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Traditional knowledge system in *palung* salt-making in Bali Island

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Abstract

This study presents the case of an original and traditional knowledge system of *palung*, which is used in salt-making in the coastal communities of Bali. The study emphasizes the practicalities of the system and its epistemology using anthropological and sociological methods. It is known that the traditional knowledge system of *palung* salt production has been preserved through the generations as a form of local wisdom. This traditional knowledge system emphasizes the use of local natural resources in accordance with the coastal ecosystems of Bali, where the cultivation of extracted soil (*tanah sari*), sand, bamboo, and coconut trees is carried out manually. This study has evidenced that the *palung* process successfully produces salt of excellent taste and quality. Based on laboratory tests conducted on *palung* salt samples, the results show that it does not contain any heavy metals and that it has good nutritional content. Because of its use of available natural resources, this traditional knowledge system is sustainable and environmentally friendly.

Keywords: Traditional Knowledge, Salt-making, *Palung*, Coastal Community, Preservation, Local Technology

Introduction

In Indonesia, salt is generally produced by coastal communities. The common process of salt production is using traditional technology. However, these communities are typically weak and vulnerable in a socioeconomic sense. Therefore, identifying, analyzing, and developing the potential of coastal resources to improve the welfare of coastal communities is necessary [1]. In 2011, the Indonesian government implemented the Salt Empowerment Business Program and introduced various institutional and physical technologies [2–4]. In addition, regulations to protect and empower salt farmers and fishermen in coastal communities were implemented through Law No. 7 of 2016. With these programs and regulations, the traditional aspects of salt production are protected, thus ensuring that high-quality salt is produced. However, it is not competitive in relation to current consumption and industrial needs. The process of salt production in Bali, where *palung* technology is used, differs significantly in comparison with other areas of Indonesia.

Balinese *palung* salt is a product that is based on the local ecosystem and the traditional knowledge of its coastal communities [5]. This technological process of salt production is unique and specific to Bali. It uses renewable, natural, and local resources, including soil, sand, bamboo, and coconut trees, in a seawater evaporation process. This means that the salt is hygienic, of high quality, and tastes good. The results of laboratory tests showed that *palung* salt contains no arsenic (As), copper (Cu), or mercury (Hg), meaning that it is devoid of harmful metals. *Palung* salt has good nutritional value, with moisture (1.6 g), protein (0.1 g), minerals (98 g), energy (2 kcal), and potassium (196 mg). Thus, salt is a desirable product that can penetrate numerous markets, including Japan, Korea, France, and the USA [5]. As previously stated, the salt-making uses traditional knowledge systems. With *palung* salt, the knowledge system is amassed from the collective experiences of the coastal communities of Bali [6]. There is a wealth of traditional knowledge about the ecology of the area and its natural resources, and this knowledge can be used as an adaptation strategy to support efforts to improve the welfare of the area [7].

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The traditional knowledge system of *palung* salt-making has cemented itself in the culture of Balinese coastal communities. The knowledge system is original, owned, and developed by local communities. It is developed in the form of skills, techniques, and cultural practices that allow communities to manage their natural resources [8]. This knowledge is an economic asset, as it determines the livelihoods of the local people and belongs to the community [9].

While the knowledge system of *palung* salt-making is traditional, it is not stagnant. It is adaptable to changing environments as a result of ecological and economic changes [5]. For example, the eruption of Mount Agung in 2017 damaged the *palung* industry in Buleleng and Karangasem. Likewise, the growth of the tourist industry in Bali in recent years has encouraged the commercialization of land in coastal regions. This has led to coastal land being repurposed and used as sites for resorts and hotels rather than for salt-making. In this context, many salt farmers have moved to work in tourism, thus threatening the preservation of *palung* methods. Thus, the current situation poses a serious threat to the existence and sustainability of *palung* salt. At the same time, it cannot support local communities, who need diverse economic activities in order to survive. The local food system should become along with the institutions and organizations that regulate it [10]. This phenomenon is somewhat different from other regions of Indonesia. According to Blaikie, traditional knowledge systems are vulnerable. This vulnerability is due to rapid population growth, migration, and natural disasters. These adverse changes lead to cultural divisions, land degradation, commercialization, and economic downturns [11].

This paper discusses how the traditional knowledge system of *palung* salt-making is preserved in Bali, the threats it faces, and the ways in which it has had to adapt. This study used anthropological and sociological methods of data collection via in-depth interviews, focus-group discussions, and after-fact observations [12] made by observing photographs related to the salt-making process in Buleleng. The in-depth interviews and focus-group discussions were conducted with salt farmers, traditional leaders, and actors in the salt and tourism sectors. The sample was selected using the snowball sampling technique [13].

Local wisdom in *palung* technology

This section analyzes how *palung* technology as a form of cultural heritage has existed for centuries as a unique element of local wisdom. The existence of this form of traditional technology dates to the pre-colonial period. Thus, the modes of *palung* salt-production are traditional and pre-capitalistic [5]. These characteristics remain to this day. As a traditional technological system, *palung* salt is closely connected with the Balinese people.

Over the centuries, it has brought numerous economic and sociocultural benefits to local communities [10].

It is impossible for a technology system to be born without an existing knowledge system already being in place [14]. However, usually, the traditional knowledge system that develops in society is not systematically or analytically formulated. Rather, it develops through a process of extraction, where best practices are identified throughout the historical development of the system. Local knowledge and technology systems are closely related to the opportunities and challenges faced by the community concerned. A local community's system of knowledge and technology can thus be viewed as a response to the opportunities and challenges of the local environment. In this respect, the *palung* system is also related to local thinking; the technological equipment used is based on local potential; and the distribution of *palung* products is based on local social and cultural networks. Salt is a form of income for local communities.

Palung salt is an integral aspect of the Balinese sociocultural system. According to the Balinese people, salt is an essential requirement of daily dishes. As well as this, when the Balinese finish cooking their meals, they give offerings in the form of rice and salt. These offerings, given as a token of gratitude to the spirits who have protected them, must be given before they eat their meal. The Balinese believe that salt must be used to resist evil forces.

Palung salt technology cannot be separated from the economic system of the local community. The discovery of local knowledge and technology is usually related to the economic needs of the community. This is in accordance with the concept developed by Kaplan and Manner's concept. This concept is entitled technoeconomics and refers to the fact that technology is related to people's livelihoods. Technology does not only refer to the equipment used in productive activities but also to the knowledge and value systems that are behind these productive activities. As a system of traditional knowledge and technology, *palung* salt technology is inherently traditional. Thus, *palung* salt is part of the collective memory of Balinese communities—it is both a common property and a common heritage [15].

There are numerous elements of local wisdom ingrained in the *palung* technique. First, there is the dominant role of human labor in *palung* production. The various production processes are conducted manually by locals. These processes begin with land preparation and end with harvesting. The process of making *palung* salt is closely related to the environment of the local community. For example, in terms of making the salt (a process called *petasikan*), a certain type of soil must be cultivated and then compacted. This type of soil is found in hilly areas and contains salt from the sea. In another process, saltwater that is taken from the sea is

processed into *nyah* (saltwater brine). This water must be taken directly from the sea by workers using a traditional container made of palm leaves (*dipikul*).

After the *petasikan* soil is prepared, the salt farmers make *nyah* with the *tanah sari*. This soil is taken from mountainous areas near the coast. This soil is typically spread out to dry. The soil is also doused with seawater a number of times to ensure it has a high salt content. A plot of land is cultivated to prepare the *tanah sari*. Thus, there is a level of creativity in ensuring that the sea is integrated with the land in accordance with the conditions of the surrounding natural environment.

Aspects of local wisdom can also be seen in the different types of equipment used in the process of making the *palung* salt. The use of raw materials from the surrounding environment has made this technology sustainable. This is evident in the *tinjungan* tool used—this is a device used for filtering saltwater brine (*air garam tua*). The *tinjungan* is made of bamboo and is traditionally woven and shaped into a cone. The *tinjungan* typically has a diameter of 275 cm with a height of about 75 cm (Fig. 1). The area around the *tinjungan* is reinforced with a board that is made from local wood, usually *segon* wood. Meanwhile, the inside of the cone is filled with coconut fibers to filter the saltwater brine so that the soil containing the salt does not fall into the reservoir of saltwater.

The *brombong* is another tool that is locally produced. This tool is made from old palm trees and is roughly 2 m long with a niche in the middle that holds the saltwater brine. The *brombong* is positioned horizontally on the ground so that it can be placed under the *tinjungan*. Then, the saltwater brine is drained away. Another unique tool is the *palung*. This tool is made from old coconut trees. While the *brombong* is used to hold saltwater brine from the *tinjungan*, the *palung* is used to evaporate the saltwater brine to obtain the *palung* salt.

Thus, it is clear that there is a mutually dependent relationship between the knowledge systems of Balinese communities and *palung* technology. There is a synergistic relationship between traditional knowledge, technology systems, economic systems, and the natural environment. This relationship has ensured that *palung* salt technology is able to sustain itself, as it involves using equipment made from local materials. The use of these local materials does not damage the environment.

Traditional knowledge systems in the salt-making process

Palung salt-making requires special processes and techniques that represent the significance of the traditional values of Balinese communities. This knowledge process is important because it can be implemented as a nationwide method of production and influences every policy towards national salt production. It also relates to the manufacturing process, which can be separated into two phases, namely, *techne* and *phronesis* [16]. These knowledge processes of salt-making are often in the form of shared knowledge, which is implicitly or tacitly owned by several groups of people. This knowledge is practical in salt production systems, as stated by Grenier [8], who emphasizes that local Balinese people have a strong desire to utilize natural resources. Numerous traditional villages in Bali are still based on agriculture and marine resources. In these villages, knowledge regarding the utilization of natural resources tends to be co-opted by older generations. However, knowledge transformation, which is shared by the entire community, is subject to obstacles and challenges in efforts to inherit said knowledge through oral traditions. This leads the knowledge of processes and techniques to differ, depending on the community.

Knowledge transformation within salt-making requires a fundamental change from the subsistence production model to industrial orientation. By combining



Fig. 1 *Palung* as the evaporation media to crystallize salt. The media uses old coconut trees and many traditional values are incorporated in the system

the traditional knowledge of salt farmers with modern technology (e.g., greenhouses), the salt industry will continue to develop. As such, this section looks at the limitations of traditional technology in the process of *krosok* salt-making using the *palung* method; this method uses a low level of technological processing [5].

The majority of salt-making systems in Bali use the solar evaporation method. In the production process, there are some important steps that must be followed to maintain the salt's quality and distinctiveness. *Palung* salt has a slightly bitter taste compared to other salt types. There are roughly seven processes that must be carried out by salt farmers in order to produce salt. The processes are complex and involve soil extraction and saltwater brine processing (*tulud*). Ponds are usually owned by individuals, but some are owned by the state. A salt farmer (*penyekap*) typically works on their own land (*pajak*) with their family.

The first step in the process is preparing the pond, which is cleared of rubbish and dirt. The pond is leveled with the help of a rake that is made of bamboo (*pangkrak*). The land area that is used to process the *tanah sari* is 20.5 m. After the soil is leveled, the *palung* is prepared on a drying table. Farmers will determine whether the *palung* is in a good or bad condition. If it is not of high quality, it will be worked on with the help of a *palung* expert. Currently, it is difficult to find *palung* experts due to a lack of interest among younger generations in pursuing this skill. Salt farmers need approximately 50 *palung* that will last for up to 30 years. After ensuring that all the equipment is suitable to use, the salt farmers can begin the production process.

Typically, salt farmers will begin each salt season by worshipping spirits in front of their houses and making offerings. Prayers are made and offerings are given by one female family member in the mornings and evenings. They pray for success in their salt-making and wish for a prosperous life. For Balinese people, the existence of salt is significant, as almost every stage of the Balinese life cycle is celebrated by offering up traditional food that is mixed with salt [17]. Thus, salt plays an important role in Balinese life, thus meaning that it is viewed as a sacred thing. Salt is a natural resource from the sea and a natural resource from the mountains—this is known as the *nyegara-gunung* concept. This concept is related to the existence of holy places of worship in the “center” and in the sea [18].

During the soil-management stage, the *tanah sari* is managed. This soil originates in hills and mountains. In some salt-producing centers that use *palung* technology, salt ponds are usually located near hilly areas or in mountains. This clearly highlights the beliefs of the Balinese people in relation to the aforementioned *nyegara-gunung* concept. The pond area, which can be found

quite close to the shoreline, is used to facilitate the transportation of seawater to the drying table. Meanwhile, green areas are located near the pond consists of nutrients and minerals. These green areas are overgrown with coconut trees and various plants that are believed by local residents to improve the soil layer and supply groundwater. Maintaining the green areas around the ponds is paramount to the quality of the salt and is referred to as “green conservation.”

After the completion of the soil-management stage, the next step is to filter the seawater using the soil. To remove the saltwater brine, the leveled soil is doused with seawater. This also makes it difficult for grass and wild plants to grow in the ponds. This process is referred to as *ngewayahi*. It is usually conducted twice a day for four consecutive days. The soil is drained away after being rinsed with the seawater. It is then flattened using a *tulud* and is left for roughly four days. Then, the soil is mixed so that the salt content rises.

In one *pajak*, there are four plots of salt. The first plot must be smooth and loose. This smoothening is done using the *pangkrak*. Salt farmers believe that the drier the soil, the higher the mineral content. The dry soil must be collected in a way that ensures the air can circulate. The soil is then raised into a mound and placed in a *tinjungan*. The *tanah sari* is left for around 4 days and is watered twice a day [19].

In the process of transporting seawater, the salt farmers used a *sene*, which is made of thick plastic. The process of seawater collection also requires expert knowledge. The farmers usually wait for small waves to reach the shore. They then fill the *sene* with water and carry them on their shoulders. For generations, farmers have believed that small waves contain the highest levels of salt. Thus, they often wait for the right time (i.e., when small waves hit the shore). The *sene* is used to transport the seawater; which currently, it is made of plastic or aluminum, but in the past, it was apparently made from *ntal* leaves from the *ntal* tree, a type of palm tree that is becoming more scarce.

Ntal leaves are also used as filters in the *tinjungan*. To manufacture the saltwater brine using the *tinjungan*, a curtain-coating technique is used. The coating technique will be different in each *petasikan* (traditional village of salt farmers). In Les in Buleleng, for example, this coating technique is conducted using three layers: the *ntal* leaves form the base layer; sand, the *tanah sari*. In Tejakula, the farmers place five layers inside the *tinjungan*, and the layers consist of wood, *tapis*, sand, more *tapis*, and the soil extract. The soil extract in the uppermost layer is stepped on until it becomes solid, and then it is watered using seawater from the *sene*. The salt farmers can then obtain clean saltwater, which is stored in a container called a *brombong*.

The next step involves placing the saltwater brine on a drying table using the *palung*. The saltwater brine is then evaporated to obtain the salt granules. If temperatures are sufficiently high, the salt should crystallize quite quickly. August is typically the most suitable month to harvest salt, as the hot weather means that the volume of the harvest will double.

The salt is then ready to be harvested when it is carded using bamboo. It is drained into containers (*saingan*) and must be placed at the top of the *palung*. The saltwater will then drip into the *palung*. Figure 2 illustrates the entire process of salt-making using the *palung* method.

Due to climate change, salt farmers in Bali now realize that they are vulnerable to the weather [20]. During the dry season (when salt is made), the weather can be unpredictable. In Tejakula and Amed, this is a cause of worry among salt farmers. However, farmers in Kusamba and Klungkung cover the *palung* so that it is safe from rain. The weather affects the success of the production process. If the water fails to evaporate, the production process must be repeated.

Family ties are important in the salt-making process, as the working relationship is based on family. There is no exploitative relationship in the salt business, as the labor is divided among groups. In this context, men and women enjoy the same level of involvement in the process. Balinese societies tend to be patriarchal [21]. However, salt farmers have strengthened the issue of

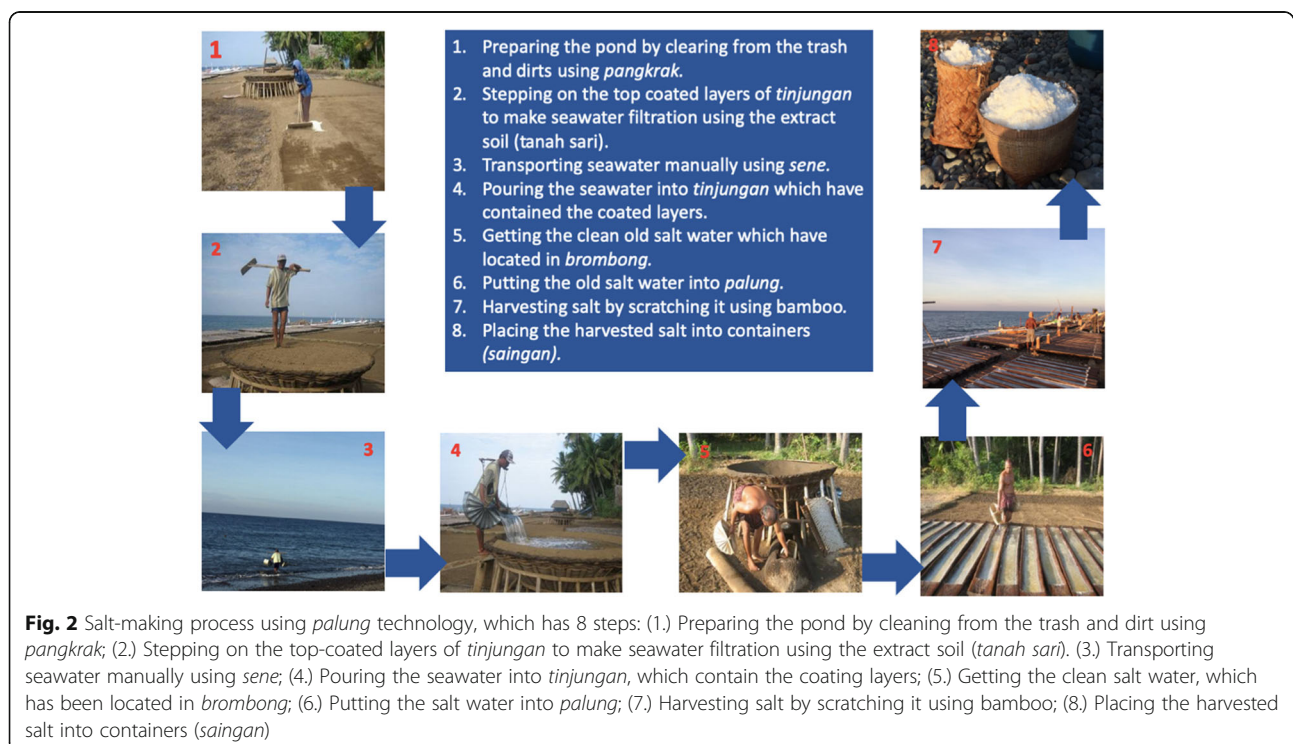
gender equality by allowing men and women to do the same work.

The sustainability of *palung* salt: opportunities and challenges

Local wisdom and production processes make the economic activity of salt production unique and distinct to Bali. However, the *palung* salt industry does not meet basic needs. It has the potential to be developed to increase the economic standing of Balinese people, especially the *palung* salt farmers.

Opportunities are widespread in this regard. Data from Statistics Indonesia of Bali Province (2018) show that the price of traditional salt in Bali in 2018 was Rp 4750 per kilogram. The lowest price was between January and July, at Rp 4000 per kilogram, while the highest was between September and December, at Rp 6000 per kilogram. In areas of salt production along the north coast of central Java, salt prices were around Rp 550 per kilogram during the harvest and increased to Rp 1150 per kilogram during the rainy season. Thus, it is clear that the cost of traditional Balinese salt, which includes *palung* salt, is relatively higher than the price of salt from other areas.

In an attempt to increase the economic value of *palung* salt, efforts have been made to produce artisan salt. This type of salt can only be found in Buleleng. Artisan salt is produced in Tejakula and is made of *palung* salt that is cleaned and mixed with mountain water, then



evaporated in a greenhouse. This production process produces different types of salt. Artisan salt from Tejakula is used in cooking and in the beauty industry. Gourmet salt is also produced using the same process as artisan salt, but the raw materials differ in this regard. Gourmet salt produces porous pyramidal salt. Both artisan salt and gourmet salt are produced for the global market. However, they are also sold in the domestic market. In order to expand and strengthen the sale of gourmet salt in the domestic market, producers, with the help of the Indonesian government, cooperate with the Indonesian Hotel and Restaurant Association. In this way, gourmet salt is distributed to hotels and restaurants throughout Indonesia [22].

Tejakula artisan salt is sold to a wider market due to the establishment of a business network and product standardization. The business network was established through mutual cooperation between salt cooperatives and salt manufacturers. The cooperatives buy salt from the members and sells it to the manufacturing companies. As a result, the salt produced by the farmers, as cooperative members, can be absorbed, while the manufacturers can provide the raw materials. Product standardization is ensured through laboratory tests, product packaging, and labeling. Through these strategies, *palung* salt can penetrate the global market and reach countries such as Japan, South Korea, and France [5].

The development of the tourism industry, which is expanding to areas where *palung* salt is produced, creates a new opportunity for the improved economic welfare of *palung* salt farmers. Bali is the most preferred destination in Indonesia for tourists. Statistics Indonesia of Bali Province (2018) reported that in 2017, the number of foreign tourists who visited Bali reached 5,697,739. The tourists came from all over the world. Tourism has led to employment opportunities for Balinese people in travel agencies, hotels, restaurants, etc. In this context, the production process and traditional technology used in *palung* salt can be turned into a tourist attraction. Foreign tourists are usually very interested in attractions that document the culture, lifestyle, and traditional activities of locals. Balinese *palung* salt will be attractive to tourists, as traditional salt production that uses *palung* can only be found in Bali. The potential of *palung* salt tourism is quite promising, as tourism along the north coast of Bali is dominated by natural attractions, especially marine tourism.

Tourism in Bali is similar to a double-edged sword. It does lead to opportunities for locals to improve their quality of life through increased earning opportunities. However, it also allows locals to earn money easily, meaning that they become quite fond of "fast cash." It is unsurprising that young people in Bali prefer to work in tourism, as the easy money they earn from tourism makes the work

that their parents do (e.g., farming) quite undesirable. Consequently, young people in Bali do not have the necessary skills to cultivate the land. As an example of this, some local rice varieties are now rare or extinct [23].

The impact of tourism is being felt on *palung* salt communities. Some villages that were known for their salt production have stopped producing it, as the salt farmers have changed jobs. The areas in which salt is produced are becoming smaller on a daily basis, as they are being sold for tourism development. This land conversion has occurred in Tejakula (Buleleng), Kusamba (Klungkung), and Amed (Karangasem) [19]. This reflects the declining interest in producing *palung* salt. From this perspective, it can be said that the development of tourism is endangering the *palung* salt industry.

This declining interest in maintaining the salt industry is also reflected in government policies, which do not favor salt farmers. However, the government also imports salt. There is no synchronization of data between the relevant ministries; thus, the demand for salt versus the levels of traditional salt production are unclear. This lack of synchronization is always used as an excuse to import salt. Uncontrollable levels of imported salt lead to falling prices for traditional salt. This adversely affects salt farmers [24].

Another challenge to the sustainability of the *palung* salt industry is related to environmental changes in coastal areas. Beaches in Bali are prone to abrasion. Data collected by the Environment Agency of Bali Province showed that of Bali's 430 km of coastline, 187 km is suffering from abrasion, and 81.7 km of it is badly eroded. Beaches in southern Bali are some of the worst in this regard and include Pengambangan beach in Jembrana, Candidasa beach in the Karangasem district, and Padangalam beach in Denpasar [25, 26]. Sea dikes in Tejakula have been built to protect the beaches, and the *palung* salt farmers also benefit from these, as it allows them to keep producing salt.

Conclusion

The *palung* salt industry reflects the traditional knowledge system of Balinese coastal communities. This system guarantees the sustainability of locals and coastal ecosystems. *Palung* salt production has successfully penetrated the global market. However, the salt-making process is based on a knowledge system and traditional technology that faces threats in relation to coastal erosion, tourism, generational change, and government policies that are unhelpful to salt farmers.

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Authors' contributions

YR formulated the research argumentation that is clearly stated in the "Introduction" section and verified the theoretical and analytical method. She encouraged all authors to investigate specific traditional values in the making of salt and supervised the findings of this work. She also coordinated the job descriptions among authors. STS performed the research findings of local wisdom aspects inside of the technology that used for the salt-making by *palung* system. He addressed and identified the traditional types of equipment and materials that contribute to the salt-making then analyzed why it valued by the salt farmers. MPU formulated the future analysis of salt production using *palung* technology. He classified and identified into two categories including challenges and opportunities of the future of *palung* technology system. NNM analyzed the local knowledge in the process of the salt-making from the very beginning until the end. It performed in the third section and supported with the figure explain the whole process of salt-making. She also participated in the drafting of the final manuscript. SR performed the land use data and contributed the image visualization of the salt-making activity captured by a camera drone. MG and ME performed the data collection and processing. All authors read and approved the final manuscript.

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Availability of data and materials

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Ethics approval and consent to participate

Not applicable

Competing interests

The authors declare that they have no competing interest.

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