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RESEARCH ARTICLE

Status of the Salt Industry in the Philippines: Production, Challenges, and Opportunities

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ABSTRACT

Despite being archipelagic, the Philippines heavily relies on salt imports to meet its annual demand. There is a dearth of literature on the country's salt industry, including verified production data, current practices, and factors affecting declining domestic production. This paper seeks to bridge these knowledge gaps, generating baseline data to provide applicable policy direction and sustainable development strategies for the Philippine salt industry. Contrary to the industry report, local salt production is estimated at 114,623.29 MT, or 16.78% of the country's annual salt requirement. Occidental Mindoro is the biggest salt-producing province, with a 57.43% share in production. A myriad of factors has contributed to the decline in domestic production, such as failure to adapt to the changes brought by climate change, passage of ASIN Law, profitable land-use conversion, market competition, and stringent food safety standards and product quality requirements. Moreover, limited government policies that can be associated with the lack of agency tasked to oversee the industry, unattractive business environment, and limited access to government support services have pushed local salt producers into obscurity. The labor-intensive and seasonal production, unreasonable labor practices, and small economic returns have steered the growing disinterest among younger generations, which may indicate a total demise of the industry in the long run. The country should maximize its inherent natural advantages to scale up domestic salt production and lower importation. This could be done by institutionalizing an orchestrated approach to set forth holistic solutions to the multifaceted challenges for the sustainable development of the Philippine salt industry.

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1. INTRODUCTION

The Philippines had a thriving salt industry at the height of production in the 1990s. Nearly 85% of the country's annual salt requirement was sourced locally, particularly in the provinces of Bulacan, Pangasinan, Occidental Mindoro, and Cavite (Francisco et al. 2022). The importance of salt can never be overemphasized due to its varied application. However, despite the industry's huge potential because of its universal need, this once vibrant undertaking dwindled to the brink of extinction. The domestic salt production currently falls short of meeting the total demand of 683,000 MT (De Leon 2022). This deficiency has led to an increase in salt imports. According to the industry report, which has been widely published in various news outlets, locally produced salt constitutes only 7% of the country's annual demand, while the remaining 93% is imported from countries such as Australia and China (Moran 2018; Chanco 2022; Santos 2022).

Heavy importation has taken its toll on local producers as the price of locally produced salt sunk to its lowest when cheap imported salt penetrated and flooded the Philippine markets. Most local producers struggled to keep their businesses, prompting them to downsize or cease operations (Castañeda 2003). This has resulted in loss of livelihood, dollars lost due to importation, and increased vulnerability to food supply chain disruptions. Dependence on importation

may also jeopardize salt-dependent enterprises such as fish processing, coconut, food, and other industries (Tan et al. 2022).

The Philippines can use its inherent natural advantages to increase domestic salt production, lower importation, and create more opportunities for local enterprises. The country ranks fifth among countries with the longest coastline of 36,289 km and first in the highest coastline-to-land area ratio, a substantial resource base for salt production (Delos Reyes et al. 2021). Given that the Philippines has a huge potential for expanding salt production with its vast shoreline, the government should undertake immediate steps to revitalize the industry by addressing policy gaps, strengthening technological and market capabilities, and providing necessary support services to the salt industry stakeholders.

To date, there is a dearth of literature concerning the Philippine salt industry, including validated data on the volume of salt production, existing salt production practices, and critical issues or factors contributing to the decline in domestic production. This paper primarily aims to fill in existing information gaps and generate baseline data with its outputs discerned to provide applicable policy direction, management interventions, or strategies for the sustainable development of the salt industry. In-depth analysis and understanding of the current situation at the grassroots level and determination of the strengths and weaknesses of the industry are imperative to set forth holistic solutions to the multifaceted challenges of the salt industry. This will guide the policymakers, regulatory agencies, and other stakeholders in formulating targeted area- or process-specific programs to develop and strengthen the local salt industry and ensure sustainable and inclusive growth among its stakeholders.

2. MATERIALS AND METHODS

2.1 Study areas and selection of respondents

The study covered all provinces in the Philippines engaged in salt production (Figures 1-3). The registry of salt producers was requested from BFAR Regional Fisheries Offices (BFAR RFOs), Department of Trade and Industry (DTI), and Local Government Units (LGUs). Prior to the actual survey interview, area assessment and Key Informant Interview (KII) with selected BFAR RFOs and LGUs were conducted to validate the consolidated lists. A complete enumeration was carried out to estimate the actual production volume. The key informants for the survey interview were either registered owners, caretakers, or salt farm workers who know the production process and the salt-making enterprise's inflow and outflow.

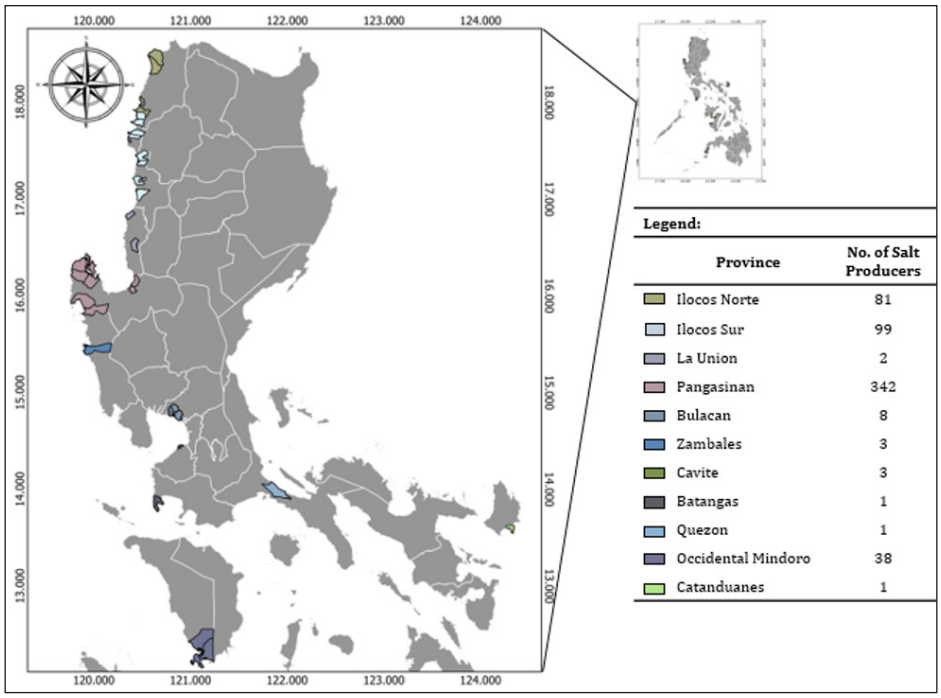

Figure 1. Salt-producing provinces in Luzon.

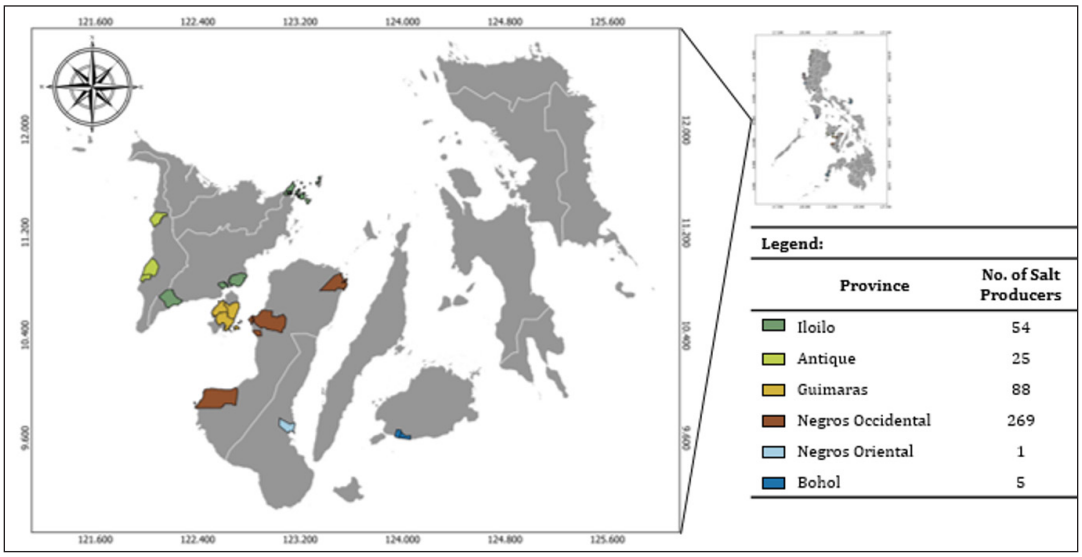

Figure 2. Salt-producing provinces in Visayas.

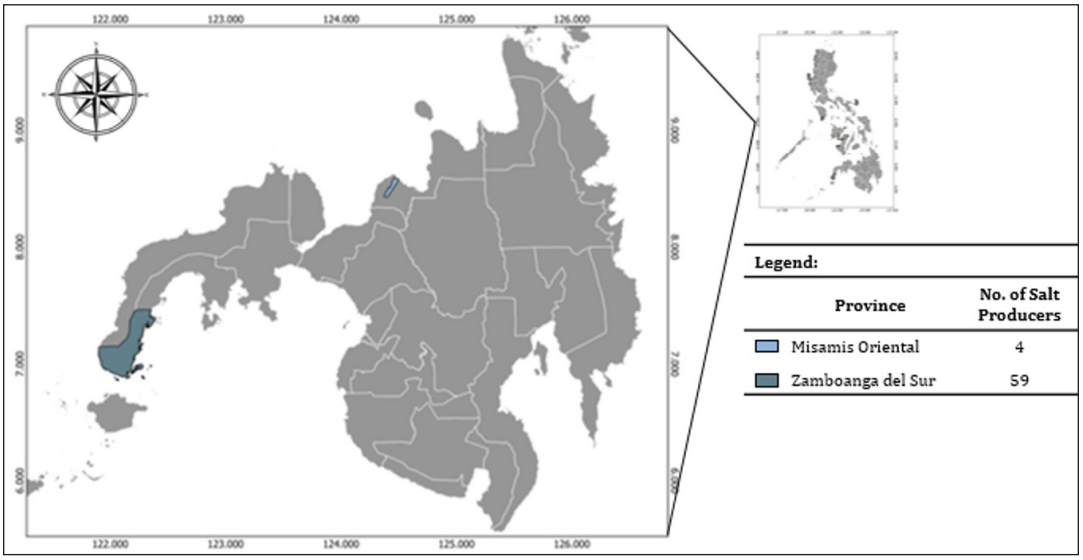

Figure 3. Salt-producing provinces in Mindanao.

2.2 Data collection

The data was collected from October to December 2022 to determine the current production status, identify critical issues, and develop policy recommendations and strategies for developing the salt industry. Primary data were obtained using pre-tested structured interview schedules and the KII guide. Focus Group Discussions (FGD) and KII were conducted with representatives from the BFAR RFOs, LGUs, local or national business organizations, and other government and non-government institutions directly engaged in the salt industry's production, management, regulation, and policy development.

A structured survey interview was carried out with 1084 salt producers to elicit first-hand and specific information from the respondents regarding salt-making practices, production volume, product marketing and distribution, issues, constraints, specific needs, and other relevant concerns. The respondents comprise approximately 90% of the total number of salt producers in the country. The uninterviewed salt producers predominantly consist of subsistence producers in Cuyo and Magsaysay, Palawan. Their

impact on local salt production is deemed minimal, with an estimated volume of 387 MT, as per LGU records. This constitutes merely 0.3% of the total production volume.

The research instrument or survey questionnaire was pre-tested among purposively selected salt producers prior to the actual data collection to ensure the questions were clear to the respondents and to minimize errors in recording responses. Triangulation was done to draw more depth into the participants' responses and ensure the validity and credibility of the findings.

2.3 Data processing and analysis

Data obtained from interviews were encoded and tabulated into spreadsheets. Both qualitative and quantitative approaches were utilized in this study. The qualitative research was part of identifying actors and their respective roles, relationships between them, activities and processes along the chain, as well as issues, challenges, and other concerns. On the other hand, descriptive statistics such as central tendency, frequency, and percentage measurements were included in the quantitative analysis.

3. RESULTS AND DISCUSSION

3.1 Estimated annual volume of salt production

The Philippines produces approximately 114,623.29 metric tons of salt annually, which accounts for around 16.78% of the country's total demand of 683,000 metric tons (De Leon 2022). The projected production volume is approximately 140% higher than the industry report suggests. Nevertheless, the Philippines has been grappling with La Niña for the last three years, causing a significant decrease in production. During this period, local salt production has plummeted to an annual volume of 89,673.87 metric tons, accounting for only 13.13% of the country's salt demand.

Table 1 highlights that Occidental Mindoro, situated in the MIMAROPA Region, dominates salt production, contributing to 57.43% of the local output. The province's strategic geographic location and favorable climate create an optimal environment for salt production. Occidental Mindoro has at least 38 salt producers, with approximately 1,400 hectares of salt farms. Of these, 920 ha operate under Fishpond Lease Agreements (FLAs), while 480 ha are privately owned. The production per hectare is 62.5 metric tons annually, subject to varying weather conditions. The majority of salt farms are located in the municipalities of San Jose and Magsaysay. As an island province, there is significant untapped potential for expanding salt production, with approximately 3,000 ha of FLAs available, yet only 920 ha are currently in use. In 2018, a multisectoral salt council was established to formulate a strategic roadmap for the salt industry. The province aspires to establish itself as the "Salt Capital of the Philippines," achieving both domestic and international standards through socially responsible and environmentally friendly salt production practices (Muyot and Asuncion 2022).

All provinces in Region I actively engage in salt production, collectively accounting for 31.93% of the nation's output. Pangasinan alone constitutes around 95% of this production. The largest salt farm in Pangasinan generates approximately 20,000 MT of salt, substantially contributing to the province's total annual output of around 60,000 MT. However, following its recent closure, the province's overall salt production has sharply decreased to 36,000 MT. The municipality of Dasol dominates the salt production at 39.35%, followed by Alaminos at 18.61%, Bani at 17.52%, Infanta at 14.90%, and minimal contribution of other municipalities such as Anda, Bolinao, Mangaldan, and San Fabian. Ilocos Norte and Ilocos Sur have low productivity despite the large number of salt producers. Ilocos is among the few that adopt the traditional leached brine boiling method of salt production (Francisco et al. 2022). Unlike the solar evaporation method, the process is more laborious while the economic return is relatively low. Most of the producers are either subsistence or small-scale that could yield 30–60 kg of salt for 8–12 hours of cooking. Due to the tedious and time-consuming process, production frequency is limited to 2–3 times a week, even less at times. Until the 1990s, the majority, if not all, of households in coastal communities in Ilocos were engaged in salt-making. The ASIN Law played a pivotal role in reshaping the salt industry landscape, significantly impacting businesses and market dynamics. Initially, salt producers supplied their products to neighboring regions such as CAR and Cagayan Valley. However, following the enforcement of the law, the salt market became confined within their municipalities due to the imperative of iodization compliance. Many salt producers, faced with intense market competition, unregulated prices, and the looming threat of sanctions for non-compliance, were compelled to cease operations and explore other sources of income. Meanwhile, in La Union, only a few producers are involved in salt production using the cooking method, resulting in minimal contribution

Table 1. Estimated annual volume of salt production.

Region	Province	Average Annual Volume of Salt Production (MT)						Annual Volume of Salt Production from 2020-2022 (MT)*					
		Solar Production in Ponds	Solar Production using PEP Sheets	Cooking Method	Artisanal Salt Production	TOTAL	%	Solar Production in Ponds	Solar Production using PEP Sheets	Cooking Method	Artisanal Salt Production	TOTAL	%
I	Ilocos Norte	-	-	1,454.67	134.47	1,589.14	1.39	-	-	822.06	93.23	915.29	1.02
	Ilocos Sur	-	-	53.28	208.87	262.15	0.23	-	-	41.25	119.57	160.82	0.18
	La Union	-	-	92.28	-	92.28	0.08	-	-	32.76	-	32.76	0.04
	Pangasinan	29,185.14	-	5,472.94	-	34,658.08	30.24	23,547.46	-	5,197.36	-	28,744.82	32.05
	Subtotal	**29,185.14**	**-**	**7,073.17**	**343.34**	**36,601.65**	**31.93**	**23,547.46**	**-**	**6,093.43**	**212.80**	**29,853.69**	**33.29**
III	Bulacan	4,600.00	-	-	-	4,600.00	4.01	2,835.99	-	-	-	2,835.99	3.16
	Zambales	-	-	106.02	-	106.02	0.09	-	-	106.02	-	106.02	0.12
	Subtotal	**4,600.00**	**-**	**106.02**	**-**	**4,706.02**	**4.11**	**2,835.99**	**-**	**106.02**	**-**	**2,942.01**	**3.28**
IV-A	Cavite	205.01	-	-	-	205.01	0.18	165.01	-	-	-	165.01	0.18
	Quezon	-	-	3.12	-	3.12	0.003	-	-	3.12	-	3.12	0.003
	Batangas	167.99	-	-	-	167.99	0.15	144.00	-	-	-	144.00	0.16
	Subtotal	**373.01**	**-**	**3.12**	**-**	**376.13**	**0.33**	**309.01**	**-**	**3.12**	**-**	**312.13**	**0.35**
IV-B	Occidental Mindoro	65,831.00	-	-	-	65,831.00	57.43	52,500.00	-	-	-	52,500.00	58.55
V	Catanduanes	-	0.90	-	-	0.90	0.00	-	-	-	-	-	-
VI	Iloilo	1,229.63	-	-	0.42	1,230.05	1.07	469.25	-	-	0.60	469.85	0.52
	Guimaras	-	1,095.75	-	0.41	1,096.16	0.96	-	675.80	-	-	675.80	0.75
	Antique	-	34.13	-	15.84	49.97	0.04	-	24.25	-	12.45	36.70	0.04
	Negros Occidental	-	3,070.93	-	-	3,070.93	2.68	-	1,854.72	-	-	1,854.72	2.07
	Subtotal	**1,229.63**	**4,200.81**	**-**	**16.67**	**5,447.11**	**4.75**	**469.25**	**2,554.77**	**-**	**13.05**	**3,037.07**	**3.39**
VII	Bohol	-	-	-	4.23	4.23	0.004	-	-	-	3.77	3.77	0.004
	Negros Oriental	7.00	-	-	-	7.00	0.01	-	-	-	-	-	-
	Subtotal	**7.00**	**-**	**-**	**4.23**	**11.23**	**0.01**	**-**	**-**	**-**	**3.77**	**3.77**	**0.004**
X	Misamis Oriental	-	1,649.25	-	-	1,649.25	1.44	-	1,025.20	-	-	1,025.20	1.14
TOTAL		**101,225.78**	**5,850.96**	**7,182.31**	**364.24**	**114,623.29**	**100.00**	**79,661.71**	**3,579.97**	**6,202.57**	**229.62**	**89,673.87**	**100.00**

*La Niña

from this sector.

Ranking third among the Philippines' leading salt-producing regions, Western Visayas boasts 436 producers spread across Negros Occidental, Guimaras, Iloilo, and Antique. This region constitutes 40.22% of the total salt producers interviewed, primarily comprised of subsistence and small-scale producers, contributing merely 4.75% to the local salt production. Dominating the production landscape, Negros Occidental leads with over half of the total output, followed by Iloilo, Guimaras, and Antique. Notably, Leganes in Iloilo once flourished as a prominent salt-making hub, transforming extensive swampy areas into fish ponds and salt beds. However, the industry now grapples with the adverse effects of climate change, as alterations in rainfall patterns, distribution, and rising sea levels have significantly impacted salt farms, resulting in declining producers.

In the 1980s, Central Luzon, specifically Bulacan province, supplied around 162,000 metric tons or 45% of the country's salt requirement (Castañeda 2003). However, current annual production has dwindled to 4,600 metric tons, with only three municipalities—Paombong, Malolos, and Bulakan—still actively involved in salt production. This decline is primarily attributed to the impact of rapid urbanization and the influx of cheap imported salt due to globalization. Given the upcoming reclamation and expansion projects along Manila Bay, the region's current 4.11% contribution is expected to diminish further. Moreover, industrial, commercial, and domestic pollution has rendered certain areas unsuitable for salt production.

Misamis Oriental exclusively partakes in salt production in the Northern Mindanao region, leveraging its long-sheltered coastlines. Within the town of Alubijid, salt production is not just perceived as a commercial endeavor; instead, it is embraced as a familial enterprise. The production volume correlates with the number of polyethylene plastic (PEP) sheet rolls utilized per season. The province yields a minimum of 1,649 MT annually, with the potential for further increase contingent upon prevailing weather conditions.

The CALABARZON region makes a minimal contribution to domestic salt production, with three provinces involved in salt-making—Cavite, Batangas, and Quezon. Cavite has a similar case to Bulacan, where salt importation and encroaching urbanization have led to the industry's decline. Once a major player alongside Bulacan, Pangasinan, and Occidental Mindoro, Cavite now hosts only three remaining salt farms in Noveleta and Kawit, producing approximately 205 metric tons annually. Meanwhile, Calatagan in Batangas has one enduring salt farm with 400 beds, each measuring 33.45 m^2 and yielding up to 168 metric tons yearly. Quezon, with its Type IV Climate and evenly distributed rainfall throughout the year, finds solar salt production unviable. In Atimonan, the Caridad Ilaya Multi-Purpose Cooperative has adopted the Department of Science and Technology – Industrial Technology Development Institute's (DOST-ITDI) technology for cooked salt production since 2018 to take advantage of the long coastlines in Lamon Bay. The cooperative produces around 624 kg of fine-grain salt monthly. Notably, Las Piñas, which serves as the gateway to CALABARZON, was once renowned for its first-class salt. The Irasan salt beds in Barangay Pulanglupa thrived until the 1990s, but land developments and pollution from industrial and domestic sewage draining into Manila Bay led to the demise of this once-thriving industry, leaving only memories of Las Piñas' salt-producing past.

Two provinces in Central Visayas, namely Negros Oriental and Bohol, have historically been involved in salt production. The Sycip Plantation Farmworker's Agrarian Cooperative in Manjuyod, Negros Oriental, was once a key player, producing approximately 30,600 metric tons of salt during its peak in the 1980s. Their primary market was dried fish processors in Negros Occidental. A significant decline in production was recorded from 2004 onwards, with annual output dropping to 7 MT due to the impacts of climate change. Unfortunately, due to unpredictable weather patterns, the cooperative had to halt operations in 2019 temporarily. *Asin Tibuok*, known for its dinosaur egg-like appearance, is a salt unique from Bohol made using a pre-Hispanic traditional "ash" salt-making method that is on the brink of extinction. Currently, only five *Asin Tibuok* production areas remain operational, sustaining their activities over the past three years. The production quantity of each processor is contingent on demand and raw material availability. Small-scale processors have an annual capacity of approximately 600–1000 pieces, while established manufacturing corporations can produce 1200–2000 pieces of *Asin Tibuok* per year. The overall production is estimated at 4.23 metric tons annually. The demand for this product predominantly arises from the export and tourist markets, as the trade of non-iodized salt is deemed illegal in the Philippines.

The sole association engaged in salt production within the Bicol Region ceased operation in 2020. Salt production in the province dates back to 2015 through the provision of salt production inputs such as PEP sheets from the Provincial Agriculture

Office (PAO) of Catanduanes. The production period spans from April to August, yielding an average monthly capacity of 100 kg. The PAO-Catanduanes has disclosed plans to revitalize the association for salt production, employing the cooking method of the DOST-ITDI.

Salt farms in Zamboanga City have become non-operational, with the first closure observed in 1995 at Brgy. Arena Blanco. Since 2006, three salt farms have ceased operations primarily due to unpredictable weather conditions. In 2019, the last salt farm situated in Brgy. Mampang also shut down, citing similar issues.

3.2 Production volume per method

The methods of salt production in the Philippines were classified into four namely, (1) solar evaporation method in ponds, (2) solar evaporation using PEP sheets, (3) cooking method, and (4) artisanal salt production (Figure 4). Solar evaporation using PEP sheets is the most widely practiced method in the country because of low capital investment. With regards to volume, solar production in ponds dominates at 101,227 MT or 88.31% of the total salt production. It was followed by the cooking method, solar salt production using PEP sheets, and artisanal salt production.

Salt production using the solar evaporation method in ponds is widely practiced in several provinces, including Pangasinan, Bulacan, Cavite, Batangas, Occidental Mindoro, Iloilo, and Negros Oriental. During summer, fishponds in these areas are converted into salt farms to maximize their use. The combination of high air and pond water temperature, along with strong summer winds, accelerates evaporation, leading to an increase in salinity. This makes these areas more suitable for salt production rather than fish culture. The typical size of each salt bed is 5.5 m x 6.0 m or 33.45 m2, with an average yield ranging from 30 kg to 50 kg per day, depending on weather conditions.

In certain provinces such as Catanduanes, Guimaras, Negros Occidental, and Misamis Oriental, salt producers employ Polyethylene Plastic (PEP) sheets in dried-up ponds or on shores to create salt beds. Each roll of plastic sheets can create several plots, varying numbers based on the bed size. For instance, in Catanduanes, the standard size is 4 m x 3 m, with a production capacity of 8.0 kg per bed. In Western Visayas, salt beds are typically 1.2 m x 1.5 m, allowing one roll of PEP sheets to generate 30–36 plots, each yielding an average of 1.5 kg of salt per day. Meanwhile, in Misamis Oriental, the standard salt bed size is 3 m x 1.2 m, and each roll of plastic sheets can produce 10–16 beds, yielding an average of 2.5 kg of

Figure 4. Methods of salt production in the Philippines.

salt per day. Subsistence and small-scale producers resort to PEP sheets because they are cheaper, readily available, and do not require earth-moving work.

Cooking is an alternative approach to salt production that is particularly suitable even during the rainy season. In contrast to the solar evaporation method, which yields granulated and off-white salt crystals, the cooked salt boasts a finer texture and pristine white color. This method has become a prominent industry in Infanta, Pangasinan, contributing to 76.20% of the cooked salt distributed in the Philippines. Producers in various provinces, including Ilocos Norte, Ilocos Sur, La Union, Zambales, and Quezon, also employ this method. The process involves evaporating salt water in large open vats, utilizing heat from cook stoves. Unlike the solar evaporation method, which undergoes various evaporation stages to increase salinity, the cooking method directly utilizes seawater. In addition, imported or locally produced rock salt, often of the lowest class, is introduced to create a fully saturated brine solution.

Artisanal salt refers to unrefined sea salt derived directly from the sea and extracted through indigenous practices. Local artisanal salts include Sugpo Asin from Pangasinan, Ilocos Sea Salt from Ilocos Norte and Ilocos Sur, Asin sa Buy-o from Zambales, Tultul from Guimaras, Budbud from Iloilo and Antique, and Asin Tibuok from Bohol. The manner of production can be very labor-intensive, intricate, and time-consuming, which translates to low productivity. Artisanal salt comprises only 0.3% of the total salt production in the Philippines.

3.3 Factors that contribute to the declining local salt production

The Philippine salt industry has been plagued by various issues and challenges that have led to dependency on imports to meet the country's increasing demand for salt. These were identified during round table discussions, consultation meetings, and FGD with various salt industry stakeholders and clustered under a common theme to capture the most common issues and constraints faced by salt producers per province, as presented in Table 2. It can be discerned from the table that some constraints are localized in a specific area, except climate change and limited support for the industry, which are common problems of salt producers.

3.3.1 Orphan industry

Unlike other key commodities, the salt industry faces significant challenges, primarily from its "orphan" sector classification, which lacks dedicated oversight. The absence of a specific agency to govern the salt industry leaves stakeholders without a clear avenue to voice concerns or seek support, exacerbating the industry's struggles.

A pivotal factor contributing to the industry's plight is the dearth of government policies and support services. Unlike commodities such as rice, sugar, and tobacco, the salt industry lacks protective laws or policies, leaving it vulnerable to external pressures. This vacuum in the regulatory framework can be directly linked to the industry's orphan status, highlighting the need for comprehensive legislation to guide and safeguard local salt stakeholders. The impact of this neglect is palpable, especially in provinces like Occidental Mindoro, a top producer, where Muyot and Asuncion (2022) noted a scarcity of local initiatives related to the salt industry. The absence of a clear direction, coupled with limited government intervention, hinders the industry's growth and development.

Financial constraints further compound the industry's challenges, as salt farm development demands substantial initial capital investment (Tan et al. 2022; Muyot and Asuncion 2022). Small-scale producers, often reliant on microfinance and informal lenders, face high interest rates without the safety net of collateral. Banks' reluctance to accept agricultural lands as collateral exacerbates the situation, limiting access to crucial funding. This financial bottleneck forces many producers to adhere to traditional, less efficient farming methods, hampering productivity and hindering growth prospects. The repercussions are profound, with some producers forced to downsize or cease operations due to insufficient capitalization, perpetuating a cycle of debts. The critical need for financial support and investment becomes apparent, underscoring the urgency for government intervention and policy formulation to uplift the salt industry.

Multiple house bills were proposed to address crucial challenges in the local salt industry, such as the longstanding absence of government policies and the need for a dedicated agency overseeing salt production. It was not until May 25, 2021, that the House of Representatives formally adopted House Resolution No. 00171. This resolution calls explicitly on various government agencies to categorize salt

Table 2. Percentage (%) share of common issues and constraints of salt producers per region and province

Region	Province	Climate Change	RA 8172	Profitable Land-Use Conversion	Market Competition	Changing Business Interest	High Rental Fees	Limited Supply of Materials	Orphan Industry	Food Safety Compliance	Limited R&D Studies	Aging Salt Producers	Labor Practices
I	Ilocos Norte	58.02	6.17	-	-	-	-	100.00	100.00	6.17	-	34.57	-
	Ilocos Sur	97.98	39.39	-	75.76	-	-	100.00	100.00	1.01	-	29.29	-
	La Union	0.00	0.00	-	-	-	-	100.00	100.00	-	-	50.00	-
	Pangasinan	89.47	2.92	-	-	-	12.28	100.00	100.00	10.53	0.29	24.56	19.88
III	Bulacan	100.00	-	100.00	-	100.00	-	100.00	100.00	25.00	-	25.00	-
	Zambales	-	-	-	-	-	-	100.00	100.00	-	-	66.67	-
IV-A	Cavite	100.00	-	100.00	-	100.00	-	100.00	100.00	-	-	100.00	-
	Quezon	-	100.00	-	-	-	-	100.00	100.00	-	-	-	-
	Batangas	100.00	-	-	-	-	-	100.00	100.00	-	-	-	-
IV-B	Occidental Mindoro	100.00	100.00	-	100.00	-	-	100.00	100.00	10.00	100.00	13.16	-
V	Catanduanes	100.00	-	-	-	-	-	100.00	100.00	-	-	0.00	-
VI	Iloilo	100.00	-	-	-	-	-	94.44	100.00	-	-	31.48	-
	Guimaras	100.00	-	-	-	-	19.32	9.09	100.00	12.50	-	21.59	-
	Antique	100.00	-	-	-	-	-	-	100.00	-	-	24.00	-
	Negros Occidental	100.00	-	-	-	-	10.04	-	100.00	14.87	-	26.02	-
VII	Bohol	100.00	-	-	-	-	-	-	100.00	100.00	-	60.00	-
	Negros Oriental	100.00	-	-	-	100.00	-	-	100.00	0.00	100.00	0.00	-
IX	Zamboanga del Sur	100.00	-	-	-	100.00	-	-	100.00	-	-	50.00	-
X	Misamis Oriental	100.00	96.61	-	-	-	96.61	-	100.00	45.76	-	18.64	-

producers as part of the Fisherfolk Sector, extending to them the same assistance and benefits provided to fisherfolk. Furthermore, several Senate and House bills with a unified objective of revitalizing the Philippine salt industry have been successfully passed. These legislative efforts are pivotal to providing the industry with the essential direction, support, and resilience it urgently requires.

3.3.2 Climate change

Salt production in the Philippines largely depends on the natural process of solar evaporation. The productivity of salt farms is greatly affected by climatological factors such as air temperature, humidity, rainfall, wind speed, and solar radiation, among others. Salt producers bear the brunt of changes in seasonal patterns due to climate change (Helmia and Sasaoka 2018; Roland et al. 2019). The country lies in the world's most cyclone-prone region which makes it highly vulnerable to the impacts of climate change, including sea level rise, increased frequency of extreme weather events, rising temperatures, and extreme rainfall. On average, 19-20 cyclones pass through the Philippines yearly, of which 7-9 make landfall (USAID 2017). Erratic weather patterns due to the occurrence of La Niña for the past three years dealt a strong blow to the salt industry. Sudden rains during summer and extended wet seasons have severe effects on salt production. Roughly 22% reduction in production volume was recorded from 2020-2022 due to La Niña.

Salt producers in Negros Oriental, Zamboanga City, and Catanduanes, which all belong to Type III and IV climates, respectively, have already ceased operation due to unpredictable weather patterns. The Type III climate is characterized by no pronounced rainy seasons and a relatively short dry season lasting only from one to three months, while Type IV climate has no dry season with rains evenly distributed throughout the year. Production areas in Leganes, Iloilo, and Bulacan are highly vulnerable to severe flooding brought by subsidence and rising sea levels, which led to the closure of a number of salt farms.

Salt production using the solar evaporation method is ideal only in provinces with Type 1 climate, such as Ilocos Norte, Ilocos Sur, La Union, Pangasinan, Zambales, Bataan, Occidental Mindoro, parts of Oriental Mindoro, Palawan, and Antique. The Type 1 climate is characterized by two pronounced seasons: dry from November to April and wet during the rest of the year. Despite being in a Type I climate, these provinces are not exempted from the worst manifestations of climate change. Climate predictability becomes harder for salt producers, making salt production a constant gamble among many of them (Francisco et al. 2022). The production cycle is narrowed down from 90 to 45–50 days a year. Apart from limiting the productivity of salt farms, heavy and excessive rains cause submergence or flooding of salt beds and damage to reservoirs and dikes, resulting in high repair and maintenance costs.

3.3.3 Limited availability of materials for salt production

Repair or upgrading of existing salt farms is beset by challenges such as shortage of essential materials, including clay tiles and wood planks, coupled with a deficiency in heavy equipment such as backhoes, bulldozers, tractors, dump trucks, and dredges for earth-moving works. This aligns with Tan et al. (2022) findings, indicating that the high cost of flooring materials is the primary constraint of salt producers in the Visayas. Clay tiles, crucial for salt bed flooring to prevent the salt from coming into contact with the ground during harvest, are increasingly scarce, often requiring sourcing from distant locations like Vigan, Ilocos Sur. The dwindling number of manufacturers has labeled this pottery industry as endangered. Repair or construction of salt beds becomes costly due to the limited availability of clay tiles. Each salt bed with a standard size of 5.5 x 6.0 m necessitates at least 750 kg of clay tiles. Despite having a service life of 30-50 years, their limited supply prompts some producers to opt for HDPE geomembrane as an affordable and readily available alternative for salt bed crystallizers.

In addition to clay tiles, wood planks are also an essential component of salt beds. These are used as salt bed division and brine confinement. *Gemelina* spp. is a preferred wood species as it is one of the most fast-growing plantation wood species. However, exposure to saltwater affects its durability, necessitating replacement every three years or sooner to avoid leakage and overflowing. A significant challenge for salt producers lies in the time-consuming permit process for cutting and transporting wood, adding to the overall turnaround time. The supplier handles permits for transporting wood from the plantation to the warehouse, while the buyer is responsible for permits to move wood from the warehouse to salt farms. According to the respondent, this entire procedure spans a minimum of 15 days to a month.

The expensive rental cost and limited availability of heavy equipment for earth moving works also restrict salt farm development as well as improvement and rehabilitation among salt producers. Salt farm development is usually carried out during the summer season. This season is also conducive for construction projects of both government and private entities. Salt farm development tends to be overshadowed, given the corrosive nature of saltwater, which accelerates the wear and tear of iron and steel components in heavy equipment, making them less readily accessible for such projects.

For cooking methods, the scarcity of fuel, such as rice hull and wood, poses a significant challenge, particularly for small to medium-scale producers. The availability of rice hulls as a free waste product has shifted due to the exploration of its potential as a sustainable energy resource. With an estimated annual production of two million tons in the Philippines, representing about five million BOE in energy, the demand for rice hulls has surged in various industries. The rising demand from sectors like the tobacco industry, feed mills, and rice mechanization has led to an unregulated increase in the price of rice hulls. This surge in cost presents a significant constraint for cooked salt producers, affecting their operational expenses. The high volume requirement by larger companies utilizing rice hulls as an energy resource exacerbates the challenges faced by small to medium-scale producers, limiting their access to this biomass. Furthermore, the environmental impact of biomass burning, including carbon emissions, adds another layer of concern. The carbon emissions from biomass burning not only contribute to climate change but also have local environmental impacts. The release of particulate matter, carbon monoxide, and other pollutants during combustion can degrade air quality, posing health risks to nearby communities. Balancing the demand for biomass with sustainable sourcing practices, coupled with the adoption of cleaner and more efficient cooking technologies, is crucial for developing an eco-friendly approach that minimizes the environmental footprint associated with salt production.

3.3.4 Aging population of salt producers

According to Francisco et al. (2022), one essential aspect of ensuring the longevity of salt production is the intergenerational transfer of knowledge, skills, and practice. While salt farming is treated as a family affair wherein all family members, including children, have their respective roles in the process, this is only seen as a stepping stone for the children to finish their studies and make a better living to move out of what has been regarded as a "poor man's activity."

Based on the socio-demographic profile of salt producers, only 4.61% belong to the age group 18–30, while 46–59 years old constitute 40.41% of the respondents interviewed. This indicates an aging population of salt producers that could threaten the industry's revival. The labor-intensive process and small economic return from salt production have greatly influenced the perspective of the younger generations towards salt-making. There is a growing disinterest among younger generations in taking over their family's salt-making enterprises as they opt to pursue professional careers in the cities. For this reason, the number of workforce in the salt industry is projected to drop at an alarming rate, and the long-time tradition of salt farming could be pushed into obscurity.

The rare varieties of artisanal salt are already on the brink of extinction. The aging population of the few remaining skilled artisans is one of the most cited reasons that could lead to the total demise of the ebbing craft. Generations of skilled artisans are slowly retiring, and no one wants to inherit the tradition because of the sheer amount of effort demanded by the process.

Addressing this challenge not only entails the intergenerational transfer of knowledge and skills, but this once lucrative undertaking should also be revived by building opportunities for value-creation through technological upgrades, infrastructure development, conformity to food safety standards, and mainstreaming of products in both local and international markets, among others. The government should leverage funding and resources to execute appropriate policies, initiatives, and strategies to develop, strengthen, and improve the salt industry and ensure sustainable and inclusive growth among stakeholders. Improving the viability of salt farming can change the image and perception of the youth towards this undertaking.

3.3.5 Passage of Republic Act No. 8172 (ASIN Law)

In 1995, Republic Act No. 8172, otherwise known as ASIN Law, was enacted to combat the high incidence of iodine deficiency in the country. The law requires all local producers of food-grade salt to iodize

the salt they produce, manufacture, import, trade, or distribute for human and animal consumption. Only industrial-grade salt intended for the treatment, processing, or manufacturing of non-food products is exempted from salt iodization. While the passage of the law has curbed iodine deficiency disorders in the country (Perlas et al. 2017), it has become a deterrent to the development of the salt industry.

Stringent sanctions were levied for law violations, yet the government has fallen short in providing essential support to salt producers and manufacturers, such as training and equipment. Most small-scale producers find themselves compelled to halt operations due to a lack of training, funds, or resources to comply with mandatory salt iodization. Consequently, some salt farms have been repurposed into lucrative ventures such as fishponds and residential and commercial properties. However, monitoring and adherence to the ASIN Law vary nationwide, depending on the region. In Western Visayas, for instance, the majority of the salt is traded as non-iodized, highlighting a significant gap in compliance even after law enforcement. Tan et al. (2022) note that regional trading continues to prioritize non-iodized salt due to higher demand. This may elucidate why the salt produced in the region does not extend its trade to nearby provinces.

The implementation of the ASIN Law had a profound impact, particularly in imposing market restrictions on non-iodized salt, including artisanal and gourmet varieties, ultimately leading to the industry's decline. The limitations on trading non-iodized salt within municipalities or province-wide created intense market competition, causing oversupply during peak seasons and a subsequent sharp decline in farm gate prices. Additionally, some traders exploited the situation by monopolizing non-iodized salt prices for further processing. Many salt farms were prompted to cease operation as salt production has become a seasonal, low-income enterprise characterized by high market competition and unregulated prices.

In efforts to comply with mandatory iodization, some producers and traders resorted to manual iodization to avoid product confiscation and penalties. However, the absence of specific procedures or guidelines for manual iodization resulted in variations among producers in terms of the ratio of water and fortificant powder, fortificant solution and salt, and mixing frequency, among others. The Rapid Test Kit (RTK) is the commonly used method to determine the iodine content of salt by adding two drops of the test solution on the salt surface and comparing the color with the chart included in the kit. If the tested salt turns purple, the iodized salt will be packed in sacks for distribution. Despite commendable efforts by producers to adhere to the law, the lack of standard procedures poses a risk of producing poor-quality iodized salt, as highlighted by the Nutrition Center of the Philippines (2010). Only a limited number of respondents, mostly large-scale producers, use iodizing machines due to the associated maintenance and operational costs. Some producers, albeit receiving support from government agencies in the form of iodizing machines, face challenges such as a lack of technical capacity and inputs needed for salt iodization, rendering these machines mostly non-operational.

The DOST-ITDI, through their i-SALT project, has developed salt processing equipment like the saturated brine feed reservoir, spin dryer, and iodizing machine in 2018 to help salt processors boost their production, improve salt quality, and comply with the requirements of mandatory iodization. The project's impact is further amplified through targeted training sessions in selected municipalities. These sessions cover iodization techniques and the use of WYD iodine checkers to empower salt producers with the tools and knowledge necessary for compliance. The initiative aligns with the government's efforts to enhance regulatory compliance, benefiting both salt producers and consumers.

3.3.6 High cost of land rental fees

Tenants comprise the majority of the respondents interviewed and allocated a substantial portion of their income to land rental fees. Payment typically takes the form of sharing agreements, determined by the overall yield at the end of the production season. There is no fixed rate for these sharing agreements. In provinces like Pangasinan and Misamis Oriental, the arrangement with landowners can range from 50-50, 60-40, or 65-35. Meanwhile, in Western Visayas, compensation is often provided in the form of finished products ranging between 2-5 and 8-11 sacks per roll of PEP sheets per season in Iloilo, Guimaras, and Negros Occidental, respectively. Salt farm development, including repair of ponds and dikes, whenever necessary, is the counterpart of the landowner. Regarding production inputs, agreements range from 50-50 when both tenant and landowner equally share costs and may shift to 60-40 or 65-35 if the landowner supplies materials for salt production.

These sharing arrangements lack a standard measure of value, meaning that the value of the products in exchange for the rent does not correspond to the actual cost of materials and land rental fees. It prevents tenants from gaining extra income during peak season and limits their capacity to invest in product quality or productivity-enhancing methods and technologies. However, most of the tenants do not have the required resources to own or lease land from the government suitable for salt production and, therefore, choose to resort to this type of trading.

Another problem is the need for a lease agreement between the tenants and land owner that clearly defines the terms and conditions of the agreement such as lease duration, termination, rental fee, and payment schemes, as well as the expectations and obligations of both parties. Disputes are, therefore, bound to occur under a verbal agreement. The land owner could terminate the agreement anytime without prior notice. This inculcates fear among the tenants because they can be evicted from the land they have cultivated all their lives, thus taking away their only source of livelihood. Some of them have taken over the place of their deceased parent as tenants of the land.

3.3.7 Market competition due to GATT-WTO tariff reduction

The Philippines was among the 111 countries that signed the Uruguay Final Act at Marrakesh, Morocco, on April 15, 1994. Under the terms of the Uruguay Round Agreement, which took effect on January 1, 1995, the GATT will be known as the World Trade Organization (WTO). The Senate ratified and concurred in the Agreement establishing the WTO on December 14, 1994, taking into account the four fundamental principles of the GATT, namely, non-discrimination, transparency, negotiated exchange of trade concessions, and special and different treatment of developing countries. The treaty aims to minimize barriers to international trade by eliminating or reducing quotas, tariffs, and subsidies. It was intended to boost economic recovery after World War II (Majaski 2023).

The salt industry faced a significant downturn as the country commenced importing cheaper industrial-grade salt from India and the Middle East in the same year. This influx has impacted the local salt industry, making it challenging for domestically produced food-grade salt to compete on price. The imported industrial-grade salt, exempted from mandatory iodization, is remarkably inexpensive compared to locally produced alternatives. Merchants have devised a strategy to blend locally produced sea salt with imported industrial-grade salt. This process aims to produce food-grade iodized salt, allowing for a more cost-effective final product. Despite the inherent costs involved in reprocessing industrial-grade salt into a food-grade variant, factoring in the high cost of logistics and other inputs, the price of the finished product remains considerably lower than that of locally produced salt. A critical aspect contributing to the affordability of imported salt is the tariff structure. According to the ASEAN Harmonized Tariff Nomenclature (AHTN) 2017, the applicable tariff rates for salt are notably low, standing at 1%. Furthermore, for member countries under the ASEAN Trade in Goods Agreement (ATIGA), the tariff rate is reduced to 0%. This favorable tariff environment significantly contributes to the low cost of imported salt, further accentuating its competitiveness in the market.

As trading and prices are controlled by a few major salt traders who are also importers, salt producers are left with no choice but to sell their products at very low prices, particularly during peak season, to compete with imported salt in the market. Moreover, the challenging archipelagic geography of the Philippines makes marketing in neighboring provinces financially impractical for small-scale producers due to high logistics costs. Consequently, these producers heavily depend on local traders or buyers to facilitate the marketing of their salt.

As respondents in Ilocos Sur recounted, nearly all coastal municipalities were engaged in salt production in the 1990s. However, high market competition due to the influx of imported salt has exacerbated the implementation of the ASIN Law, which led to the closure of most salt-making facilities in the province. In response to monopolistic trading issues, salt producers in Occidental Mindoro established a cooperative in 2010. Before its inception, big traders dictated the salt farm gate price in Mindoro to PHP 0.80–1.00 per kilogram. Producers within the cooperative collaboratively set a price aligned with actual production costs and product quality, urging non-members to unite on pricing. Following negotiations with traders, the market price of salt increased to PHP 2.50–3.00 per kilogram. This underscores the significance of forming a cooperative, not only for improved access to government support services but also for facilitating easier and cost-effective business transactions and establishing close linkage to suppliers, customers, services, and competitors. It concurs with the findings of Tan et al. (2022) that

forming an association has an added advantage through increased bargaining power for higher prices, enhanced market positioning, and improved access to capital resulting from reduced loan processing costs.

3.3.8 Labor practices

Salt farming is a family-based enterprise. Medium to large-scale salt producers employ contractors to manage the salt beds from pond preparation to harvest. Instead of hiring helpers, contractors usually brought their families close to the salt farms, especially during the harvest season. The usual allocation is 25 to 40 salt beds per family, while the average number of household members working in the salt farm is four. In Luzon alone, there are approximately 63,000 salt beds, meaning that between 1,500 and 2,500 families or 6,000 and 10,000 individuals rely on the salt industry as a source of livelihood. It does not consider the other workers who help in the production process, including helpers, truck drivers, baggers, and dock workers.

Salt farm workers have neither job security nor benefits that labor laws guarantee to workers in other industries. The parties do not constitute a binding contractual commitment that defines the terms and conditions of the agreement, such as contract duration, grounds for termination, and compensation, as well as the responsibilities and obligations of each party. This means that salt farm workers can be replaced anytime without prior notice, regardless of how long they have worked in the salt farms, without proper compensation. It inculcates fear among the workers because their primary source of livelihood could be taken away from them anytime.

3.3.9 Food safety compliance

Salt production and storage facilities in some areas do not comply with regulatory standards in terms of food safety and sanitation. Salt beds are often prone to contamination due to exposure to animal wastes. The majority of salt producers have no centralized and GMP-compliant warehouse for the storage of salt. Storage facilities are usually made of light materials such as lumber, bamboo or sawali walls, and roofs either made of nipa or galvanized roof, with or without flooring. Due to a lack of financial capital, others construct a makeshift warehouse made of bamboo walls and loose flooring made of leaves or net, with only tarpaulin roofing. There are also several salt producers who utilize open spaces near the production areas due to the absence of storage facilities. Concrete warehouses that comply with GMP requirements are limited to medium and large-scale salt producers only. According to Muyot and Asuncion (2022), warehouse facilities are vital for storing newly harvested salt to let the moisture dissipate and protect the product from quality deteriorating factors before it is marketed during the lean months. This will result in a higher profit for salt producers as high-quality salt commands premium prices in the market.

In terms of salt iodization practices, salt producers generally iodize manually, with no standard procedures or guidelines being followed. They either mix manually using bare hands or shovel or use a plastic sprayer, pressurized garden sprayer, or plastic hand spray bottle to spray the fortificant solution during salt iodization. Since there is no approved guideline for manual iodization, the process varies per producer in terms of the ratio of fortificant solution and salt as well as mixing method and frequency. The Nutrition Center of the Philippines (2010) also reported that subsistence to small-scale producers employ other non-standardized techniques of salt iodization. These include manual mixing of fortificant powder and salt, manual sprinkling of the fortificant solution to salt, sprinkling of fortificant powder to the concentrated brine while being cooked, and spraying the fortificant solution to coarse salt then grind the iodized salt into finer granules, among others. A lack of standard procedure for salt iodization may yield non-homogenized and poor-quality iodized salt.

Testing of the iodized salt at the manufacturer's level is required to determine if it conforms with the FDA standard. Two methods are used to determine salt's iodine content: the RTK and WYD iodine checker or the standard titration method (Llaguno and Palma 2017). However, the majority are using the RTK, while the WYD iodine checker is common to medium and large establishments. It was observed that producers who are using the RTK method usually drop the test solution directly on top of the iodized salt in one area only instead of randomly collecting samples. The said practice does not assure that products are entirely homogenized. Moreover, salt iodization occurs in the cooking area; hence, iodized salt is exposed to cooking residues. Some producers of iodized salt do not have an appropriate warehouse for storing the finished product. Iodized salt placed in sacks is usually kept in open yards with galvanized roofing or covered with canvas.

According to the FDA Circular No. 2013-007, the recommended iodization level in the Philippines

is between 30 to 70 ppm across distribution channels, whether in bulk or retail, imported or local. However, the UNICEF and WHO recommend a narrower range of 15–40 ppm. Harmonizing national regulations with international standards can enhance global cooperation in combating iodine deficiency disorders. Nonetheless, thorough scientific assessments and public health considerations are crucial for determining the most appropriate iodization levels, considering regional variations in dietary patterns and iodine requirements. Reviewing RA 8172 in light of UNICEF and WHO recommendations, the Philippines can contribute to a more unified and evidence-based approach to salt iodization globally.

Furthermore, the need for GMP and SSOP training among salt farm workers significantly impacts various aspects of salt production, encompassing handling, processing, storage, marketing, and distribution. This absence of training not only hinders the implementation of standardized procedures but also poses a heightened risk to the overall quality and safety of the salt produced. Establishing comprehensive training programs would not only enhance worker competence but also contribute to the adherence to GMP and SSOP, thereby fostering improved practices throughout the salt production chain.

3.3.10 Limited research and development studies on salt production

There are no standardized methods for salt production. Lack of standard design, process, and method for salt production and reliance on age-old traditional salt-making practices affect the productivity of salt farms in terms of yield and product quality. In the solar evaporation method, different types of lining for salt crystallization are being used, such as clay tiles, bricks, HDPE geomembrane, PEP sheets that can either be transparent or black, cement or cement mixed with apog, bricks, stones, and ceramic tiles. Each type of lining differs in production yield, cost and efficiency, and product quality. There is neither a standard size nor layout for evaporating ponds and crystallizing beds nor the required salinity for each production stage. For the cooking method, there is no standard process for the preparation of brine solution, such as the ratio of raw salt to the water, mixing duration, cooking duration, as well as the quantity and type of fuel used. The production yield in both solar evaporation and cooking methods is highly dependent on salinity as they are directly proportional. However, there is no standard process for determining the salinity of seawater for salt production. The use of senses such as taste and visual inspection to measure the saltiness and turbidity of water cannot give accurate results and can be subjective. Without a hydrometer, salt producers trust their instincts when measuring brine salinity using floatation tests using twigs, wood, bamboo, bamboo leaves, and egg or merely a sense of taste and touch. Establishing a standardized method of salt production that applies to all salt producers is necessary to maximize the productivity of salt farms and produce high-quality and excellent salt at the lowest possible cost.

The limited research and development studies on salt production in the Philippines underscore its status as a non-priority commodity for research funding agencies. One contributing factor is the absence of a dedicated agency overseeing the salt sector, leading to a lack of strategic focus and investment. Research endeavors have been scant, with funding agencies channeling their resources towards sectors perceived as more critical or lucrative. Over the years, this oversight has resulted in minimal attention towards advancing salt production methods and addressing industry-specific challenges. Recognizing this gap, the industry advocates for establishing a Salt Center to serve as a focal point for research, development, innovation, and training aimed at addressing critical issues plaguing the salt industry.

The oversight has consequences, particularly in adapting to challenges posed by climate change and meeting food safety standards. The absence of innovation and interventions has hindered the industry's ability to keep pace. Conducting research and development studies becomes imperative to foster technological development, provide applicable policy direction, and develop innovative project-based interventions for the development of the salt industry. Technological development and process standardization emerge as crucial elements in this context. These advancements are anticipated to boost farm productivity, enhance product quality, improve market competitiveness, and ensure conformity to food safety standards. The ultimate goal is to expand market reach and achieve higher yields for the salt industry. Addressing these aspects can lead to a more coherent strategy for the sustainable growth of the salt industry in the Philippines.

3.3.11 Changing business interest

Due to the previously discussed factors, the low and seasonal income derived from salt production

renders salt-making an alternative source of income rather than primary. Some salt producers, specifically tenants, still struggle to make ends meet for their families despite working in the salt farms for several decades. Younger generations, seeing no future in salt production, started migrating to cities in search of better and stable work opportunities, thus leaving the elders no one to pass on the custom.

Medium to large-scale producers in Cavite and Bulacan invested their funds in more sustainable and profitable businesses such as aquaculture production. Instead of engaging in salt production, some businessmen have switched to salt trading and manufacturing, which are more profitable than salt farming. Others decided to sell their salt farms to land developers for conversion into industrial, commercial, or residential properties. Investors have little to no interest in reviving Bulacan's salt industry since rapid urbanization has made land prices exceptionally high. The global climate crisis has also made Bulacan communities vulnerable to severe flooding. In addition, the deterioration of water quality in Manila Bay has made certain areas in Cavite and Bulacan unsuitable for salt production.

In Negros Oriental and Zamboanga City, the primary reason for the discontinuation of salt production is the frequent occurrence of rain during the summer season and the unpredictability of weather conditions. The interviews uncovered that some producers have lost interest in salt production as they bear the brunt of unpredictable weather patterns using the existing method. Furthermore, they already have other income-generating activities besides salt production, such as agricultural production, seaweed farming, or other commodity-based businesses.

3.3.12 Profitable land-use conversion

Prior to the ratification of the General Agreement on Tariffs and Trade (GATT) by the Senate in 1994, salt production was considered a profitable enterprise. However, when cheap salt imports penetrated and flooded the Philippine markets in the same year, the price of locally produced salt sank to its lowest to compete with imported salt (Castañeda 2023). Salt farms started closing one after the other as producers opted to invest their funds in more sustainable and profitable businesses. The majority of the salt farms, particularly in Bulacan and Cavite, were converted into fishponds and residential and commercial properties to create profit avenues. In Las Piñas City, the reclamation of the bay area and the subsequent construction of the Coastal Road disrupted salt production in the area. Since then, land reclamation has become insatiable, and encroaching urbanization has made land values unfavorable for salt production. At present, Bulacan and Cavite are considered highly urbanized areas because of the continuous urban expansion of Metro Manila into the said provinces. The conversion of salt farms has continued to displace the remaining salt producers who are only tenants or lease the farms from private entities or the government through fishpond lease agreements.

Pollution from industrial, commercial, and domestic sewage in Manila Bay has also made certain areas unsuitable for salt production. Waters along Manila Bay are contaminated with oil and grease from nearby ports. Marine pollution is indeed a major threat to the salt industry as contaminated water currents could bring urban wastes that may affect the purity of salt extraction. In a study by Peixoto et al. (2019), microplastics (MPs) were found in commercial salts from 128 brands from 38 different countries spanning five continents. These are defined as plastic particles less than 5 mm in size that are considered global environmental pollutants. Commercial salts contaminated with MPs may contribute to the potential long-term adverse effects of human exposure to the particles.

At present, only a few remaining salt producers in Cavite and Bulacan continue to thrive amidst the challenges brought by rapid urbanization. This is projected to decrease further, given that several reclamation and expansion projects along Manila Bay, spanning Bulacan, Pasay, and Cavite, are in the pipeline, which indicates an impending total weakening of the industry in the coming years and may just become part of the province's past.

3.4 Management options

Dependence on importation leaves the industry vulnerable to food supply chain disruptions. Given that the Philippines has a huge potential for expanding salt production with its vast shoreline, the government should undertake immediate steps to revitalize the Philippine salt industry by addressing policy gaps and technological challenges as well as providing adequate financial, production, postharvest, marketing, and other support services to salt producers. Reclaiming the lost glory in salt sufficiency is a long-term objective that requires a road map development, given the many challenges ahead, as the

environment today is extremely different compared to decades ago. Philippines should leverage public funding and resources to execute appropriate policies, initiatives, and strategies to develop, strengthen, and improve the salt industry and ensure sustainable and inclusive growth among stakeholders.

The following management options were conceived based on the substantial findings generated from this study regarding the key issues and immediate needs of the salt industry.

3.4.1 Recognizing salt as an aquatic resource

Section 4 (5) of RA 8550, as amended by RA 10654, defines aquatic resources as fish, all other aquatic flora and fauna, and other living resources of the aquatic environment, including but not limited to salt and corals. Recognizing salt as an aquatic resource could be the government's starting point, as this would allow the salt industry to benefit from the existing policies relating to the protection, management, and development of aquatic resources.

3.4.2 Formulation of the Philippine Salt Industry Roadmap

This should contain short-, medium-, and long-term development plans, following the value chain approach from production to commercialization toward a sustainable, competitive, and resilient Philippine salt industry.

3.4.3 Creation of new law for the salt industry

It is imperative to institutionalize an orchestrated approach to address policy gaps and strengthen technological and market capabilities to revitalize the Philippine salt industry. The passing of proposed bills for developing the Philippine salt industry should be prioritized to serve as an overarching policy to address identified gaps and challenges.

Given the recent developments in the salt industry, RA 8172 should be reviewed to set forth holistic solutions to the multifaceted challenges that have affected local salt production. Iodization requires certain economies of scale, equipment, marketing, and distribution support to make it conducive for small and medium-scale producers. The former needs more technical capacity to carry out the iodization process. Allowing the sale of non-iodized Philippine-made food-grade sea salt will encourage more local salt producers to grow their businesses and increase their production. In addition, since approximately 83% of salt distributed in the Philippines is imported, importing iodized salt instead of industrial grade could create a bigger impact on addressing the inadequacy of food-grade iodized salt in the local market. At least 50-60% of imported salt may be certified food-grade and iodized at the point of origin.

The evolving landscape of the salt industry demands a proactive legislative approach. Amendments to RA 8172 may not adequately address the complexities arising from emerging challenges. Creating a new law is imperative to ensure a comprehensive regulatory framework. Such legislation would offer a more tailored response, surpassing the limitations of outdated provisions and aligning seamlessly with the contemporary dynamics and requirements of the salt industry. This proactive step is essential to effectively tackle present and future issues while fostering the industry's sustainable growth.

3.4.4 Strengthening of ancillary industries for salt production

Various factors, such as the limited supply of materials and equipment for salt farm development and production process, have affected the repair, upgrading, or expansion of existing salt farms. Ancillary industries should also be strengthened to ensure sustainability in salt farming operations, such as but not limited to clay tiles, wood planks, heavy equipment for solar evaporation method, and rice hull or other fuel sources for cooking method.

3.4.5 Strengthening of financial and government support services

The viability of salt production should be improved to encourage the private sector and the youth to venture into this kind of enterprise. The government should address gaps in infrastructure, such as the lack of postharvest, processing, and storage facilities, farm-to-market roads, and other support facilities. The establishment of shared postharvest and storage facilities in strategic places will ensure the availability of high-quality salt even during the off-season. The provision of Good Manufacturing Practice (GMP) compliant storage facilities will reduce revenue losses and contribute to price stabilization since salt prices may drastically decrease during peak season. Moreover, roads linking the salt farms to the market should be developed to ease the handling

process during the distribution and transportation of products to intended markets. The government should also incentivize salt farming through tax incentives, farm inputs subsidies, equipment grants, and many others to encourage private sector investors to put their working capital, management, local workforce, and technological resources. Increasing access to government credit programs for developing, operating, and improving salt farms, purchasing equipment for salt production, or other related purposes will ensure sustainability in salt farming operations. Providing continuous training programs to develop or upgrade the skills and competencies of salt farmers and producers, fostering innovations through research and development initiatives to ensure product authenticity, traceability, and food safety compliance, granting incentives to businesses and industries with linkages to salt farming, and building opportunities for value-creation through technological upgrade and mainstreaming of products in both local and international markets are all crucial to ensure the industry's survival and sustainability for the years to come.

3.4.6 Technology benchmarking

Benchmarking in other salt-producing countries to scout for the best salt production and postharvest technologies that are not entirely weather-dependent and are suitable in the Philippine setting is also recommended.

3.4.7 Identification of new areas for salt production

A comprehensive assessment of coastal regions becomes imperative in the pursuit of salt sufficiency in the Philippines. By strategically identifying suitable areas, the nation can capitalize on its vast coastline to enhance salt production. Given the climatic diversity across the archipelago, a nuanced approach is necessary. Type 1 climate provinces, characterized by distinct dry and wet seasons, present an ideal environment for solar salt production. However, recognizing the climatic variations in other provinces is crucial. Innovative techniques, such as hydroponic salt farming or controlled evaporation systems, must be explored to overcome challenges posed by different weather patterns. Governments should invest in applied research and development to address the overarching goal of salt self-sufficiency. This fosters collaboration between the private sector, academia, and industry experts to devise innovative solutions tailored to the Philippines' unique conditions. By leveraging technology and scientific advancements, the nation can unlock the potential of salt production throughout the year, irrespective of climatic challenges. Through concerted efforts in research and development, the nation can position itself to meet the challenges and ultimately attain self-sufficiency in salt production.

4. CONCLUSION

Contrary to the industry report, local salt production in the Philippines is estimated at 114,623.29 MT, or 16.78% of the country's annual salt requirement. However, the country has been experiencing La Niña for the past three years, resulting in a substantial decline in production. It is estimated that salt production has dropped to 89,673.87 MT for the past three years, or 13.13% of the annual demand. Occidental Mindoro is the biggest salt-producing province, with a 57.43% share in local salt production. It is followed by the Ilocos Region, Western Visayas, Central Luzon, Northern Mindanao, and the minimal contribution of CALABARZON and Central Visayas.

A myriad of factors has contributed to the decline in local salt production, such as failure to adapt to the changes brought by climate change, passage of ASIN Law, profitable land-use conversion, market competition, and stringent food safety standards and product quality requirements. Moreover, limited government policies and support services, stemming from the lack of agency tasked to oversee it, an unattractive business environment, as demonstrated by the high cost of land rental fees, and limited availability of materials for salt production have pushed local salt producers into obscurity. The labor-intensive and seasonal production, unreasonable labor practices, and small economic returns have steered the growing disinterest in salt farming among younger generations, leading to changing business interests and an aging population of salt producers. Failure to set forth holistic solutions to the said problems may indicate a total demise of the industry in the long run.

The Philippines should maximize its inherent natural advantages to scale up domestic salt production and lower importation. It is imperative to institutionalize an orchestrated approach and leverage public funding and resources to execute appropriate policies, initiatives, and strategies for the sustainable development of the salt industry.

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AUTHOR CONTRIBUTIONS

Montojo UM: Conceptualization, Methodology, Writing-Review and Editing, Supervision, Project Administration, Funding Acquisition. **Banicod RJS:** Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Data Curation, Writing- Original-Draft, Visualization **Tadifa GC**: Conceptualization, Methodology, Validation, Formal Analysis, Investigation, Visualization. **Tila CAS:** Validation, Formal Analysis, Investigation. **Baldoza BJS:** Validation, Formal Analysis, Investigation. **Tanyag BE**: Validation, Formal Analysis, Investigation. **Garcia LC:** Supervision, Project Administration, Funding Acquisition.

CONFLICTS OF INTEREST

The authors declare that no known financial and personal relationships with other people or organizations could have appeared to influence the work reported in this paper.

ETHICS STATEMENT

No animal or human studies were carried out by the authors.

REFERENCES

Castañeda D. 2003. Bulacan salt farms melt down. [cited 24 April 2023]. https://www.bulatlat.com/news/3-34/3-34-saltfarms.html

Chanco B. 2022. Importing salt. The Philippine Star. [cited 28 April 2023]. https://www.philstar.com/business/2022/09/02/2206709/importing-salt

Delos Reyes JA, Lat AT, Reodica TJI, Manalo CJB. 2021. Profitability Analysis of Small and Medium Scale Salt Enterprises, Misamis Oriental, Philippines. Holistica Journal of Business and Public Administration. 12(3):69–85. https://doi.org/10.2478/hjbpa-2021-0023

De Leon D. 2022. What led to the demise of the Philippine salt industry and what needs to be done. [cited 04 May 2023]. https://www.rappler.com/newsbreak/explainers/what-led-demise-needs-to-be-done-salt-industry-philippines/

Francisco AB, Llamar NL, Chavez EH. 2022. Salt-making as a stunting enterprise and practice: the case of Ilocos Sur, Philippines. Social Sciences, Humanities and Education Journal. 3(2):159–169. https://doi.org/10.25273/she.v3i2.12682

Helmia A, Sasaoka M. 2018. Dealing with socioeconomic and climate-related uncertainty in small-scale salt producers in rural Sampang, Indonesia. Journal of Rural Studies. 59:88–97. https://doi.org/10.1016/j.jrurstud.2018.02.005

Llaguno E, Palma AM. 2017. Evaluating the effectiveness of the rapid test kit used in the field monitoring of iodine content of salt in the Philippine market. Philippine Engineering Journal. 38(1):39–54.

Majaski C. 2023. What Is the General Agreement on Tariffs and Trade (GATT)? [cited 24 April 2023]. https://www.investopedia.com/terms/g/gatt.asp

Moran R. 2018. Investigating the effects of iodization in the salt industry. [cited 15 April 2023]. https://fnbreport.ph/6553/investigating-the-effects-of-iodization-in-the-salt-industry/

Muyot N, Asuncion C. 2022. Constraints and challenges of salt farming in Occidental Mindoro, Philippines. Cognizance Journal of Multidisciplinary Studies. 2(6):1–9. https://doi.org/10.47760/cognizance.2022.v02i06.001

Nutrition Center of the Philippines. 2010. A Survey of Salt Importers, Producers and Traders in the Philippines: an Evaluation of Internal and External Quality Assurance and Control. Philippine Department of Health. National Nutrition Council. pp. 1–55. https://www.studocu.com/ph/document/sti-college/accountancy/ncp-2010-salt-survey-final-report/14126706

Perlas L, Ulanday JR, Marcos J, Serafico M, Desnacido J, Alibayan M, Duante C, Capanzana M. 2017. Iodine Deficiency Disorder Among Filipino School Children, Pregnant and Lactating Women and the Elderly 20 Years After the Act for Salt Iodization Nationwide Law. Journal of Endocrinology and Metabolism. 7(3):86–93. https://doi.org/10.14740/jem414w

Peixoto D, Pinheiro C, Amorim J, Oliva-Teles L, Guihermino L, Vieira MN. 2019. Microplastic pollution in commercial salt for human consumption: A review. Estuarine, Coastal and Shelf Science. 219:161–168. https://doi.org/10.1016/j.ecss.2019.02.018

Republic Act No. 8172. An Act Promoting Salt Iodization Nationwide and for Related Purposes [Philippines]. 20 December 1995. https://www.officialgazette.gov.ph/1995/12/20/republic-act-no-8172/

Roland A, Erasmus HO, Rosina AK. 2019. Impacts of climate variability on salt production in Ghana: Case of Songor Salt Project. Journal of Sustainable Development. 12(1):1-9. https://doi.org/10.5539/jsd.v12n1p1

Santos J. 2022. Isn't it ironic? PH imports 93% of salt supply. Manila Bulletin. [cited 28 April 2023]. https://mb.com.ph/2022/08/30/isnt-it-ironic-ph-imports-93-of-salt-supply/

Senate Bill No. 1334. Philippine Salt Industry Development Act 2022. 20 September 2022. http://legacy.senate.gov.ph/lisdata/3945935852!.pdf

Tan R, Lizada J, Delos Reyes J, Lat A, Reodica TJ, Manalo CJ. 2022. Value Chain Analysis in the Visayas Region, Philippines. J ISSAAS. 28(2):62–80. http://issaasphil.org/wp-content/uploads/2022/11/7.-Tan-et-al.-2022.-Value-Chain-of-Salt-in-the-Visayas-Region-Philippines.pdf

USAID. 2017. Climate change risk profile: Philippines. [cited 28 April 2023]. https://www.climatelinks.org/sites/default/files/asset/document/2017_Climate%20Change%20Risk%20Profile_Philippines.pdf