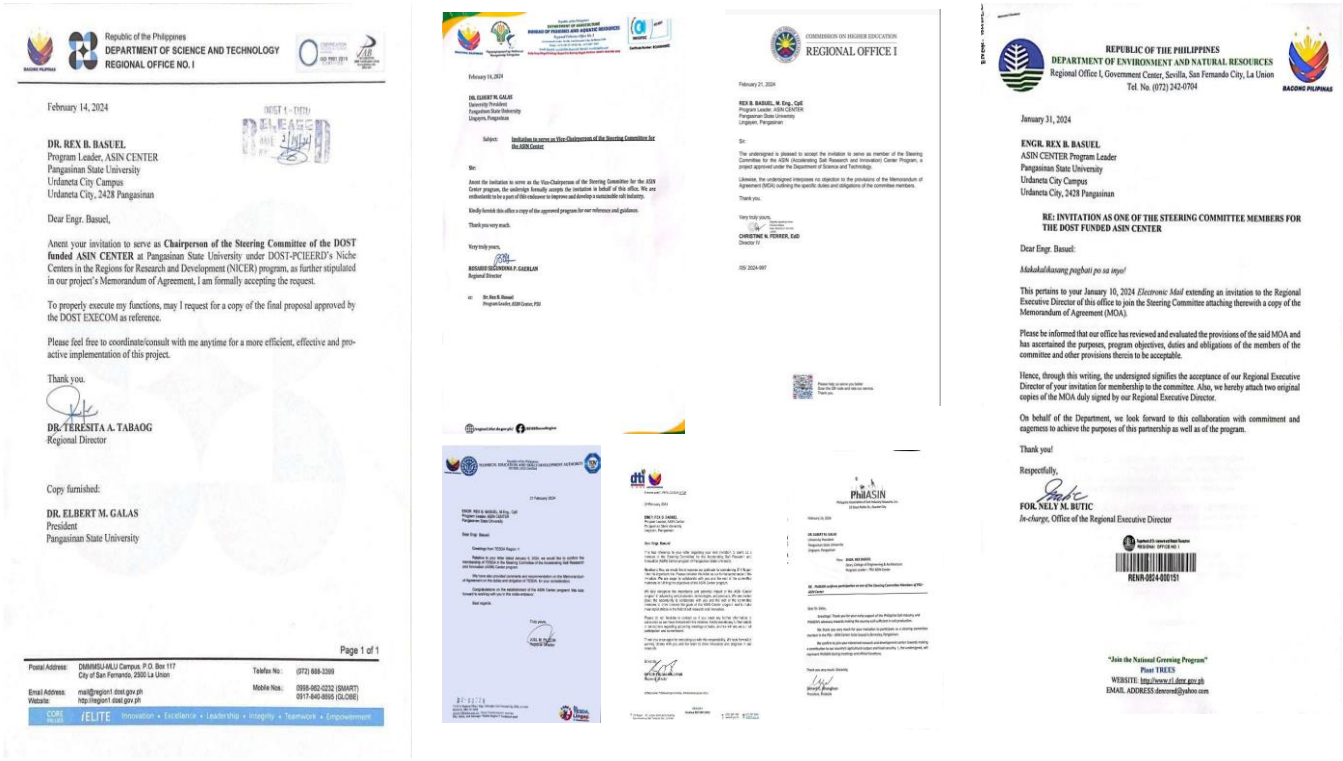


Figure 13. Meeting with Salt Center Japan



Republic of the Philippines
DEPARTMENT OF SCIENCE AND TECHNOLOGY
REGIONAL OFFICE NO. I

February 14, 2024

DR. REX B. BASUEL
Program Leader, ASIN CENTER
Pangasinan State University
Urdaneta City Campus
Urdaneta City, 2428 Pangasinan

Dear Engr. Basuel,

Anent your invitation to serve as **Chairperson of the Steering Committee of the DOST funded ASIN CENTER** at Pangasinan State University under DOST-PCIEERD's Niche Centers in the Regions for Research and Development (NICER) program, as further stipulated in our project's Memorandum of Agreement, I am formally accepting the request.

To properly execute my functions, may I request for a copy of the final proposal approved by the DOST EXECOM as reference.

Please feel free to coordinate/consult with me anytime for a more efficient, effective and pro-active implementation of this project.

Thank you.

DR. TERESITA A. TABAOG
Regional Director

Copy furnished:

DR. ELBERT M. GALAS
President
Pangasinan State University

Page 1 of 1

Postal Address: DMMMSU-MLU Campus, P.O. Box 117, City of San Fernando, 2500 La Union
Telefax No.: (072) 688-3309
Email Address: mail@region1.dost.gov.ph
Website: http://region1.dost.gov.ph
Mobile Nos.: 0956-982-0232 (SMART) 0917-840-8895 (GLOBE)

CORE VALUES /ELITE Innovation • Excellence • Leadership • Integrity • Teamwork • Empowerment

COMMISSION ON HIGHER EDUCATION
REGIONAL OFFICE I

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Regional Office I, Government Center, Sevilla, San Fernando City, La Union
Tel. No. (072) 242-0704

BAGONG PILIPINAS

January 31, 2024

ENGR. REX B. BASUEL
ASIN CENTER Program Leader
Pangasinan State University
Urdaneta City Campus
Urdaneta City, 2428 Pangasinan

RE: INVITATION AS ONE OF THE STEERING COMMITTEE MEMBERS FOR THE DOST FUNDED ASIN CENTER

Dear Engr. Basuel:

Makakaliksang pagbati po sa inyo!

This pertains to your January 10, 2024 *Electronic Mail* extending an invitation to the Regional Executive Director of this office to join the Steering Committee attaching therewith a copy of the Memorandum of Agreement (MOA).

Please be informed that our office has reviewed and evaluated the provisions of the said MOA and has ascertained the purposes, program objectives, duties and obligations of the members of the committee and other provisions therein to be acceptable.

Hence, through this writing, the undersigned signifies the acceptance of our Regional Executive Director of your invitation for membership to the committee. Also, we hereby attach two original copies of the MOA duly signed by our Regional Executive Director.

On behalf of the Department, we look forward to this collaboration with commitment and eagerness to achieve the purposes of this partnership as well as of the program.

Thank you!

Respectfully,

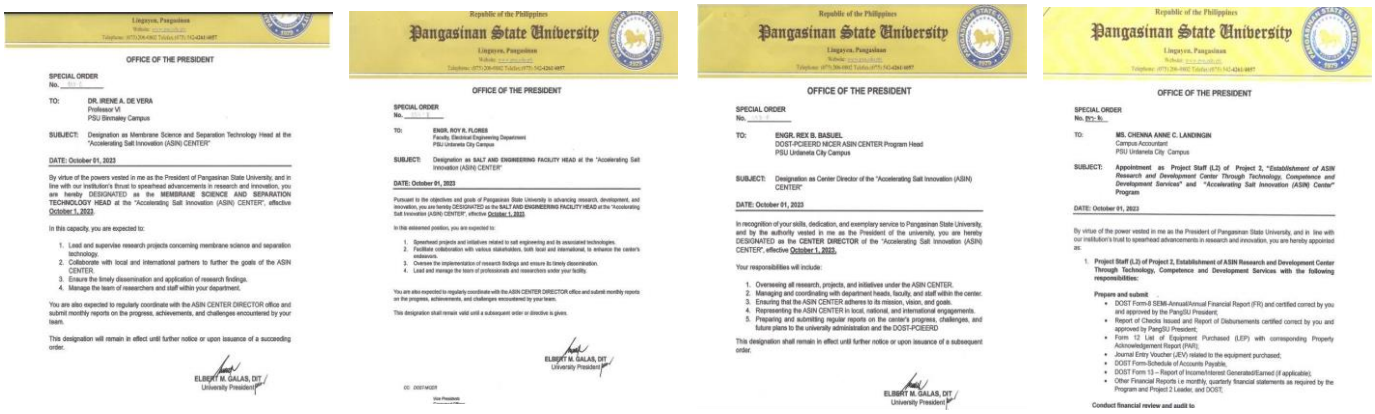
FOR. NELY M. BUTIC
In-charge, Office of the Regional Executive Director

"Join the National Greening Program"
Plant TREES
WEBSITE: http://www.r1.denr.gov.ph
EMAIL ADDRESS:denrowmd@yahoo.com

Figure 14. Acceptance Letter from ASIN Center Steering Committee Members

Objective 2

Figure 15. ASIN CENTER Organization Structure



OFFICE OF THE PRESIDENT

SPECIAL ORDER

TO: DR. IRENE A. DE VERA
Professor VI
PSU Binmaley Campus

SUBJECT: Designation as Membrane Science and Separation Technology Head at the "Accelerating Salt Innovation (ASIN) CENTER"

DATE: October 01, 2023

By virtue of the powers vested in me as the President of Pangasinan State University, and in line with our institution's thrust to spearhead advancements in research and innovation, you are hereby DESIGNATED as the MEMBRANE SCIENCE AND SEPARATION TECHNOLOGY HEAD at the "Accelerating Salt Innovation (ASIN) CENTER", effective October 1, 2023.

In this capacity, you are expected to:

1. Lead and supervise research projects concerning membrane science and separation technology.
2. Collaborate with local and international partners to further the goals of the ASIN CENTER.
3. Ensure the timely dissemination and application of research findings.
4. Manage the team of researchers and staff within your department.

You are also expected to regularly coordinate with the ASIN CENTER DIRECTOR office and submit monthly reports on the progress, achievements, and challenges encountered by your team.

This designation will remain in effect until further notice or upon issuance of a succeeding order.

ELISBET M. GALAS, DIT
University President

Republic of the Philippines
Pangasinan State University
Lingayen, Pangasinan

OFFICE OF THE PRESIDENT

SPECIAL ORDER

TO: ENGR. ROY R. FLORES
Faculty, Electrical Engineering Department
PSU Urdaneta City Campus

SUBJECT: Designation as SALT AND ENGINEERING FACILITY HEAD at the "Accelerating Salt Innovation (ASIN) CENTER"

DATE: October 01, 2023

Pursuant to the objectives and goals of Pangasinan State University in advancing research, development, and innovation, you are hereby DESIGNATED as the SALT AND ENGINEERING FACILITY HEAD at the "Accelerating Salt Innovation (ASIN) CENTER", effective October 1, 2023.

In this esteemed position, you are expected to:

1. Spearhead projects and initiatives related to salt engineering and its associated technologies.
2. Facilitate collaboration with various stakeholders, both local and international, to enhance the center's endeavors.
3. Oversee the implementation of research findings and ensure its timely dissemination.
4. Lead and manage the team of professionals and researchers under your facility.

You are also expected to regularly coordinate with the ASIN CENTER DIRECTOR office and submit monthly reports on the progress, achievements, and challenges encountered by your team.

This designation shall remain valid until a subsequent order or directive is given.

ELISBET M. GALAS, DIT
University President

CC: DOST-NICER

Republic of the Philippines
Pangasinan State University
Lingayen, Pangasinan

OFFICE OF THE PRESIDENT

SPECIAL ORDER

TO: ENGR. REX B. BASUEL
DOST-PCIEERD NICER ASIN CENTER Program Head
PSU Urdaneta City Campus

SUBJECT: Designation as Center Director of the "Accelerating Salt Innovation (ASIN) CENTER"

DATE: October 01, 2023

In recognition of your skills, dedication, and exemplary service to Pangasinan State University, and by the authority vested in me as the President of the university, you are hereby DESIGNATED as the CENTER DIRECTOR of the "Accelerating Salt Innovation (ASIN) CENTER", effective October 1, 2023.

Your responsibilities will include:

1. Overseeing all research, projects, and initiatives under the ASIN CENTER.
2. Managing and coordinating with department heads, faculty, and staff within the center.
3. Ensuring that the ASIN CENTER adheres to its mission, vision, and goals.
4. Representing the ASIN CENTER in local, national, and international engagements.
5. Preparing and submitting regular reports on the center's progress, challenges, and future plans to the university administration and the DOST-PCIEERD.

This designation shall remain in effect until further notice or upon issuance of a subsequent order.

ELISBET M. GALAS, DIT
University President

Republic of the Philippines
Pangasinan State University
Lingayen, Pangasinan

OFFICE OF THE PRESIDENT

SPECIAL ORDER

TO: MS. CHENNA ANNE C. LANDINGIN
Campus Accountant
PSU Urdaneta City Campus

SUBJECT: Appointment as Project Staff (L2) of Project 2, "*Establishment of ASIN Research and Development Center Through Technology, Competence and Development Services*" and "*Accelerating Salt Innovation (ASIN) Center*" Program

DATE: October 01, 2023

By virtue of the power vested in me as the President of Pangasinan State University, and in line with our institution's thrust to spearhead advancements in research and innovation, you are hereby appointed as:

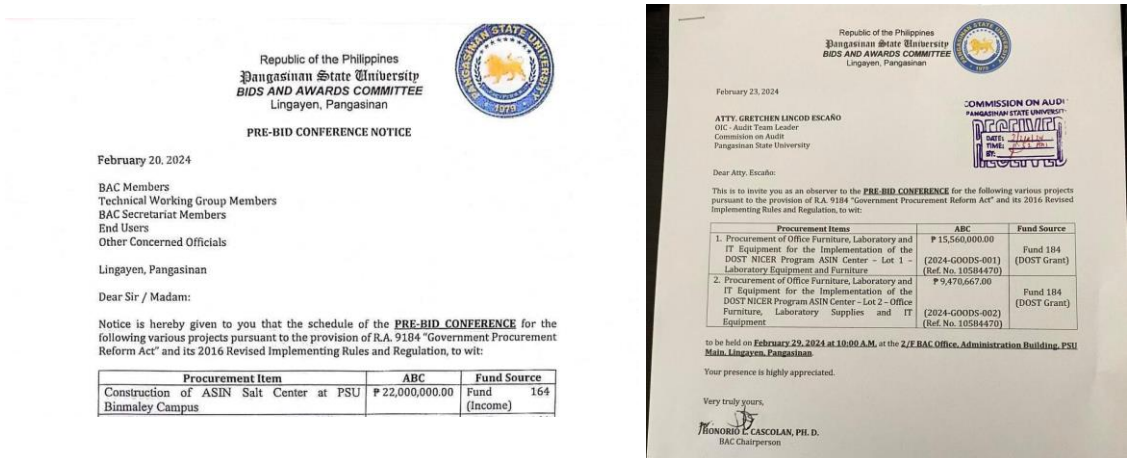
1. **Project Staff (L2) of Project 2, Establishment of ASIN Research and Development Center Through Technology, Competence and Development Services with the following responsibilities:**

Prepare and submit

- DOST Form-8 SEMI-Annual/Annual Financial Report (FR) and certified correct by you and approved by the PangSU President;
- Report of Checks Issued and Report of Disbursements certified correct by you and approved by PangSU President;
- Form 12 List of Equipment Purchased (LEP) with corresponding Property Acknowledgement Report (PAR);
- Journal Entry Voucher (JEV) related to the equipment purchased;
- DOST Form-Schedule of Accounts Payable;
- DOST Form 13 – Report of Income/Interest Generated/Earned (if applicable);
- Other Financial Reports i.e monthly, quarterly financial statements as required by the Program and Project 2 Leader, and DOST;

Conduct financial review and audit to

Figure 16. Special Order for the Designation



Republic of the Philippines
Pangasinan State University
BIDS AND AWARDS COMMITTEE
Lingayen, Pangasinan

PRE-BID CONFERENCE NOTICE

February 20, 2024

BAC Members
Technical Working Group Members
BAC Secretariat Members
End Users
Other Concerned Officials

Lingayen, Pangasinan

Dear Sir / Madam:

Notice is hereby given to you that the schedule of the **PRE-BID CONFERENCE** for the following various projects pursuant to the provision of R.A. 9184 "Government Procurement Reform Act" and its 2016 Revised Implementing Rules and Regulation, to wit:

Procurement Item	ABC	Fund Source
Construction of ASIN Salt Center at PSU Binmaley Campus	₱ 22,000,000.00	Fund 164 (Income)

Republic of the Philippines
Pangasinan State University
BIDS AND AWARDS COMMITTEE
Lingayen, Pangasinan

February 23, 2024

COMMISSION ON AUDIT
PANGASINAN STATE UNIVERSITY
RECEIVED
DATE:
TIME:
BY:

ATTY. GRETCHEN LINCOD ESCAÑO
OIC - Audit Team Leader
Commision on Audit
Pangasinan State University

Dear Atty. Escaño:

This is to invite you as an observer to the **PRE-BID CONFERENCE** for the following various projects pursuant to the provision of R.A. 9184 "Government Procurement Reform Act" and its 2016 Revised Implementing Rules and Regulation, to wit:

Procurement Items	ABC	Fund Source
1. Procurement of Office Furniture, Laboratory and IT Equipment for the Implementation of the DOST NICER Program ASIN Center – Lot 1 – Laboratory Equipment and Furniture	₱ 15,560,000.00 (2024-GOODS-001) (Ref. No. 10584470)	Fund 184 (DOST Grant)
2. Procurement of Office Furniture, Laboratory and IT Equipment for the Implementation of the DOST NICER Program ASIN Center – Lot 2 – Office Furniture, Laboratory Supplies and IT Equipment	₱ 9,470,667.00 (2024-GOODS-002) (Ref. No. 10584470)	Fund 184 (DOST Grant)

to be held on **February 29, 2024 at 10:00 A.M.** at the **2/F BAC Office, Administration Building, PSU Main, Lingayen, Pangasinan**.

Your presence is highly appreciated.

Very truly yours,

HONORIO C. CASCOLAN, PH. D.
BAC Chairperson

Figure 17. Pre-Bid Conference Schedule (Building and Equipment)

Figure 18. Building Design and Floor Plan (PSU Binmaley Campus)

The development of training programs on salt farming along with the establishment of the website (managed by Sir Gabriel Villanueva from PSU Urdaneta Campus IT Department) and social media promotion for salt initiative are also in progress.

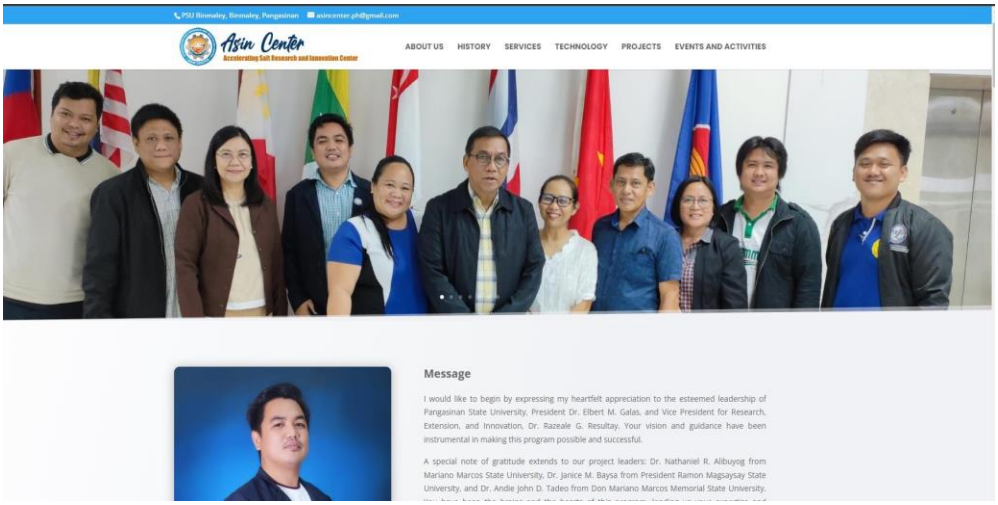


Figure 19. Overview of ASIN CENTER Website

Objective 3

The development of the two technologies namely, the integrated filtration and electrodialysis for cooked salt brine production and spray pipe and mesh net technology for seawater evaporation system for solar dried salt is currently in progress with both technologies in the design phase.

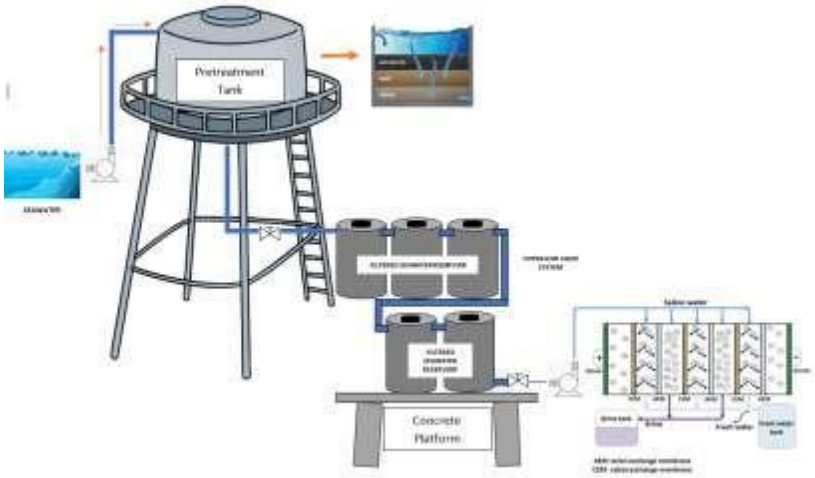


Figure 20. Diagram of the Integrated Filtration and Electrodialysis for Cooked Salt Brine Production

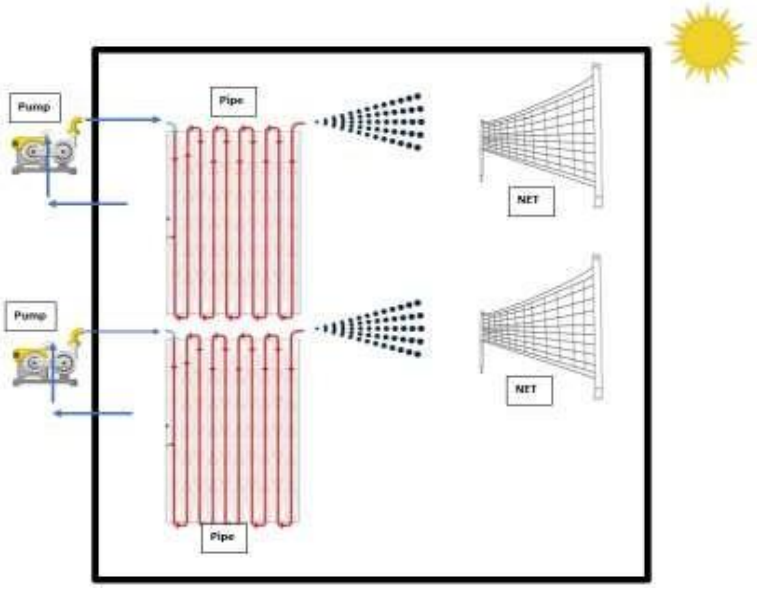


Figure 21. Diagram of Spray Pipe and Mesh Net Technology for Seawater Evaporation System for Solar Dried Salt

Objective 4

Seminar and training to farmers/producers/associations, LGUs, and academe related to the technologies to be developed is scheduled to take place in the second year of the project.

- OUTPUTS (6Ps)

6Ps Metrics	Expected Output	Actual Output
Publications	1 Papers for presentation to National/International symposiums/Conferences 1 research publications in peer-reviewed journals 1 IEC materials	**Output Y2:** Ongoing research papers for • Characterization and Optimization of Salt Production Processes and Products for Enhanced Sustainability and Quality in Northern Philippines • Material Flow Analysis of Salt Industry in the Philippines • Environmental Performance of Salt Industry in the Philippines
Patents/IP	2 Utility Model to be submitted/acquired after the project	Year 2
Products	• Integrated filtration and Ion-exchange membrane electrodialysis method for Cooked Salt • Spray Pipe and Net Method for Solar Evaporation System for Solar Salt • Documentary on salt production and best practices of India and Japan	Designing Stage Designing Stage Year 2
People services	• At least 2 trained personnel/researchers abroad on the field of salt production technologies, and sea water science. • At least 1 salt producer association trained on enhanced and new technologies on salt production. • Conducted at least 2 seminars to salt farmers, region 1 LGUs, and academe related to salt.	Year 2

	• At least 1 employed staff personnel in the laboratory.	
Places and Partnership	Established Asin R&D Center: Membrane Science and Separation Technology Facility Salt and Engineering Facility Analytical Laboratory Linkages and partnerships with MOU forged with: 1 International Institution (India and Japan Salt Center) DENR, TESDA, BFAR Pangasinan Province of Pangasinan Municipality of Infanta, Dasol, and Alaminos MMSU, DMMMSU, LYCEUM PhilASIN	**ASIN Center Building:** • Posted on Philgeps (20/02/2024) • Pre-Bid Feb. 27, 2024 **ASIN Center Equipment** • Posted on Philgeps (22/02/2024) • Pre-Bid Feb. 29, 2024 **Japan Y1:** PSU BOR Approved MOU PSU BOR Approved Travel **In Process:** International Affairs Service (IAS) CHED Approval DOST Approval VISA Application **India Y2:** PSU BOR Approved MOU **MOA/MOU:** **International:** PSU BOR Approved MOU • Japan & India **Local/Regional** PSU BOR Approved MOA • Steering Committee Acceptance Letters • BFAR1, CHED1, DENR1, DTI1, TESDA1, DOST1 **National:** PhilASIN
Policy	1 policy paper – quality control in Salt Production and Processing – This will be submitted to DOST and policymakers that filed bills for salt revitalization.	Year 2

- POTENTIAL OUTCOMES

- Successfully forged partnership with a local enterprise, a national organization, and two esteemed international partners.
- Acquired knowledge on the best practices in the fields of desalination and salt production research.
- Trained and capacitated five highly skilled and proficient project members.
- Developed two cutting-edge salt production technologies – Integrated Microfiltration and Desalination System and Spray Pipe and Net Method for Solar Evaporation System.
- Established and fully operationalized the cutting-edge Asin R&D Center, with its facilities.
- Developed and seamlessly executed the short-term courses and impactful training initiatives on salt farming.
- Established significant collaborative endeavors by solidifying memoranda of understanding (MOU).
- Successfully facilitated and delivered educational workshops, seminars, and training sessions.

- POTENTIAL IMPACTS (2Is)

Social Impact:

- A cutting-edge research facility would have been established in the Philippines, catering to the research community's needs, facilitating advanced studies, and fostering innovation in salt production.
- Specialized courses and training programs would have been developed with the objective of enriching the knowledge and expertise of salt farming communities. These initiatives would also seek to instill a passion for salt farming among future generations of farmers.

Economic Impact:

SOLAR DRIED AND COOKED SALT METHOD:

CURRENT LOCAL SALT:
Local solar salt sells for **P4.00 to P6.00 per kg**. or **P4,000.00** to **P6,000.00/MT** (**1MT = 1,000kg)** at the **FARM GATE** level.

Total local salt production is estimated at **123,000 MT per year** during an El Nino year.

1 hectare of evaporators and salt crystallizers = **45 MT per season**

45 MT x P6,000.00 / MT = P 270,000.00 per year

CURRENT IMPORTED SALT:

Imported salt from Australia is priced between **US$55.00 to $60.00 CNF per MT**, and has a landed cost (including arrastre and stevedoring, port charges) of **P3,600.00 up to P4,000.00/MT**

PhilASIN president **Mr. Gerard Khonghun** said that the Philippines imported **628,500 metric tons,** or equivalent to **92 percent** of the country's salt requirements in **2019 and 2022.**

628,500 MT x P6,000.00/MT = P 3,771,000,000.00 (3.8771B) per year of imported salt.

Cooked Salt (Refine and Iodized):

Current Cooked Salt Production and Expenses **(JM Salt Manufacturer – Infanta Pangasinan)**
Current Furnace **= 25 units the biggest Salt Cooked Producer in Philippines**
Gross (Approximately) per year **= 14,400bag x P 600 = P8,640,000.00 per year (45kg/bag)**

Expenses:

Particular	Quantity	Unit Cost	Total Actual Cost/Year
Imported Australian Salt	12,240 bags	320.00	4,014,720.00
Rice Husk	14,400 bags	210.00	3,024,000.00
Labor (Salt Workers Salary per bag of harvested salt)	14,400 bags	45.00	648,000.00
Electricity (12 months)			18,000.00
Diesel (water pump) – 12 months			38,400.00
TOTAL EXPENSES – 74%			**7,887,120.00**
NET (per year) -26%			**752,880.00**

After **5 years** of Project Implementation:

Strategies: Ion Exchange Membrane Method (Brine Concentrator) for Cooked Salt, Salt production research and development, policy, and Marketing.

Target furnaces increase = **25 New Furnaces**
Target Importation Reduction = **50% = P4,014,720.00 x 50**% = P2,007,360.00, cooked salt farmers can save P2,007,360.00 per year and could reduce the importation of Australian Salt by **50%.**

Return of Investment

Investors in salt farms and job creation.
New investors in salt farm operations will provide working capital, management, labor force and integrate technologies and knowledge from Asin R&D Center.

Each salt farm will directly employ about **2 technology expert workers per hectare**. This means at **30 hectares**; the salt industry will create **60 new jobs**. For the cooked salt, **2 technology**

expert salt workers per 5 furnaces. Thus, for the additional 25 new furnaces could create **additional 10 new jobs**. Each salt farm job will create another upstream or downstream job for suppliers of materials, equipment, logistics and transport services.

Employment Generation:

At the end of the project, expert technicians will be needed in the field of reverse osmosis which is the new method adopted and used by salt farmers to produce salt. The PSU will also hire personnel, laboratory technicians, chemists, and membrane engineers in the centers.

Risk Management Plan:

To ensure that the project will be implemented properly and to attend the target outputs, close coordination will be done with concerned agencies including the LGU, salt farmer and operators, BFAR, DOST, DENR and other agencies as deemed necessary. Likewise, capacity building on the operation of salterns and use of equipment that will be procured will be done to train the project staff and research staff that will be hired by the project. The training on the use of equipment will be part of the package of procuring the needed equipment. Moreover, S&T consultants will be tapped by the project to help and guide the researchers to undertake the project and set directions to meet the expected output of the project and the program as a whole.

Other gaps that were identified would be the slow procurement of needed equipment for the project. To address this, a project will be assigned to closely coordinate with the Bids and Awards Committee of the University. Advance preparation of procurement papers will also be done to ensure that needed equipment will be available when they are needed.

Sustainability:

The center will hire a full-time center manager, responsible for overseeing the entire operation. Additionally, research assistant and technical personnel proficient in utilizing all laboratory equipment will be employed. The facility will be maintained by a team of three experts and knowledgeable faculty members, supplemented by student assistants or interns from our institution and other universities.

The Asin R&D Center can achieve sustainability through analytical and testing fees to its Analytical Laboratory by carefully establishing competitive pricing structures that balance the costs of operation, equipment maintenance, and staff salaries, while also ensuring the fees are perceived as reasonable and justifiable by the target clientele in order to maintain a steady stream of clients and revenue. Moreover, the center can ensure long-term sustainability through commercialized products and technical services by strategically aligning its research with market demands, fostering industry collaborations, protecting intellectual property, and effectively marketing and scaling its innovations.

The center can boost its long-term sustainability by establishing strategic partnerships with government and commercial institutions, leveraging their resources and networks, expertise and experience, and funding opportunities to foster collaborative research, secure grants and contracts, drive innovation, improve profits, and become more socially responsible. More importantly, the institutionalized budget for the center will be proposed to the university and the Board of Regents to ensure that the center remains funded; the center will uphold this by optimizing this resource allocation and demonstrating the value and impact of its research outputs to stakeholders.

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I. APPENDICES

II. PROBLEMS

- Difficult to find qualified personnel.
- Issues in equipment specifications.
- Delay in the launching of the ASIN Center due to the availability of invitees and construction of the center building.
- Other salt producers specifically in Pasuquin, Iloco Norte are resistant to host an interview and provide data on salt.

III. RAW DATA

IV. ATTACHMENTS

i. DOST Form No. 8 Semi-Annual Financial Report
ii. DOST Form No. 11 List of Personnel Involved
iii. DOST Form No. 12 List of Equipment Purchased (include the PAR)